Ecological Site Classification Quick Start Guide Version 4.3.3

What is the Ecological Site classification decision support system (ESC-DSS)?

ESC is a tool designed to assist and complement a forest management professionals' knowledge. It does this by helping to match tree species to site conditions and provide a mechanism to explore and contextualise site conditions such as soil fertility, soil moisture, wind, and climate. ESC has been designed to help support a Forester's decision-making process by providing a quick appraisal of a site's potential character and to help explore the effects of predicted climatic changes to site, and species interactions over time.

When should and shouldn't you use ESC?

ESC should primarily be used on sites with no recent site history, or where it is appropriate to investigate the potential effects of climate change on species suitability.

As a predictive model, ESC can only provide accurate information when it is provided with accurate site soil or vegetation data.

ESC is not suited to urban tree planting or urban forestry as these systems contain variables and factors not represented by ESC.

ESC is not a substitute for forestry best practice, knowledge, and experience. Where extensive local knowledge and experience is present this may override, or be supported by, ESC outputs.

Key considerations when using ESC

- When underplanting, local conditions will not accurately reflect the influences of the over-storey. There may be positive aspects such as protection from extreme heat or exposure, but there is no direct way to describe the shade tolerance requirements of species directly within ESC.
- There can be significant variability of outcomes on poorer site types. This can be because of competing species such as heather, etc, or underlying geologies.
- Tree species suitability is gauged according to ecological requirements and minimum growth rates. A suitable species might still be "unsuitable" if, for example, management and yield class interact unfavourably – for example, fast growing broadleaves at high density without thinning might be vulnerable to snapped stems through wind damage, shallow root-ing might limit stability of all tree species etc.
- Yield Class estimates assume optimal seed selection, establishment, and maintenance. Many broadleaved species have bias in favour of high yields on good sites, and some lesser-known tree species have understated yields because trials on poorer sites might be non-existent or limited.
- In coastal situations, exposure and salt burn effects are understated.
- ESC Yield Class is not a predictor of individual tree growth but stand growth.
- ESC does not always represent the realities of ex-agricultural land.
- ESC does not consider provenance or genetics.

Limitations of ESC

- ESC uses a simple model that is applied to only ~60 species.
- It assumes that site variable interactions are limited to temperature and one other limiting factor. In reality, there are complex interactions between variables, some of which are not described by ESC.
- Future climate data and models are very pessimistic. It is recommended that decisions are based on the 2050/AWC (Available Water Capacity) model and to ensure adequate measures are in place for 2080 (range of tree species, flexible management practices/Low impact silvicultural systems/thinning).
- There is no direct assessment of the impacts of previous afforestation/land use, for example, improvements to soil biota that might improve tree growth, fallow/rewilded sites which may limit tree growth etc.
- On sites with extreme conditions (i.e., with soils of very poor/ or wet and very wet status), we are uncertain of the performance of many species and so there might be opportunities to incorporate lesser-known species into management.
- ESC does not integrate the site objectives into the tool. The user must select species suitable for the objective and silviculture they are pursuing. For more detailed silvicultural support, see the Forest Development Type (FDT) guidance.

Priority of inputs for output accuracy

Inputs listed in order of accuracy 1 = best, 6 = worst

Soil Nutrient Regime:

1. Vegetation survey
2. Soil type / soil survey input
3. Assumptions based on soil maps + site visit with 30cm hole + soil Matrix
4. Assumptions based on soil maps + site visit without survey + soil Matrix
5. Soil maps only
6. 'Default Profile' in ESC

Soil Moisture Regime:

1. Soil type
2. Vegetation survey (if soil is fresh or wetter), it is rare for indicator plants in GB to yield a drier soil type
3. Assumptions based on Landscape analysis + flood risk maps + visual site assessment.
4. Visual site assessment only
5. 'Default Profile' in ESC

1. Overview

The current system is structured to provide an interface organised as follows:

	Resource links
Quick navigation	Tool selector *Changing the option will change the contents of the tool options window.*
Tool options	Map view + legend
Results window	

