Specification of NFI growing stock calculations

Introduction

The NFI survey consists of a sample of 1 ha. squares that are split into sections containing a single category of woodland, or non-woodland. Within each woodland section a number of assessments are made, some at the section level and others at mensuration plot level within the section. (Some assessments, outwith the mensuration assessments, are made at component group level within sections). The mensuration plots within a section are normally full or partial circular plots of radius 5.64 metres, which if complete will define an area of 0.01 hectares. Partial plots sometimes occur which are bounded by the section boundary and therefore contain an area of less than 0.01 hectares. Within any woodland section there will normally be either 2 or 3 circular mensuration plots defined, but under certain circumstances circular mensuration plots are not selected and the whole section is taken as the area of mensurational assessment[1].

Within any section, the growing stock is classified into individual stand components, with each component being a combination of storey, species within storey, and tree status (alive or dead). The mensurational assessments taken in the field survey need to be translated into growing stock properties of each component present in the stand. This document specifies the procedures and calculations that are to be performed in order to derive these growing stock properties.

Section and plot level assessments

A number of assessments are made and are stored in the NFI survey data model at the section level. In the calculations of growing stock properties of stand components, use is made of only three of these section level assessments:

1. The total area of the section lying within the square.

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[1] A full specification of mensurational observations made in individual sections is given in “NFI: Mensuration protocol for the National Forest Inventory”. The mensuration protocol forms a part of the NFI Field Survey Manual.

2. The identification of storeys in the stand occupying the section, obtained by assessment of the structure of the stand throughout the section. The number of storeys identified in a section is determined by the assessed structure of the stand. Types of structure that can occur are:
   - Single even-aged storey
   - Multiple storey (2 or 3 storeys)
   - Single complex storey
   - Mixed (composed of a complex understorey and a single overstorey)
3. The actual or estimated planting year (pyear) of the components of the stand.

An assessment is also made at the section level of the incidence of individual stand components and their occupancy of the section. This assessment is **not** used in growing stock calculations, except in the case of thickets, where the section-level information is used to identify the presence and incidence of species within the thicket.

As noted above, mensurational assessments are made either within two or three circular or partial plots, or over the whole section, which is then defined as the mensurational assessment plot. (It is important to distinguish the use of the whole section as a mensurational plot, and the separate processes involved in making and recording other assessments at the section level.) According to the defined NFI mensuration protocol1, some measurements are common to mensurational assessments taken within either a (full or partial) circular plot or over the whole section, while others vary according to whether the sample is a circular plot or the whole section.

There is a special protocol applied when a storey within either a circular or whole section plot is recorded as a thicket. This is described separately below. Otherwise, the following information will normally be available for each mensuration plot.

Measurements common to plot-level and section-level mensurational assessments

1. A count of all trees of total height greater than 1.3 m. (This has not been implemented in the field protocol)
2. dbh of each measurable tree present, where a measurable tree is any tree of at least 1.3 m. in total height and a dbh of at least 4 cm.
3. The species of each measurable tree.
4. The status (dead or alive) of each measurable tree.
5. The storey to which each measurable tree belongs.

Measurements specific to full or partial circular plots

1. The area of the plot. (If it is a full plot, its area will be 0.01 ha., while for a partial plot the area will be less).
2. The dbh of the dominant height sample tree for each storey present in the plot.
3. The total height of each identified dominant height sample tree (one for each storey present).
4. For a first and second stand height sample tree within each storey present in the plot, their dbh and total height.
5. For the first stand height sample tree within each storey only, an upper and lower crown height and two measurements (perpendicular to each other) of crown diameter.

Measurements specific to whole section plots

1. For each storey in the section, and associated with each of three random sample points within the section, the dbh and total heights of three sample trees (labelled the first, second and third stand height sample tree associated with each storey and random sample point).
2. For each first stand height sample tree defined above, its upper and lower crown heights and two measurements (perpendicular to each other) of crown diameter.

