

Managing invasive and non-native forestry species



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About this guidance

This guidance is for forest owners and managers. It explains how recent legislation relating to invasive and non-native woodland species applies in Scotland, and offers advice on managing them. It builds on information provided on the [FCS website](#), where updates to the guide will also be provided. Note that this guide is not a definitive statement of the law and independent advice should be sought for specific legal issues.



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1. Overview of legislation

Summary

- In Scotland it is now an offence to plant non-native trees, shrubs or plants, or to release non-native animals, into 'the wild'.
- This offence does not apply to exempt species (those that are commonly used in Scottish forestry), but they must still be managed according to the UK Forestry Standard.
- To plant a non-native tree or shrub that is not exempt, or to release a non-native animal, into the wild you must get a licence from Scottish Natural Heritage.
- If you allow any other non-native species to spread into 'the wild' you will be committing an offence.



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1.1 New legislation

In order to stop the spread of non-native species in Scotland, the **Wildlife and Natural Environment (Scotland) Act** (the WANE Act) was passed in 2011. The WANE Act reinforces some of the offences under the **Wildlife and Countryside Act 1981** (the 1981 Act).

In relation to forestry, it is now an offence for a forest owner or manager to plant or cause to grow in the wild any plant outwith its native range. However, if you are dealing with an **exempt** forestry species – these are listed at [Appendix 1](#) – then the WANE Act **does not** put any regulatory burden on you beyond the UK Forestry Standard.

1.2 Forestry exemption

Exempt species are the non-native species widely used in Scottish forestry. They are listed at [Appendix 1](#) and on the **exemption order page** of our website. These species are exempt because they are important to the Scottish economy and their maturation patterns and invasive potential are understood well enough to allow the risk of their spreading to be managed and lowered.

However, these species must still be managed according to the UK Forestry Standard. In other words, in normal Scottish forestry scenarios you will need to comply with the UK Forestry Standard, and by doing that you will have complied with the WANE Act. [Section 2](#) explains how to do this.

1.3 Other forestry species

For a non-native forestry species that is not exempt, you must get a licence from Scottish Natural Heritage if you want to plant it or cause it to grow in the wild. This means placing or setting seeds, seedlings and plants (or parts of plants), or allowing natural regeneration into the ‘wild’ areas defined in [section 1.4](#) below.

The licence process is outlined in [section 3](#). It also applies if you want to release a non-native animal.

If you allow a non-native species that is not exempt or licensed to spread into the wild you will be committing an offence.

The Scottish Government’s **Code of Practice on Non-Native Species (2012)** (the Code) explains the legal responsibilities of those who own, care for and manage non-native species, or those who take part in activities that might introduce a non-native species to Scotland. It explains what the offences are, how an offence can be avoided, and the penalties that may be imposed if an offence is committed. We advise all forest managers to read the Code.



Sitka spruce



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1.4 Wild and non-wild areas

'In the wild' includes most kinds of forest and woodland. The Code classifies land as 'wild' or 'non-wild' by how intensively it is managed even once trees are established. Policy woodland may fall into either category, for example. It is your responsibility to understand the difference and consider how it applies to your land. Note that the Code's definition of 'wild' does not relate to other types of 'wild land', such as discussed in the National Planning Framework 3.

Non-wild areas are those which are intensively managed provided they are regularly monitored.

For example:

- agricultural land;
- enclosed land used to create grazed woodland and wood pasture;
- land used for Christmas tree production;
- orchards;
- tree nurseries;
- arboreta; and
- silvicultural research trial areas.