- Resource links – the terms of use, update history, case studies, manual, contact email.
- Quick navigation – enter a six figure Ordnance Survey GB grid reference, the map will zoom into the region of interest.
- Tool selector – Ecological Site Classification and related decision support tools can be selected from a list.
- Maps of species suitability alongside climatic and topographic data can be accessed using Forest Maps.
- Tree species suitability can be evaluated using Ecological Site Classification (Tree Species).
- Native Woodland suitability can be evaluated using Ecological Site Classification (NVC Woodland).
- If ESC base data is required for sample sites, this can be obtained by uploading a file containing a list of Ordnance Survey GB grid references (i.e. two letters followed by six digits e.g. NT090950), this will return a common separated value file containing the four ESC climate variables and the modelled soil properties for the given site.
- Data is entered via the Tool Options windowpane (e.g. soil properties and management options).
- The outcomes of an analysis are displayed in the Results Window, alongside options to save the data where applicable as a csv or pdf file.

2 . Site and Query Parameters

The input panel for Ecological Site Classification includes the options to amend site level data on soil type, operations, and query parameters.

a) Soil Moisture Regime
Select the appropriate soil moisture regime for the site. We assume that this data is obtained through a formal soil survey.

b) Soil Nutrient Regime
Select the appropriate soil moisture regime for the site. We assume that this data is obtained through a formal soil survey. Note there are now three categories of very poor site (VP1, VP2 and VP3). VP1 is the most impoverished (e.g., FC deep peat soil type 10a), VP2 the intermediate grade (e.g. FC deep peat soil type 11a) and VP3 is the richest (e.g. FC podzolic peaty gley soil type 6z).

Soil data for common FC soil types are included in appendix A.

c) Brash Management
If a new planting site ignore this option. If restock, select this option if the site will be replanted quickly (<18 months after felling) to take advantage of nutrients from decomposing brash.

d) Drainage
Wet sites (soil moisture regimes very wet, wet, very moist and moist) can benefit from drainage, which has the effect of drying the site and slightly improving the nutrient availability on very poor sites.

e) Fertiliser/Nursing mixture
The application of fertiliser can raise the site nutrient regime; however, this is only warranted on very poor and occasionally poor soil nutrient regimes. Depending upon the site type some species may require several applications and/or a unique fertiliser prescription based upon specific site/species issues (e.g., imbalance in NPK ratios).

There is evidence that pines planted in mixture with other species can ameliorate nitrogen deficiencies on certain sites, but not PK or other limitations. The favoured mixture species for use with Sitka spruce is Alaskan Lodgepole pine, as this will grow more slowly, and the stand is therefore more likely to self-thin.

Larch, birch and alder may also confer nurse benefits though they may not be suitable in some situations due to site requirements, or their tendency on exposed sites to damage leaders of adjacent trees through crown whipping.

f) Results Filter
This list provides options to constrain the results list to suitable species only, native only and so on. When looking at native woodland creation remember that NVC types have different niches to the suitability ranges of component species. For example, Scots Pine is suitable on a wide range of soil types (very poor to rich), but the related W18 native woodland only tends to occur where the soil nutrient regime is very poor or poor (see pages 48-49 of bulletin 124).

g) Climate Scenarios
The ESC model can be run against different climate scenarios. For current operational use we recommend the baseline scenario with some thought given to the consequences for selected species should the site become drier in the future.

h) Update button
Assuming a site has been identified on the map, the update button allows the same site to be re-analysed but with different soil or management options.

3. Map View

The map displays the dataset currently selected. The following actions are available

a) zoom in/out using mouse wheel or the +/- control on the map. Pinch to zoom may work on devices with touch interfaces.

b) pan by holding mouse down and dragging the map

c) zoom to region of interest by holding down shift key then pressing left mouse button to draw a box, on release of the mouse button the system zooms in to the selected region.

d) click to analyse – if the left mouse button is clicked the system analyses the site with the user selected (or default) site variables and query parameters.