Thicket assessment

When the whole stand within a mensuration plot (whether it be a circular plot or the whole section), or a particular storey within the plot, is classed as thicket, the information recorded for that stand or storey will be:

1. A stocking density class of the thicket (selected as ‘high’, ‘medium’ or ‘low’.
2. The total height of a representative tree.

Components

A component within a section is a species or species grouping within a storey of a stand, which may be subdivided into status (alive or dead). Components are separately defined at the section and at the plot level in NFI assessments. It is the plot level identification of individual components that are used in growing stock calculations.

Components at the plot level may be a subset of the components found at section level (some species, species groups or storeys identified at section level may not be present within the mensuration plots). However, there is a further subdivision at plot level into status (dead or alive).

The definition of components at plot level is therefore different from that at section level, and is defined by the combination of storey/

species/status that is found in any of the mensuration plots within the section. Any section level component (storey or species) that is not present in any of the mensuration plots will not be registered in the analysis of growing stock.

Allocation of share of total section area to plot components

A share of the total section area is allocated to each live plot-level component, and is intended to represent the “growing space” available to that component. This is calculated in a two-stage process of allocating shares of the total section area to each of the storeys present in the plots, then allocating shares of the area occupied by each storey to the live components found within the storey. For single-storey stands, the storey is defined to occupy the whole area of the section and only the second stage is necessary.
(Note: The allocation of the share occupied by storeys is based on the canopy share rather than on their relative basal areas. Basing the share on basal area tends to overestimate the stocking density of sparse overstoreys. On the other hand, the share of individual live components within storeys is allocated on the basis of the basal areas of the live components of the storey. It is thought that a relationship of proportionality between crown area and basal area holds more closely within storeys than across storeys.)

Allocation of share of total section area to storeys

(a) For circular plot assessments

1. For each first stand height tree (stand height trees are always live trees) within each storey within each plot, calculate the estimated sample crown area from the two crown diameter measurements (*a* and *b*) by use of the formula:
   *Crown area = π*a*b/4*
2. Within each storey within each plot, multiply the sample crown area by the no. of live measurable stems belonging to the storey within the plot, to obtain estimated total crown area occupied by the storey within each plot.
3. If a storey is a thicket, the crown occupancy of the thicket is assumed to be equal to the whole plot area (see thicket assessments below).
4. For each plot, multiply the estimated total crown area occupied by each storey by the factor *(0.01/[plot area in ha.])* to adjust it to a full 0.01ha. plot. (In the case of a full plot, this adjustment factor is 1.)
5. Sum the adjusted total crown areas of each storey across the plots to obtain total crown occupancy of the storey within the plots. If

any storey is absent in any plot, the contribution from that plot to the crown area occupied by that storey will be zero.

6. Allocate the total section area to each storey of the stand in proportion to the total crown occupancy of each storey within the plots, i.e.:
   *Area occupied by storey in the section = Area occupied by storey in the plots * total section area / Sum of areas occupied by all storeys in the plots*

(b) For section plot assessments

1. For each first stand height tree associated with each sample point and each storey, calculate the estimated sample crown area from the two crown diameter measurements (*a* and *b*) by use of the formula:
   *Crown area = π*a*b/4*
2. For each storey, find the mean of the three crown areas associated with each of the three sample points. If there is no first sample tree associated with a particular sample point, resulting in the sample point having no associated crown area, it is treated as missing and therefore does not contribute to the calculation of this mean.
3. For each storey, multiply the average crown area of the sample trees by the number of live measurable stems belonging to the storey within the section to give the estimated crown occupancy of the storey.
4. If a storey in a section plot is a thicket, it is assumed that the crown occupancy of the thicket equals the whole section area (see thicket assessments below).
5. Adjust the crown occupancies of each storey such that they sum to the total section area, by multiplying each storey occupancy by the factor *(total section area / sum of estimated occupancies of all storeys).*

Allocation of share of storey occupancies to components within storeys

Except in the case of thicket, this is performed by using the basal areas of the live components as a proxy for its crown occupancy within a storey.