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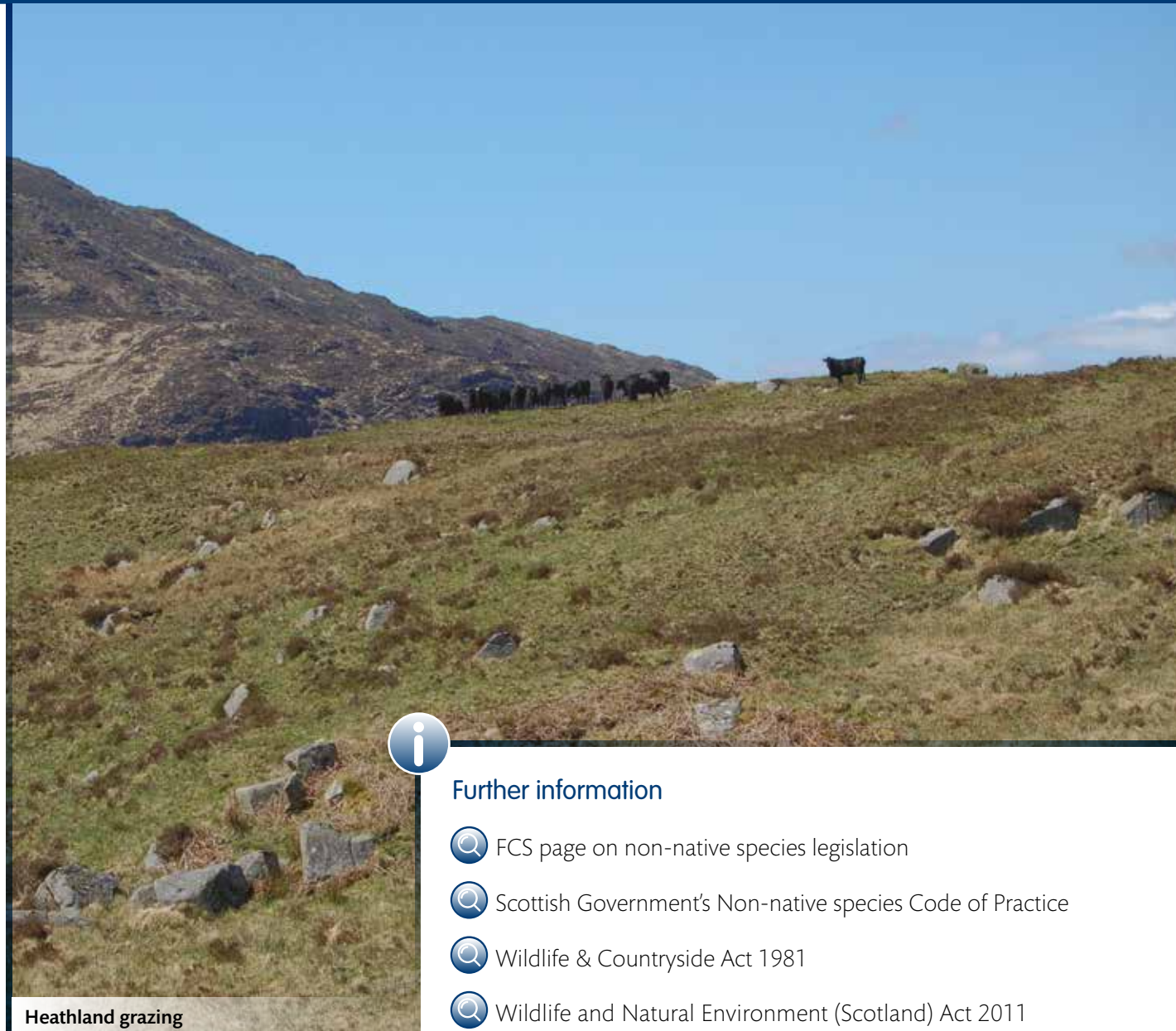
Non-native forestry species planted here will not need to be exempt or licensed, nor will it be an offence to allow them to regenerate onto this type of land so long as it is intensively managed and regularly monitored. You must still comply with the UK Forestry Standard.

Wild areas are essentially everywhere else, including:

- open hill grazing land;
- heather moorland; and
- woodlands and forests not covered by the above description.

Note the implication for land use change. Establishing woodland on non-enclosed agricultural land will make that land 'wild' because once the woodland is established it will no longer be intensively managed. Non-native forestry species that are planted or allowed to naturally regenerate in a newly-wild area like this must be exempt or licensed.

In legal terms, there is a defence to this offence, of "exercising due diligence" and "taking all reasonable steps". [Section 4](#) describes how you can take precautionary measures and thereby demonstrate this defence.



Heathland grazing



Further information

- [FCS page on non-native species legislation](#)
- [Scottish Government's Non-native species Code of Practice](#)
- [Wildlife & Countryside Act 1981](#)
- [Wildlife and Natural Environment \(Scotland\) Act 2011](#)



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2. Managing invasive and non-native forestry species

Summary

- Non-native forestry species must be managed according to the UK Forestry Standard and its Biodiversity Guidelines, whether or not they are exempt under the WANE Act.
- There are four UK Forestry Standard guidelines relevant to managing invasive species.
- Forest plans submitted for approval should reflect them.