4. Results View

a) Site Data
The first table lists all the site data and the user inputs. Sometimes SMR and SNR will be amended according to the impact of a site operation (e.g., drainage).

b) Results

Species suitability results are displayed for all 62 species available unless the user subsets the list via option 4(f). Suitability scores are presented in the classic-coloured chart on the right-hand side and complemented with the underlying model outputs on the left-hand side.

There is a link at the top of the table that allows the results to be saved in CSV or PDF format.

ESC Score	Description	Interpretation
0.75+	Very suitable	Factors will not significantly constrain growth
0.5 – 0.74	Suitable	Some impact upon growth, for example lower yielding Sitka spruce on a peaty gley (YC 14-16).
0.3 – 0.49	Marginal	Species in this category may have significantly reduced growth, high risk of check or absolute failure. Examples -Sitka spruce on certain deep peats without fertiliser exhibiting wide variation in growth rates (YC 0-10). -Downy birch on very poor sites forming a scrub woodland.
0 – 0.29	Unsuitable	In this category the species will usually fail to establish extensive tree cover.

The species suitability scores operate on the basis that a higher value means a particular factor (AT, SMR etc) is unlikely to prevent tree growth. Values above 0.75 are very suitable and have the lowest risk, but the incidence of failure or significantly reduced growth is usually much higher when one or more factors is below 0.5.

The numeric outputs give a little more information about how marginal or suitable a species may be on a given site. For example, a species with a suitability score of 0.50 in reality may be close in performance to another with a score of 0.49.

ESC Species Symptoms by Climatic/Edaphic (Soil) Variables and Suitability Classes

Variable	Suitability Class	Effects
Accumulated Temperature (AT)	Unsuitable	- High mortality due to winter cold. - Very slow growth. - Potentially death at any age.
	Marginal	- Significantly reduced growth rate.
	Suitable	- Growth reduction of 25-50%
	Very Suitable	- No warmth constraints
Continentality	Unsuitable	- n/a
	Marginal	- n/a
	Suitable	- n/a
	Very Suitable	- n/a
DAMS	Unsuitable	- High mortality due to wind exposure
	Marginal	- Significantly reduced growth rate. - Severe stem form problems
	Suitable	- Possible stem form problems
	Very Suitable	- No exposure constraints
Moisture deficit	Unsuitable	- High mortality due to drought. - Limited growth due to excessive rainfall
	Marginal	- Severe growth constraints - Stem damage risk from drought cracks
	Suitable	- Some growth constraints - Possible drought cracks (Grand/Noble fir)
	Very Suitable	- No constraints
Soil Moisture Regime	Unsuitable	- Mortality due to anaerobic conditions (wet sites) - Mortality due to dry conditions (very dry sites)
	Marginal	- Severe growth constraints due to limited rooting in wet soil. - Difficulty sustaining growth of larger trees due to limited water availability on dry soils.
	Suitable	- Some growth constraints due to limited water availability on dry soils. - Wet conditions inhibit update of nutrients.
	Very Suitable	- No constraints
Soil Nutrient Regime	Unsuitable	- High mortality due to acid soil conditions. - Check, trees unable to grow due to nutrient deficiencies. - Mortality associated with carbonate soils.
	Marginal	- Uneven and limited growth due to lack of nutrients. - Stunted stems.
	Suitable	- Some reduction in growth potential.
	Very Suitable	- Good growth. - Coarse branching on richer soils (Scots pine, birch)

5. Other ESC Terms

Suitability

Ecological Site Classification uses the term suitability to describe the likely success of a particular tree species establishing and growing to maturity on a given site. There are two measures of suitability, one broadly considers timber in terms in yield potential, the other the ecological suitability of the site. It is possible for situations to arise where a species is ecologically suited to a given site despite being unsuitable for timber production.

Timber Suitability

In ESC4 the definition of very suitable is the potential to achieve 75% or more of the maximum general yield class for the given species in British conditions. The threshold for suitable is 50% or more and marginal is 30% or more. Unsuitable conditions for timber production are defined as those where the predicted yield is less than 30% of the maximum possible in British conditions.