(a) For circular plot assessments

1. If the storey is a **thicket**, allocate the components of the storey in proportion to the section assessment of the composition of the storey:
   *Area allocated to component = Area occupied by the storey * proportion of storey occupied by the component at section level*
   Otherwise;
2. Within each plot, find the total basal area of each live component in the plot (i.e. sum of $\pi*(dbh)^2/4$ for all live measurable stems of the component within the plot).

3. Adjust the basal areas of each live component within each plot by multiplying by the factor *(0.01/[plot area in ha.])* to adjust it to a full 0.01ha. plot.
4. Sum the adjusted basal areas for each live component across all the plots to give a total adjusted basal area for each live component. If a component is not present in any plot, the contribution to that component from that plot is zero.
5. Allocate the share of the area occupied by each storey in the section (derived above) in proportion to the total adjusted basal areas of each live component within the storey, i.e.:
   *Area allocated to live component = Total adjusted basal area of live component * Area occupied by the storey of which the live component is a part / sum of total adjusted basal areas of all live components in the storey*

(b) For section plot assessments

1. If the storey is a **thicket**, allocate the components of the storey in proportion to the section assessment of the composition of the storey:
   *Area allocated to component = Area occupied by the storey * proportion of storey occupied by the component at section level*
   Otherwise;
2. For each live component in the section, find the total basal area of the component within the section (i.e. sum of $\pi*(dbh)^2/4$ for all measurable stems of the component within the section).
3. Allocate the share of the area occupied by each storey in the section (derived above) in proportion to the total basal areas of each live component within the storey, i.e.:
   *Area allocated to live component = Total basal area of live component * Area occupied by the storey of which the live component is a part / sum of total basal areas of all live components in the storey*

Calculation of whole section growing stock properties of components

The growing stock properties of individual components within a section that are to be derived and stored, or passed to other processes involved in producing forecasts or estimates from the NFI survey, will, where possible, include top height, age, stocking, quadratic mean dbh, basal area and standing timber volume. The derivation of each of these for any component within a plot, whether this is a full or partial circular plot, or a whole section plot, is described here.

Top height

It is assumed that all components within a single storey of a stand possess the same top height.
For circular plots, for each storey the height of the dominant trees of that storey averaged over all plots is the estimated top height for all components of that storey. (If a storey is not present in a plot, the plot does not contribute a dominant height tree to the calculation of this average).
For section plots, use the following procedure:

1. For each storey, establish an empirical relationship relating total height to dbh according to the procedures described in Appendix 1, using the total heights and dbh values measured on the sample height trees belonging to this storey.
2. Calculate the number of stems, *N*, that the top height is to be calculated on. This is defined by:
   *N = 100 * [section area]*
   Round *N* to the nearest integer.
3. From the dbh distribution of live stems in the section belonging to the storey, select the *N* largest dbh values. If the total number of live stems of the storey within the section is less than *N*, select all live stems belonging to the storey.
4. Calculate the quadratic mean dbh of the selection of dbh values.
5. Use the relationship established in 1) above to estimate the expected height of a tree with dbh equal to the mean calculated in 4). The result is the top height to be assigned to every component within the storey[2].

Age

The age of the component is calculated from the planting year of the component, which is obtained from the section level assessment. Plot level components that are differentiated by status (alive or dead) are assigned the same pyear, corresponding to the pyear of the common section level component (storey/species or species group combination).

Stocking

This is the number of measurable stems of the component in the plot.

Quadratic Mean dbh

This is the quadratic mean dbh of all stems of the component in the plot.

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[2] Note, however, the special case described inn Appendix 1 when no relationship between height and dbh can be established.