This section offers guidance on how to manage non-native forestry species so that the **UK Forestry Standard** and its **Biodiversity Guidelines** are complied with. For forest managers growing exempt species (i.e. most forest managers in Scotland) what matters is to comply with the UK Forestry Standard and stop the invasive spread of their trees (whether those trees are native or non-native). For exempt species it is the monitoring and inspection regimes of the UK Forestry Standard that apply, not the WANE Act mechanisms of Species Control Agreements and Orders.

The UK Forestry Standard defines 'invasive' as being when an animal or plant species spreads rapidly to the exclusion of other species. The point at which invasive spread becomes damaging or problematic depends on the habitat into which it moves.



We therefore recommend that forest management plans submitted to us for approval have a clear objective to manage invasive spread. Good forest management practices can then deal with the invasive potential of a species in a proportionate and sustainable way, whether it is native or not, or exempt or not.

In forest plans, the top priority should be prevention, then rapid response, and then control and containment. The four UK Forestry Standard Biodiversity Guidelines on managing invasive species reflect these management approaches as:

Management approach	Biodiversity Guideline
Prevention	BG39, BG40
Rapid response	BG37
Control and containment	BG38



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2.1 Prevention

The top priority to stop an invasive species spreading is to prevent introduction in the first place. This is delivered through two Biodiversity Guidelines (BG):

- **Plan for the control of invasive species where feasible by developing barriers to their dispersal; ensure newly created elements in habitat networks do not facilitate dispersal (BG39).**

A long-term forest management plan should have barrier measures designed in. Advice on this is given at [Appendix 2](#).

- **Consider how forest operations, such as felling and thinning, might promote the spread of invasive species and take action to control them beforehand (BG40).**

Operational plans should have precautionary measures designed in. Typical precautionary measures are suggested at [Appendix 2](#).

2.2 Rapid response

Where it has been impossible to stop an invasive species being introduced, the next priority is to respond rapidly and eradicate it, to avoid it becoming established. This is delivered through the Biodiversity Guideline:

- **Where non-native species are invasive and pose problems, control or remove them where this is feasible; take action early while populations are still small (BG37).**

The risk of a non-native species becoming invasive and posing problems will depend on its characteristics (i.e. its propensity to spread) and how sensitive the receiving habitat is. Action should be proportionate, based on the risk of invasive spread happening.

[Appendix 2](#) suggests ways to take timely, proportionate action. [Appendix 3](#) outlines the typical features and optimal regeneration conditions of forestry species used in Scotland. In combination this information should help you assess how likely and damaging it would be for the species grown on your land to spread invasively, and what should be done about it.



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2.3 Control and containment

Where both prevention and eradication have failed and an invasive species has become widely established, action should be taken to minimise its impact. This is done by controlling and containing the species, delivered through the Biodiversity Guideline:

- **Participate in collaborative actions to control invasive species (BG38).**

Collaborative actions can be instigated by landowners or organisations such as ourselves, Scottish Natural Heritage or local wildlife groups. They usually focus on invasive species identified as a national or regional priority, such as invasive rhododendron or grey squirrel. You would be expected to take part in a collaborative action that involved your land.

2.4 Demonstrating what you have done

The offer of public incentives for forestry is conditional on meeting UK Forestry Standard Requirements, and the four guidelines detailed above allow an assessment of whether that has been achieved. It is therefore recommended that forest management plans make clear how invasive species will be managed.

This might include:

- **a management statement outlining the practices used to reduce the risk of invasive spread and what action would be taken if a forestry species became invasive;**
- **a monitoring statement detailing the areas to be checked for priority invasive species.**

Western hemlock



Further information



UK Forestry Standard



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3. Applying for a non-native species licence



Any proposal to plant or regenerate a non-exempt non-native tree or shrub in the wild requires a Non-Native Species (NNS) licence. A NNS licence allows the exceptional planting in the wild of a beneficial non-native species (e.g. a biomass crop species) whose use or potential risk is not so well established as to have it exempt by order. A non-native species is one which is outwith its native range – or beyond where it is indigenous. The reference for the native range of forestry species is the New Atlas of the British and Irish Flora (Preston et al, 2002).

Scottish Natural Heritage is the licensing authority and an application form is available on their [website](#). [Appendix 4](#) explains what is needed for the risk assessment section of a licence application. NNS licences will be issued by Scottish Natural Heritage after they have consulted with us.