Marginally suitable species are usually only recommended where no other options exist or when production goals are of lesser importance as a site objective.

Ecological Suitability

The ecological suitability of a site describes the suitability of a species in terms of the most limiting factor. A species is ecologically suited to a site if the species response to each of the climatic and edaphic(soil) variables is greater than 0.5.

Note it is possible for a species to be suitable for a site ecologically, but unsuitable for timber production. This reflects the distribution of some native species and the occurrence of low-density woodlands.

In most cases productive goals are met when a species is a least suitable for timber production and is ecologically suitable for a given site. When woodland habitat is an objective an ecological suitable or marginal species may be a valid option, assuming that establishment goals (e.g., stocking density can be achieved).

Model Version

ESC models are assigned a version. Models are revised and tested as the system changes to ensure consistent outputs. The 3.1 series models onwards are revisions associated with the introduction of additional classes of very poor soil nutrient regime.

Model Class

Species suitability models are assigned a class according to the amount of evidence available to support the model. Therefore, a species recommended as suitable in class B is a safer option than an equivalent species in class C.

Model Class Comparison Table

Class A	The species is well understood in British conditions, with widespread historical planting and/or trials.
Class B	The species has been trialled in British conditions on a limited scale.
Class C	The species has very limited or no trials in British conditions, e.g., individual planting or experimental use in limited geographic extents.

6. Forest Maps Data Browser Options

The Forest Maps data browser contains folders which can be expanded by clicking on them to reveal several datasets. Clicking on the map will reveal metadata about the map currently being viewed alongside the option to download the data as a file (usually a geotiff).

a) Climatic Data
This option contains the baseline climatic data (accumulated temperature, continentality, dams (exposure) and moisture deficit for the period 1961-1990 at a resolution of 250 metres. Rainfall is provided at 5km resolution for the same period.

b) Topographic Data
These are data derived from 250m Ordnance Survey open data digital elevation models and publicly available methods for calculating topographic shelter (topex) and topographic wetness (compound topographic index). Aspect and slope where derived from models in QGIS.

c) Broadleaf Species
Climatic timber suitability maps for a range of broadleaved species.

d) Conifer Species
Climatic timber suitability maps for a range of conifer species. In some cases, such as Douglas fir, Scots pine and Sitka spruce additional information is available on provenance and soils suitability.

The species climatic suitability maps show the theoretical maximum planting extent of a selected species assuming optimal soil (edaphic) conditions within GB. However, in practice the range will be considerably reduced due other factors, particularly the site soil type. Like many aspects of decision support tools, the maps are intended to complement site level assessments, expert judgement, and local knowledge.

e) Native woodland maps (Baseline)
Native woodland maps combine the **climatic** species suitability of the main component species with the **climatic** NVC suitability guidelines published in Ecological Site Classification Bulletin 124. Information on soil type will inform the actual NVC woodland type suitable for a given location.

f) Climate Zones and Modelled Soil Data
These are the broad ESC climate zones for GB alongside ESC soil properties data (SMR/SNR) which has been modelled to 250x250 metre pixel resolution based on FC soil maps and national scale data. While the soil data indicates trends it is not intended for site level planning, users are recommended to use their own data in site analyses if possible.

g) Establishment
Maps are included for bareroot planting windows according FC Bulletin 121 and GB Seed Zones.

h) In Development

Those are provided for evaluation and are part of ongoing work which is yet to be finalised. A map is included that provides an estimate of site fertility according to underlying solid geology (based on an old, and now superseded BGS 1:625k dataset).

In addition, two new maps are in development that describe the climatic potential of broadleaved or conifer species according to the potential of various key species. Those climatic zone maps are intended to help users quickly identify the species and objectives that are likely to be supported in a given location.