Basal area

This is the sum of basal areas of all measurable stems of the component in the plot.
(Basal area of a single stem = $\pi*(dbh)^2/4$)

Timber volume

Estimation of timber volumes is to be calculated with the use of single tree tariff numbers, as described and specified in *"Forest mensuration: A handbook for practitioners"*.[3]
The first step of this approach is to calculate an estimate of timber volume for each measurable stem in the sample plots using the following procedure:

1. Determine an empirical relationship between total height and dbh within each storey of a stand. For this, all sample height trees in the same storey (including dominant trees within circular plots) are used in the procedure described in Appendix 1.
2. For each component, find the quadratic mean dbh of all stems with dbh>10 cm. across all sample plots.
3. For the quadratic mean dbh of each component, estimate the expected total height of a tree of this girth by application of the appropriate regression relationship, according to the storey containing the component.
4. For each conifer component, establish an estimated tariff number applying to that component by application of Equation 3 (p.322, *"Forest mensuration: A handbook for practitioners"*), using the species mappings for these equations specified in Appendix 2[4]
5. For each conifer component, using the basal area of each stem of the component with dbh>7cm., estimate the volume (in m^3) of each stem by application of the relationship between volume, basal area and tariff no. specified in Equation 1 (p.321, *"Forest mensuration: A handbook for practitioners"*). Stems of dbh<7cm. are deemed to have zero timber volume.
6. For broadleaf components, for each stem of the component with dbh>7 cm., estimate the volume (in m^3) of the stem by application of a formula of the form:
   $v = a + b.d^2.h^c$
   where v = volume; d = dbh; h = total height; a, b and c are parameter values[5].

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[3] FR may conduct a study to update and improve the single tree tariff relationships to be used in this process. The procedure specified here is therefore subject to change.

[4] This is an extension of Table A7.1 in *"Forest mensuration: A handbook for practitioners"* (p.317-318) to cover all species defined in the NFI field protocol

[5] These parameter values are to be supplied by FR and will be species specific.

At this point, there is an estimated volume for each measurable stem of each component in the sample plots. For a whole plot value of a component, sum the volumes of the measurable stems of that component within the plot.

Pooling and scaling results from circular plots

Top height is calculated across the plots and is a property of the component which does not vary within the stand, and age (or pyear) is assumed to be constant for the component. No pooling across plots is therefore necessary for these two properties.

Stocking, basal area and timber volume are, in principle, calculated initially on a per plot basis and therefore need to be pooled across plots, then expressed in terms of estimated values over the entire section area. While doing this, the results from partial plots also need to be scaled up to that of a full plot using the scaling factor of *(0.01/[plot area in ha.])*.

The calculations to obtain whole section values for each of these properties is therefore:

1. Multiply each plot value by the scaling factor *(0.01/[plot area in ha.])*
2. Sum the scaled values of each plot.
3. Multiply the result by the factor *([Section area in ha.]/n*0.01)* where n is the number of plots (full or partial).

For quadratic mean dbh, which is a mean *per tree* value, the necessary calculations are different and are easier to specify from the basic measurements, rather than from the means per plot:

1. Within each plot, sum the squares of the dbh values for each measured stem of the component.
2. Multiply the result for each plot by the scaling factor *(0.01/[plot area in ha.])*
3. Sum these scaled sums across the plots
4. For each plot, multiply the number of measurable stems of the component by the scaling factor *(0.01/[plot area in ha.])*
5. Sum these scaled numbers across the plots
6. Divide the result of (3) by the result of (5) and take the square root, which gives the weighted quadratic mean dbh for the component applying to the whole section.

Results from whole section plots

In the case of whole section plots, the calculations specified above for all growing stock properties directly provide the whole plot values. No further pooling or scaling of these results is therefore necessary.

Expression of growing stock properties in per hectare terms

Top height, age and quadratic mean dbh are area independent and therefore are not expressed in per hectare terms.

For stocking, basal area and timber volume (and any other stand variables related to area) there are two alternative definitions that can be used to express these for individual live components in standardised (i.e. per hectare) terms:

1. Values in terms of the allocated area of occupancy of the component. Specification of the calculation of allocated area within a section is given above, and the value per hectare of allocated area, derived from the whole section value, is given by:
   [whole section value]/[section area allocated to component]
2. Values in terms of absolute area. In this case the whole section area is used to scale the whole section value:
   [whole section value]/[total section area]

Values for dead components are only ever expressed in terms of absolute area (i.e. definition 2 above).