Further information



Scottish Natural Heritage page on NNS licence



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4. Further management for non-native species that are not exempt or licensed



Summary

- You must be able to demonstrate that you have taken all reasonable steps and exercised all due diligence to manage those non-native species on your land that are neither exempt nor licensed, as well as comply with the UK Forestry Standard.
- Forest plans submitted for approval should reflect this.

Under the 1981 Act, being able to show that you have “taken all reasonable steps” and “exercised all due diligence” to prevent a non-exempt or unlicensed non-native plant species spreading into the wild is recognised as the “defence to the offence”. It is therefore imperative that you do this if you want to demonstrate that you have not committed an offence.

We recommend that forest plans have a clear objective to manage these non-native species.

The plan should make it clear what reasonable steps and due diligence are being taken to avoid an offence occurring. We recommend you consider four aspects, especially when considering plant species such as rhododendron and for managing non-native animal species such as grey squirrels and muntjac deer.



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4.1 Work within a long-term management programme

A long-term management programme is the best way to tackle non-native species that habitually live in woodland but are not exempt or licensed. The programme should reflect the species' invasive potential and the risk of it causing a significant impact. For example, the impact of a colony of wild boar would be far greater than the impact of a drift of maize and so would require more intervention and greater diligence. Other species, for example piri-piri burr, may require occasional intervention to prevent it establishing.

Currently in Scotland, the two woodland species with the highest invasive potential and risk of significant impact are grey squirrel and *Rhododendron ponticum*. They are now both managed through long-term national strategies, with agencies, organisations, local landowners and interest groups working together to reduce their spread and damage.



Rhododendron Ponticum



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If a non-exempt or unlicensed non-native species is present on your land, it is a reasonable step and due diligence for you to seek advice on how to deal with it. Scottish Natural Heritage can advise you on non-native plants and animal, and we can advise you on non-native trees and shrubs. Any subsequent forest plan should detail the measures you will take to avoid the species spreading further.

We suggest that the measures you select for a long-term management programme are based on undertaking a risk assessment and deciding on management options.

4.1.1 Undertake a risk assessment

The best way to identify what needs to be done is to undertake a risk assessment based on the likelihood and consequences of spread. A simple assessment approach is given at [Appendix 5](#).

4.1.2 Decide on management options

Your long-term management programme needs options that are realistic, based on the estimated risk and the available resources. The non-native species on your land might be better tackled in stages - for example, starting with control and working towards eradication.



Tractor clearing rhododendron

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The options outlined in Box 1 below can be combined to make the most effective programme for a forest area.

Box 1: Management options for non-native species

Prevention of further spread is imperative so high standards of biosecurity should be maintained. Tools, clothing, footwear, vehicles and machinery must be cleaned to ensure soil and plant material does not leave the site, and disinfectants used if dealing with infected material. There is advice on biosecurity measures on our [website](#). Whole plants, cut stems and roots should be disposed of on-site, by being dried out, bagged, enclosed in a tarpaulin, used as a mulch (provided no viable seeds are present), burnt or buried. You may want to seek advice from your local SEPA office about how to dispose properly of large amounts of plant material.

Eradication is usually the ideal objective of a management programme. It allows complete restoration of the natural habitat and minimizes the need for future monitoring. Although desirable, it is not always achievable.

Control of a population reduces its density to an acceptable level so that the impact on natural habitats is minimal. It can be done, for example, by removing all plants of seed-bearing age. It allows native species to regain lost ground, but requires on-going management to maintain the *status quo*.

Containment keeps a population within certain limits so that it doesn't spread beyond a geographical area. For mobile species such as grey squirrel it is usual to create a buffer zone outside this area. This zone is carefully monitored for incursions, and may be managed to increase its effectiveness as a barrier.

Mitigation can be used to reduce the impact of invasive species on rare species or habitats, for example by fencing, creating buffer areas, translocating species, or re-creating habitats away from the impact of the invasive population.

The choice of treatment will also depend on factors such as adjacent designations, access for machinery, the extent/maturity of the infestation, and the availability of skilled contractors or volunteers. Consents for operations such as felling, pesticide use and work on designated sites should be obtained from the relevant authorities as normal.



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4.2 Undertake rapid response actions when asked

In Scotland a rapid response framework operates to deal with serious new threats from invasive non-native species. For forestry this means threats from non-exempt species that cannot be dealt with by good forestry practice according to the UK Forestry Standard. It is different from the measures outlined in [section 2.2](#) above, which are part of you managing forest species under normal circumstances.