For the broadleaved map the key is as follows:

Zone	Interpretation
OK/BE/SY/WCH	The site is climatically very suitable for one or more of Oak, Beech, Sycamore or Wild Cherry.
PBI/SBI	The site is climatically very suitable for Birch, or suitable for other broadleaved species. Good production is still possible.
OK/SY/Native	The site is climatically suitable for Birch, Oak and Sycamore, though there may be climatic constraints. Site may also be suitable for other native woodland (NVC) types where production is not an objective.
PBI/SBI	The site is only suitable for Birch, as a low yield species.
PBI/ROW	The site is possibly suitable for Birch and Rowan as native woodland habitat.

Appendix A.

1. The ESC Soil Properties of Common Forestry Commission Soil Types

The ESC properties for the main Forestry Commission soil types are tabulated below. The values applied are typical observed mean attributes, and it is common for soil moisture and nutrient regime values to vary depending upon local factors. For example, mineral soils in higher rainfall areas are more likely to be wetter and soils overlying richer bedrock may be more fertile.

Soil Moisture Regime (SMR) and Soil Nutrient Regime (SNR) are modelled as continuous variables. For convenience, they are often referred to as the following classes described in tables A.1 and A.2 respectively.

Soil Moisture Regime	Numeric value	Example
Very wet (VW)	1	Deep peat
Wet (W)	2	Peaty gley
Very moist (VM)	3	Surface water gley
Moist (M)	4	Gleyed brown earth
Fresh (F)	5	Freely draining mineral soil
Slightly dry (SD)	6	Sandy mineral soil
Moderately dry (MD)	7	Shallow sandy mineral soil
Very dry (VD)	8	Rankers, shingle, rendzinas

Table A.1: Soil Moisture Regimes

Soil Nutrient Regime	Numeric value	Example
Very poor (VP1)	0	Unflushed deep peat
Very poor (VP2)	0.5	Podzols
Very poor (VP3)	1.0	Podzolic ironpans
Very poor-Poor (VP-P)	1.5	Ironpans
Poor (P)	2.0	Peaty gleys, upland brown earth
Medium (M)	3	Brown earth and surface water gleys
Rich (R)	4	Brown earths with high base status
Very rich (VR)	5	Calcareous brown earths
Carbonate	6	Rendzinas

Table A.2: Soil Nutrient Regimes

When using ESC, the following tables allow users to enter default values for common soil types as described by the Forestry Commission Soil Classification. The table is not exhaustive because many mineral/organo-mineral soils have a wide range of potential phase interactions.

2. ESC Properties of Mineral and Organo-Mineral Soils

Tables A.3 and A.4 describe the default ESC properties of the most common mineral and organo-mineral forest soil types according to the Forestry Commission soil classification system. Note that significant variation around the default properties can be expected due to local factors such as underlying geology.

In the case of Iron pan soils two sets of information are provided, one assumes establishment will occur with the pan unbroken; the other assumes site preparation techniques will break the pan and drain the perched water table.

FC Soil Code	Description	Soil Moisture Regime (SMR)		Soil Nutrient Regime (SNR)	
		Text	Value	Text	Value
1	Typical brown earth	Fresh	5	Medium	3
1u	Upland brown earth	Fresh	5	Poor	2
1z	Podzolic brown earth	Fresh	5	Poor	2
3	Podzol	Fresh	5	Very poor (VP2)	0.5
5	Ground water gley	Very moist	3	Rich	4
6	Peaty gley	Wet	2	Poor	2
6l	Peaty gley (loamy)	Very moist	3	Poor	2
6z	Podzolic Peaty gley	Very moist	2	Very poor (VP3)	1
7	Surface water gley	Very moist	3	Medium	3
7z	Podzolic Surface water gley	Very moist	3	Poor	2
12	Rendzina	Moderately Dry	7	Carbonate	6
12b	Calcareous Brown Earth	Fresh	5	Very Rich	5
12t	Argillic Brown Earth	Moist	4	Very Rich	5

Table A.3: Mineral and organo-mineral soil properties without perched water tables.