Definition 1 expresses the growing stock properties of a live component, taking into account the space occupied by other live components present in the section. **This definition of unit area values should be used as inputs into growth models for forecasting purposes.**

Definition 2 expresses the degree of presence of any individual component, ignoring the possible presence of other components in the stand. This may be the appropriate version to use for certain NFI outputs.

Thicket assessments

In the case of thicket, special definitions and calculations are used to derive the growing stock properties of thickets:

Plot level components

A thicket is defined as being a single storey and the plot-level components within the storey are defined to be the species (or principal species in species groupings) identified for the storey at section level. (It is possible for a thicket to be a storey within a multi-storey stand. Where a thicket is present in a multi-storey stand, it assumed to be the lowest storey of that stand, so the relevant section-level assessment is that of the lowest storey of the stand) No status is recorded for thickets and it is assumed that all components are live components.

The relative occupancy of components of the storey within the plot is taken to be identical to the occupancies of the storey estimated in the section-level assessment.

Top height

The height recorded for an average tree in a thicket is used to estimate top height of the storey. An adjustment factor, which may be species and density dependent, will be applied to the recorded height to yield an estimated top height[6].

Age

As for other stands; age is derived from the pyear recorded at section level for the relevant components of the storey

Stocking rate

The thicket stand is recorded as being of high, medium or low stocking density. These are equated with the following stocking rates in stems per hectare:

Density class	Assumed stems per hectare
High	3,000
Medium	1,750
Low	500

For the estimated number of stems of the thicket within a plot, multiply the assumed stems per hectare by the area of the plot. For the number of stems of each component of a thicket within a plot, multiply the number of stems for the whole thicket within the plot by the estimated share of the thicket occupied by that component, as assessed at section level.

Quadratic mean dbh, basal areas and timber volumes

All of these growing stock properties are assumed to be zero for thickets as a whole, and for each component of the thicket.

Variances of growing stock estimates

Each measured or derived statistic of the growing stock within sections of NFI squares will be given an associated variance which will be used in future analyses of sources of variation in the NFI field survey. Procedures for the calculation of these variances have yet to be derived but will need to be accommodated in the processes with the insertion of dummy values in assigned data fields. At present these data fields can be left <null> or populated with zeroes.

[6] Specification of this conversion is to be provided by FR.

Appendix 1

Fitting an empirical relationship between total tree height and dbh

1. Denote the total height in metres of tree *i* by h_i and its dbh in cm. by d_i
2. Let $h_i' = h_i - 1.3$
3. Fit a linear regression on the reciprocals of h_i' and d_i of the form:
   $(h_i')^{-1} = \alpha + \beta d_i^{-1} + \varepsilon_i$
   where ε_i are random error terms
4. If the values of the parameters • and • in this fitted regression are both greater than zero, accept the result of this regression as the empirical relationship to be used to relate total height to dbh. This implies that the estimated total height of a tree with dbh d is given by h in the equation:
   $h = 1.3 + d/(\alpha d + \beta)$
5. If either • or • are less than zero, the above equation is poorly specified. Instead fit the simple linear regression:
   $h_i = \alpha + \beta d_i + \varepsilon_i$
6. If the value of the parameter $\beta>0$, then use the result of this regression, so that, for a tree with dbh d, its estimated total height is given by:
   $h = \alpha + \beta d$
7. Otherwise conclude that there is no established relationship between height and dbh. In whole section plot assessments, this implies that the top height of any component species is equal to the mean total height of the sample height trees of the storey of which the component is a member. In the case of timber volume calculations of components, the tariff number of a component is found with reference to the quadratic mean dbh of the stems of that component, and the mean height of the sample height trees of the storey containing the component.