The Scottish Government, or one of its agencies, will issue an alert if action is needed under the rapid response framework, and it will be advertised widely in the localities affected. Note that tree pests and diseases are dealt with by the **FC Plant Health Service** and are not part of this rapid response framework.



The Scottish Government decides on a case-by-case whether (or what) type of response is required, but in a forestry context action is likely to be required, for example, if a non-native new to the area is found. If this happens on your land, you should contact your local Conservancy or Scottish Natural Heritage office to report the case and seek their advice. You might be asked to undertake remedial action yourself or to co-operate with a co-ordinated response.

4.3 Comply with keeping, sale and notification requirements

Under the 1981 Act Ministers can ban the keeping or sale of a named invasive species, or require notification of its presence. You should ensure that you are aware of what is listed and what your responsibilities are – for example if you are required to report any species that you might come across in your area. None of the currently listed species habitually live in woodland but updates are given on the **Scottish Government website**.



4.4 Voluntary and mandatory approaches




We will make every effort to encourage landowners to manage non-native species voluntarily. Sometimes this approach will be written into a voluntary Species Control Agreement.

If this approach fails then the 1981 Act has powers to allow relevant bodies to create a mandatory Species Control Order to control an invasive non-native animal or plant.

Grey squirrel



Further information

-  [FCS page on strategic control projects](#)
-  [SNH page on rapid response protocol](#)
-  [SNH page on species control orders](#)



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5. What to do next

Forests and woodlands consisting of exempt species must be managed according to the UK Forestry Standard, which includes controlling non-native species if they become invasive. The information in this guide should help you, and your local Conservancy office will be able to advise how this should be reflected in a forest plan submitted for approval.

If you wish to plant a non-native species that is not exempt, or cause it to grow by for example allowing it to regenerate, then you must apply for a licence from Scottish Natural Heritage.

You are required under law to take all reasonable steps and exercise all due diligence towards other non-native species on your land. We recommend you demonstrate this by using the forest plan process to show what measures you will take to avoid these species spreading further.



Acknowledgements

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Appendix 1:

Non-native tree and shrub species exempt under Order

Authorisation under a Ministerial Order exempts listed non-native tree and shrub species from the offences of planting and causing to grow in the wild. The list below is of all species that are non-native to all or part of Scotland and that are exempt from the offences of the 1981 Act.

Any non-native species of tree or shrub that is not on this list will need a licence if it is to be planted or allowed to grow in the wild.

Common name	Latin name
European silver fir ■	<i>Abies alba</i>
Pacific silver fir ■	<i>Abies amabilis</i>
Grand fir ■	<i>Abies grandis</i>
Noble fir ■	<i>Abies procera</i>
Field maple ●	<i>Acer campestre</i>
Norway maple ■	<i>Acer platanoides</i>
Sycamore ■	<i>Acer pseudoplatanus</i>
Horse chestnut ■	<i>Aesculus hippocastanum</i>
Common alder ■	<i>Alnus glutinosa</i>
Grey alder ■	<i>Alnus incana</i>
Red alder ■	<i>Alnus rubra</i>
Dwarf birch ■	<i>Betula nana</i>
Silver birch ■	<i>Betula pendula</i>
Birch, specific hybrid ■	<i>Betula pendula x pubescens</i> (<i>B. x aurata</i>) hybrid birch
Downy birch ■	<i>Betula pubescens</i>
Hornbeam ●	<i>Carpinus betulus</i>
Sweet chestnut ■	<i>Castanea sativa</i>
Atlantic cedar ■	<i>Cedrus atlantica</i>
Deodar ■	<i>Cedrus deodara</i>
Cedar-of-Lebanon ■	<i>Cedrus libani</i>
Lawson cypress ■	<i>Chamaecyparis lawsoniana</i>
Nootka cypress ■	<i>Xanthocyparis nootkatensis</i>