FC Soil Code	Description	Soil Moisture Regime (SMR)		Soil Nutrient Regime (SNR)	
		Text	Value	Text	Value
4*	Ironpan	Very moist	3	Very poor (VP3)	1
4z*	Podzolic Ironpan	Very moist	3	Very poor (VP2)	0.5
4	Ironpan	Fresh	5	Very poor-Poor	1.5
4z	Podzolic Ironpan	Fresh	5	Very poor (VP3)	1
4b	Ironpan intergrade	Fresh	5	Poor	2

Table A.4: Mineral soil properties with perched water tables. *=assumes the ironpan is

not broken through ground preparation.

3. Organic soils

Table A.5 describes the properties of deep peats according to the FC soil classification system and ESC. Many of those soils would have been afforested with the assistance of drainage systems which may need to be maintained if such sites are to be restocked.

FC Soil Code	Description	Soil Moisture Regime (SMR)		Soil Nutrient Regime (SNR)	
		Text	Value	Text	Value
8a	Phragmites fen	Very wet	1	Rich	4
8b	Juncus articulatus/acutifloris	Very wet	1	Medium	3
8c	Juncus effusus	Very wet	1	Medium	3
8d	Carex	Very wet	1	Rich	4
9a	Molinia, Myrica,Salix	Very wet	1	Medium	3
9b	Tussocky Molinia/Calluna	Very wet	1	Poor	2
9c	Tussocky Molinia Eriophorum vaginatum	Wet	2	Poor	2
9d	Non Tussocky Molinia, Eriophorum vaginatum, Trichophorum	Very wet	1	Very poor (VP3)	1
9e	Trichophorum, Calluna, Molinia	Wet	2	Very poor (VP2)	0.5
10a	Lowland Sphagnum	Very wet	1	Very poor (VP1)	0
10b	Upland Sphagnum	Very wet	1	Very poor (VP1)	0
11a	Calluna	Very moist	3	Very poor (VP2)	0.5
11b	Calluna, Eriophorum vaginatum	Wet	2	Very poor (VP2)	0.5
11c	Trichophorum, Calluna	Wet	2	Very poor (VP1)	0
11d	Eriophorum	Wet	2	Very poor (VP1)	0

Table A.5: Properties associated with organic soils.

Appendix B.

Soil Phase Descriptions

Suffix	Name*	Description
a	shallow	Predominately 30-45 cm depth of soil to bedrock.
c	cultivated	Considerable alteration to physical or chemical properties or to vegetation by former agricultural use.
e	ericaceous	Vegetation contains sufficient *Calluna* (dominant to frequent) to become a weed problem after planting.
f	flushed	Considerable enrichment with nutrients from flush water, as indicated by the presence and vigour of tall *Juncus* species, *Deschampsia cespitosa* or *Molinia*.
g	slightly gleyed	Subsoil slightly mottled or with grey patches.
h	humose	Topsoil contains between 8 and 25% organic matter by weight.
i	imperfectly aerated	Applied to gley soils with less prominent grey colouration than usual for the type (but which do not quality as 7b).
k	calcareous	With pH > 7.0 in the A, E or B horizons.
l	loamy	Used for surface-water gley soils and peaty gley soils where the texture throughout the profile is not finer than sandy clay loam.
p	peaty (or deeper peat phase)	Surface horizon containing more than 20% organic matter by weight.
		Thickness definitions: 3p and 5p = 5-45 cm of peat 4p = 15-45 cm of peat 6p = 25-45 cm of peat
		(Note that types 6 and 6z have a peaty horizon 5-25 cm thick)
s	Stony	Stones occupy more than 35% of the soil volume.
v	alluvial	Soil developed in recent alluvium of sandy or coarse loamy texture.
x	indurated	Has strongly indurated material within 45 cm or surface. Implies loamy texture. Where indurated material is only moderately developed or is at depths of 45-60 cm, (x) is used.

Not all soil properties have an effect in ESC, however, the below list indicates those which will have a significant impact. When adjusting soil properties, expect a narrower variation in SMR, and a larger variation in SNR.