Appendix 2

Species mapping for single tree tariff equations

Single tree tariff no. species mapping

SPECIES CODE	**Common name**	**Type**	**Group**	**Mapped to**
SP	Scots pine	Conifer	Pine	**SP**
CP	Corsican pine	Conifer	Pine	**CP**
LP	lodgepole pine	Conifer	Pine	**LP**
AUP	Austrian pine	Conifer	Pine	cp
MAP	Maritime pine	Conifer	Pine	LP
WEP	Weymouth pine	Conifer	Pine	SP
MOP	mountain pine	Conifer	Pine	sp
BIP	Bishop pine	Conifer	Pine	LP
RAP	Monterey pine	Conifer	Pine	CP
PDP	Ponderosa pine	Conifer	Pine	SP
MCP	Macedonian pine	Conifer	Pine	cp
XP	Other pines	Conifer	Pine	sp
SS	Sitka spruce	Conifer	Spruce	**SS**
NS	Norway spruce	Conifer	Spruce	**NS**
OMS	Serbian spruce	Conifer	Spruce	NS
XS	other spruces	Conifer	Spruce	ns
EL	European larch	Conifer	Larch	**EL**
JL	Japanese larch	Conifer	Larch	**JL**
HL	Hybrid larch	Conifer	Larch	**JL**
DF	Douglas fir	Conifer	Fir	**DF**
WH	western hemlock	Conifer	Fir	**WH**
RC	western red cedar	Conifer	Cedar	**RC**
LC	Lawsons cypress	Conifer	Cypress	RC
LEC	Leyland cypress	Conifer	Cypress	RC
GF	grand fir	Conifer	Fir	**GF**
NF	noble fir	Conifer	Fir	**NF**
ESF	European silver fir	Conifer	Fir	NF
XF	other firs (Abies)	Conifer	Fir	nf
JCR	Japanese cedar	Conifer	Cedar	rc
RSQ	coast redwood	Conifer	Sequoia	GF
WSQ	Wellingtonia	Conifer	Sequoia	GF
XC	other conifers	Conifer	Other conifers	ns
MC	mixed conifers	Conifer	Other conifers	ns
OK	oak (robur/petraea)	Broadleaf	Oak	**OK**
SY	sycamore	Broadleaf	Maple	**SY**
NOM	Norway maple	Broadleaf	Maple	SY
AH	ash	Broadleaf	Ash	**AH**
BI	birch (downy/silver)	Broadleaf	Birch	**BI**
PO	hybrid poplar	Broadleaf	Poplar	**PO**
HCH	horse chestnut	Broadleaf	Chestnut	SY
AR	alder	Broadleaf	Alder	bi
CAR	common alder	Broadleaf	Alder	BI
GAR	grey alder	Broadleaf	Alder	BI
RAR	red alder	Broadleaf	Alder	bi