Common name	Latin name
Common hawthorn ■	<i>Crataegus monogyna</i>
Japanese red-cedar ■	<i>Cryptomeria japonica</i>
Spindle ■	<i>Euonymus europaeus</i>
Beech ■	<i>Fagus sylvatica</i>
Ash ■	<i>Fraxinus excelsior</i>
Holly ■	<i>Ilex aquifolium</i>
European larch ■	<i>Larix decidua</i>
Japanese larch ■	<i>Larix kaempferi</i>
Hybrid larch ■	<i>Larix x marschlinii</i>
Crab apple ■	<i>Malus sylvestris ssp sylvestris</i>
Rauli [beech] ■	<i>Nothofagus alpina</i> {synonyms <i>N. nervosa</i> and <i>N. procera</i> }
Roble beech ■	<i>Nothofagus obliqua</i>
Norway spruce ■	<i>Picea abies</i>
Serbian spruce ■	<i>Picea omorika</i>
Sitka spruce ■	<i>Picea sitchensis</i>
Lodgepole pine ■	<i>Pinus contorta var. latifolia</i>
Mountain pine ■	<i>Pinus mugo</i>
Bishop pine ■	<i>Pinus muricata</i>
Corsican pine ■	<i>Pinus nigra ssp. laricio</i>
Austrian pine ■	<i>Pinus nigra ssp. nigra</i>
Macedonian pine ■	<i>Pinus peuce</i>
Scots pine ■	<i>Pinus sylvestris</i>

■ Exempt in all Scotland ● Exempt Mainland only. **Note:** Source for the native range of partially native species: Preston et al, 2002, New Atlas of the British and Irish Flora.

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Common name	Latin name
White poplar	■ <i>Populus alba</i>
Lombardy poplar	■ <i>Populus nigra - fastigiata cultivars</i>
Hybrid aspen	■ <i>Populus tremula x tremuloides</i>
Hybrid black poplar	■ <i>Populus x canadensis</i>
Grey poplar	■ <i>Populus x canescens</i>
Gean	■ <i>Prunus avium</i>
Bird cherry	■ <i>Prunus padus</i>
Blackthorn	■ <i>Prunus spinosa</i>
Douglas fir	■ <i>Pseudotsuga menziesii</i>
Sessile oak	■ <i>Quercus petraea</i>
Oak, specific hybrid	■ <i>Quercus petraea x Quercus robur (Quercus x rosacea) hybrid oak</i>
Pedunculate oak	■ <i>Quercus robur</i>
Red oak	■ <i>Quercus rubra</i>
Blackcurrant	■ <i>Ribes nigrum</i>
Gooseberry	■ <i>Ribes uva-crispum</i>
Hairy dog rose	■ <i>Rosa caesia ssp caesia</i>
Glaucous dog rose	■ <i>Rosa caesia ssp glauca</i>
Dog rose	■ <i>Rosa canina</i>
Soft downy rose	■ <i>Rosa mollis</i>
Sweet briar	■ <i>Rosa rubiginosa</i>
Sherard's downy rose	■ <i>Rosa sherardii</i>
White willow	■ <i>Salix alba</i>
Goat willow (Pussy willow / Great willow)	■ <i>Salix caprea</i>

Common name	Latin name
Crack willow	■ <i>Salix fragilis</i>
Dark leaved willow	■ <i>Salix myrsinifolia</i>
Bay willow	■ <i>Salix pentandra</i>
Tea-leaved willow	■ <i>Salix phylicifolia</i>
Purple willow	■ <i>Salix purpurea</i>
Osier willow	■ <i>Salix viminalis</i>
Common elder	■ <i>Sambucus nigra</i>
Coastal redwood	■ <i>Sequoia sempervirens</i>
Wellingtonia	■ <i>Sequoiadendron giganteum</i>
Whitebeam	● <i>Sorbus aria sensu lato</i>
Walnut	■ <i>Species of the genus Juglans</i>
Yew	■ <i>Taxus baccata</i>
Western red cedar	■ <i>Thuja plicata</i>
Small-leaved lime	■ <i>Tilia cordata</i>
Large-leaved lime	■ <i>Tilia platyphyllos</i>
Lime	■ <i>Tilia platyphyllos and Tilia x europaea (Tilia cordata x Tilia platyphyllos)</i>
Eastern hemlock	■ <i>Tsuga canadensis</i>
Western hemlock	■ <i>Tsuga heterophylla</i>
Wych elm	■ <i>Ulmus glabra</i>
Guelder rose	■ <i>Viburnum opulus</i>
Leyland cypress	■ <i>Cupressus macrocarpa x Xanthocyparis nootkatensis = X Cuprocyparis leylandii</i>



Natural regeneration under big Douglas fir

■ Exempt in all Scotland ● Exempt Mainland only. **Note:** Source for the native range of partially native species: Preston *et al*, 2002, New Atlas of the British and Irish Flora.