Shallow (a) – one SMR class drier (4a – shallow ironpan, slightly dry -> moderately dry)
Gley (g) - phase one SMR class wetter, SNR one class richer (1g - brown earth, fresh/medium -> moist/rich)
Stony (s) - one SMR class drier (1s – stony brown earth, fresh -> slightly dry)
Loamy (l) - one SMR class drier (6l – loamy peaty gley, wet-> very moist)
Peaty (p) – one SMR class wetter (6p peaty gley, wet-> very wet)
Ericaceous (e) – sets SNR to VP2 (4e ironpan VP3-> VP2, 6e peaty gley poor -> VP2)
Podzolic (z) – SNR one class poorer (1z podzolic brown earth, medium -> poor)

Appendix C.

Frequently Asked Questions

A common critique of ESC is that Data is collected mainly from uplands and is non-transferrable to lowland soils and climates. Is this true?

This is not accurate as most of the initial research work on the system was focussed on lowland sites. The issue with the lowlands pertains to the soil classification changes with calcareous soils, and to a lesser extend poorer mineral soils. During surveying, some soils that had a calcareous phase/type were labelled as SNR carbonate, which causes problems with suitability models. On poorer soil types, rather than use mean soil SNR, a pessimistic approach is taken whereby podzolic soils are universally classed as very poor 2.

Fundamentally ESC takes a pessimistic view of any site that is very poor, wet or carbonate, because to do otherwise could lead to wildly different outcomes. What we are trying to do on those sites is prompt users to think further about the site as ESC has flagged up an issue.

At what point in a tree's life is ESC modelling in a climate projection? Fully established and existing trees? Trees that will be Established in 2050? Trees that are planted now?

If a tree is very suitable, we expect it to grow throughout its lifetime, if suitable it may grow well when young and loose vigour later. The climate projections used describe suitability assuming a consistent climate experienced throughout the life of the tree. In practice however, it is a combination of 2020,2030,2040, 2050.etc.). This is only looked at quantitatively when running simulations of growth where ESC suitability/yield is calculated for each decade and the growth trajectory is adjusted accordingly. That feature currently is not available in user facing ESC but may appear in future updates.

Why do Forest development types (FDT's) 's not have the same soil data input as ESC?

This feature has currently not been implemented due to the differences in approach for ESC and FDT development.

How is the FDT model different than the ESC model? Where are they comparable and where are they not?

The FDTs are a subset of the suitability space for each species. For example, on exposed sites, thinning related FDTs will be unsuitable. Similarly, on richer sites a species might be judged to develop coarse growth or be a poor utilisation of site potential, e.g., Scots pine and Douglas fir both grow according to ESC on rich sites, but Scots Pine FDTs would be considered unsuitable. In some situations, the use of mixed species moves primary or secondary species onto sites where they might otherwise be marginal.

Does the ESC input/FC soil classification work for agricultural /grassland

/Pasture /Arable sites, or is it limited to currently forested sites.

The FC soil classification does accurately describe ex-agricultural sites; however, these sites must be considered carefully to perform a correct assessment of SMR and SNR. Assessment of these sites should be sure to account for potential soil changes such as the development of plough-pans, historic fertiliser additions, changes in soil texture, conversion of bedrock... etc.

ESC can only derive SMR and SNR from vegetation within forested systems and so currently, soil surveys in combination with local knowledge are the most accurate way to gather SMR and SNR on these sites.

Document Change History

Version	Date Changed	Changed By	Comments
4.3.3	14 July 2022	Jake Ellery	Added Introduction Added Appendix B&C. Removed several sections for clarity. Rearranged existing sections for clarity Minor edits across document
4.2	23 May 2016	Stephen Bathgate	Revised introduction to match latest user interface. Minor text edits to table labelling. Revised text describing of suitability. Corrected case study to indicate use of drainage.
4.1	15 April 2016	Stephen Bathgate	Included default soil properties as appendix.