VAR	green alder	Broadleaf	Alder	bi
WCH	wild cherry, gean	Broadleaf	Cherry	BI
BCH	bird cherry	Broadleaf	Cherry	BI
RON	roble	Broadleaf	Nothofagus	BE
RAN	raoul/rauli	Broadleaf	Nothofagus	BE
HAZ	hazel	Broadleaf	Hazel	BI
XB	other broadleaves	Broadleaf	Other broadleaves	sy
MB	mixed broadleaves	Broadleaf	Other broadleaves	sy
SEM	smooth-leaved elm	Broadleaf	Elm	em
BE	beech	Broadleaf	Beech	**BE**
LLI	large-leaved lime	Broadleaf	Lime	ah
EEM	English elm	Broadleaf	Elm	EM
CLI	common lime	Broadleaf	Lime	ah
LI	lime	Broadleaf	Lime	ah
HBM	hornbeam	Broadleaf	Birch	BE
SC	sweet chestnut	Broadleaf	Chestnut	BE
ROK	red oak	Broadleaf	Oak	BE
EM	elm	Broadleaf	Elm	**EM**
WEM	wych elm	Broadleaf	Elm	**EM**
SLI	small-leaved lime	Broadleaf	Lime	ah
PAR	Armand's pine	Conifer	Pine	sp
PYU	Yunnan pine	Conifer	Pine	sp
PEL	slash pine	Conifer	Pine	lp
PMO	western white pine	Conifer	Pine	lp
PBR	Calabrian pine	Conifer	Pine	sp
PAY	Mexican white pine	Conifer	Pine	sp
PKO	Korean pine	Conifer	Pine	sp
PWA	Bhutan pine	Conifer	Pine	sp
PTA	loblolly pine	Conifer	Pine	cp
XBI	other birches	Broadleaf	Birch	bi
XOK	other oak spp	Broadleaf	Oak	ok
XPO	other poplar spp	Broadleaf	Poplar	po
QFR	Hungarian oak	Broadleaf	Oak	ok
FOR	oriental beech	Broadleaf	Beech	be
LCD	cedar of Lebanon	Conifer	Cedar	nf
QPU	downy oak	Broadleaf	Oak	ok
POK	pedunculate/common oak	Broadleaf	Oak	OK
YEW	Yew	Conifer	Yew	sp
NMF	Nordmann fir	Conifer	Fir	NF
ORS	oriental spruce	Conifer	Spruce	ns
XL	other larches	Conifer	Larch	el
QPY	Pyrenean oak	Broadleaf	Oak	ok
XCD	other Cedar	Conifer	Cedar	nf
CAT	Atlas cedar	Conifer	Cedar	nf
BMF	Bornmuller's fir	Conifer	Fir	nf
QAL	white oak	Broadleaf	Oak	ok
SOK	sessile oak	Broadleaf	Oak	OK
GKF	Grecian fir	Conifer	Fir	nf
RF	red (pacific silver) fir	Conifer	Fir	gf
QCE	Turkey oak	Broadleaf	Oak	ok
QIL	Holm oak	Broadleaf	Oak	ok
BPA	paper-bark birch	Broadleaf	Birch	bi

ASA	silver maple	Broadleaf	Maple	sy
FPE	red ash	Broadleaf	Ash	ah
PBI	downy birch	Broadleaf	Birch	BI
AMA	big leaf maple	Broadleaf	Maple	sy
FAM	white ash	Broadleaf	Ash	ah
FAN	Narrow-leafed ash	Broadleaf	Ash	ah
FM	field maple	Broadleaf	Maple	SY
SBI	silver birch	Broadleaf	Birch	BI
XWL	other willows	Broadleaf	Willow	bi
HOL	holly species	Broadleaf	Holly	sy
XNO	other Nothofagus	Broadleaf	Nothofagus	be
CAP	crab apple	Broadleaf	Sorbus	sy
NPU	Lenga	Broadleaf	Nothofagus	be
LPL	London plane	Broadleaf	Plane	SY
XPL	plane spp	Broadleaf	Plane	sy
BPO	black poplar	Broadleaf	Poplar	PO
ROW	Rowan	Broadleaf	Sorbus	bi
JNI	black walnut	Broadleaf	Walnut	ok
XEU	other Eucalyptus	Broadleaf	Eucalyptus	po
XWA	other walnut	Broadleaf	Walnut	ok
WPO	white poplar	Broadleaf	Poplar	po
ASP	aspen	Broadleaf	Poplar	po
PSP	blackthorn	Broadleaf	Cherry	sy
TUL	tulip tree	Broadleaf	TulipTree	be
COV	shagbark hickory	Broadleaf	Walnut	ok
WWL	white willow	Broadleaf	Willow	bi
SCI	grey willow	Broadleaf	Willow	bi
GWL	goat willow	Broadleaf	Willow	bi
IAR	Italian alder	Broadleaf	Alder	bi
JRE	common walnut	Broadleaf	Walnut	ok
BOX	box	Broadleaf	Box	bi
XCH	other cherry spp	Broadleaf	Cherry	bi
WST	wild service tree	Broadleaf	Sorbus	bi
CWL	crack willow	Broadleaf	Willow	bi
GPO	grey poplar	Broadleaf	Poplar	po
EGU	cider gum	Broadleaf	Eucalyptus	po
ENI	shining gum	Broadleaf	Eucalyptus	po
WHI	whitebeam	Broadleaf	Sorbus	bi
HAW	hawthorn species	Broadleaf	Sorbus	bi