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Appendix 2:

Reducing the risk of invasive spread through forest planning and management

This appendix sets out what you need to do to reduce the risk of invasive spread in forests. Following this advice will demonstrate compliance with the UK Forestry Standard (for all species, including those that are exempt or licensed species) and the WANE Act (for non-exempt or unlicensed species).



Forester marking out boundaries



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The advice is in five parts:

- general forestry practice for managing invasive and non-native species;
- forest planning to reduce the risk of tree species becoming invasive;
- forest planning to reduce the risk of other species becoming invasive;
- managing non-native trees in the interior of a forest; and
- managing non-native trees near the forest edge.

1. General forestry practice for managing invasive and non-native species

The UK Forestry Standard has four general forestry practice guidelines that are relevant to managing invasive and non-native species. We recommend you use them as a way to fully integrate the management of these species into your daily work.

- **Forest management plans should address the forest context and the forest potential, and demonstrate how the relevant interests and issues have been considered and addressed (GFP10).**

In your forest plan, assess the age, structure and silvicultural regime of the stands of non-native species, their invasive potential, and their proximity to dispersal paths and vulnerable habitats. Use your findings to guide decisions about the long-term restructuring of your forest and to anticipate if monitoring or further measures might be needed to reduce the threat of invasive spread in particular locations.



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- At the time of felling and restocking, the design of existing forests should be re-assessed and any necessary changes made so that they meet UK Forestry Standard Requirements (GFP12).

For the next rotation crop consider a species that poses the least possible threat of invasive spread over the timescale of the chosen silvicultural regime ([Appendix 3](#) may be useful here). Consider a buffer zone adjacent to vulnerable habitats, dispersal pathways or on the outer edge of the forest, in which species of very low invasive potential should be planted. Identify any measures needed to manage the risk of dispersal, and design in the potential for preventative felling in case of a significant increase in optimal conditions for invasive spread (e.g. if climate change is projected to bring milder or wetter conditions to the region over the timescale of the next rotation).

- Operational plans should be in place before major operations such as harvesting and engineering works take place (GFP18).

Ensure that operational plans don't create conditions that would aid, or make it difficult to assess and manage, invasive regeneration.

- Where appropriate, contingency plans should be in place for dealing with actual and potential threats to the forest and environment (GFP19).

Prepare contingency plans to deal with situations such as high seed production in thinned stands, disturbed receptor sites or buffer zones due to sanitation felling, and the proliferation of invasive species due to deer fencing.

You are required to follow these good forestry practice guidelines in all aspects of sustainable forest management. This will also make it easier for you to see what other actions are needed to comply with the specific UK Forestry Standard Biodiversity Guidelines (BG37, 38, 39 and 40). Remember that as regards exempt species, the UK Forestry Standard Biodiversity Guidelines ask you to base your actions on the risk of invasive spread.



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2. Forest planning to reduce the risk of tree species becoming invasive

Use the information opposite to help plan the most appropriate management system for stands containing potentially invasive forestry species, so that the good growth or natural regeneration that is desired in the coupe does not become a problem in the areas beyond.

Four factors determine the invasive potential of a tree species: the climatic and environmental tolerance of the species, its seed dispersal range, the age and structure of the stand, and the characteristics of the receptor site. These factors can be moderated by site and silvicultural factors, which is why good forest planning is the best way to reduce the risk of a tree species becoming invasive.

- 1 Climatic and environmental tolerance:** The climatic conditions that a species needs for seed ripening, germination and seedling development help determine its spread, along with soil and light conditions. Some species such as Western hemlock or Sitka spruce are naturally more inclined to spread because they can tolerate a wider range of conditions.
- 2 Seed dispersal range:** Depending on the species, most regeneration occurs within 100m of a forest edge source population – see Box below. The likelihood of spread is also affected by the mode and distance of seed dispersal, and the proximity of dispersal pathways (e.g. forest habitat networks, felling and thinning coupes, watercourses, paths and forest roads).
- 3 Age and structure of the stand:** Forestry species generally produce few seeds during their first 15-20 years but there can be a rapid increase in seed production in conifers retained beyond the normal forestry rotation (35+ years). The level of seed production depends on stand density and crown development, so thinned stands, for example, can produce very high levels of seed production because of the resulting crown expansion. Under a shelterwood system, a small number of mature open-grown spruce or hemlock may produce copious seed. Depending on the other three factors, thinned and shelterwood systems might therefore be best kept away from dispersal routes, vulnerable habitats or a forest's outer edges.
- 4 Receptor site:** Disturbed areas such as clearfell sites are especially receptive to regeneration. Invasive spread can be aided by the higher light levels that result from tree felling, and the bare ground, soil disturbance and weed control that result from timber extraction. Other determining factors at the receptor site are the level of seed predation, the ability of the arising regeneration to compete with other trees and plants, and its tolerance to grazing.



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Seed dispersal distances

Research has found that the normal seed dispersal range for most conifers used in Scottish forestry is less than 100m. Data for Norway spruce and Scots pine show that about 80% of seeds dispersed fall within 50m of the parent trees, and figures for Sitka spruce and Lodgepole pine are thought to be similar. Dispersal ranges also reduce in mature stands (to about 20-50m for Norway spruce and Scots pine). These figures apply to forest edges and seed travelling with the prevailing wind. It has also been shown that most of the seed dispersed at larger distances consists of hollow (i.e. infertile) cones.

Seed dispersion range is known to be affected by:

- **wind direction:** dispersal range will vary according to the prevailing wind direction during the dispersal period (that this may be different from the average prevailing wind direction throughout the year). A dispersal range can be greatly extended by a strong prevailing wind, with seeds falling some distance on the leeward side of the seed source (possibly up to 500m);
- **seed dispersal period:** this is usually seasonal but will vary from species to species, e.g. Sitka spruce seeds disperse from October to March while Lodgepole pine seeds disperse in March and April. Dispersal may vary with weather conditions (generally more seeds released in dry weather as the cones open); and
- **weather conditions:** seed range can be greatly extended on open ground covered with firm snow, but 'snow facilitated seeding' is very difficult to account for.

From this information, it may be possible to estimate a dispersal range for a species. This will help determine the size of a buffer zone if one is needed.



Mature Scots pine cone

To summarise, forest planning can reduce the risk of a particular tree species becoming invasive, by identifying its characteristics and then by undertaking an appropriate silvicultural system or designing barriers to its dispersal. The next two sections offer advice on how this might be done in two different scenarios – in the interior of a forest, and near the forest edge.

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3. Managing potentially invasive trees in the interior of a forest

Under the WANE Act, interior areas within a forest are still 'in the wild' so non-native species planted or allowed to naturally regenerate here must be either exempt or licensed. Under the UK Forestry Standard you must manage the risk of invasive spread, whether or not the species is exempt or licensed.



Planted woods on ancient woodlands sites

- Fresh plantings of less common exempt species groups such as *Nothofagus*, *Cryptomeria*, *Chamaecyparis* and *Sequoia* should be reserved for the interior of the forest, away from boundaries with sensitive habitats. There is still an incomplete understanding about how these species will behave when planted more extensively under a wider range of site conditions in Scotland than is currently done, and it is prudent to retain the opportunity to confine their potential regeneration within any plantation.
- When restocking a clearfelled area (by planting or natural regeneration), make a suitable choice of tree species based on management objectives and site conditions. Where there is dense natural regeneration of a shade-tolerant species such as Western hemlock – i.e. indicating that it is potentially invasive – you should decide whether to retain and manage this to form a future crop, or replace it with a species whose invasive potential is easier to manage.



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- If you wish to create or maintain areas of semi-natural woodland or open-space within your forest, it would be sensible to plant adjoining compartments with species that are less likely to spread e.g. pine, larch, Douglas fir. If using species such as Western hemlock, Western red cedar and Grand fir, you may need to intervene more often to restrict the spread of regeneration as the plantation ages.
- There are various ways of creating barriers to dispersal. If a mature conifer stand poses a high risk of spreading into a vulnerable habitat, preventative felling might be a worthwhile precautionary step. In mixed woodlands it may be sufficient to follow a system of sustainable silviculture that will reduce the ecological impact of regenerating non-native trees, for example by regularly harvesting sycamore coppice as fuel wood. Another system could be to undertake gradual thinning and use continuous cover forestry to reduce the prevalence of non-native trees, protect ground vegetation from heavy shading and allow the natural expansion of native vegetation. Complete removal of a stand of potentially invasive species may be impractical, very expensive, or cause excessive disturbance to the habitat in which it is growing (for example where the non-native trees are a valuable habitat for birds, bats, insects, mosses or lichens).
- Maintain good compartment records and planting maps, including target notes on the natural regeneration arising. Inspect the compartment edges regularly, to see if there is any notable spread out. Have a system for undertaking any remedial operations that might be needed.
- Be aware of what the UK Forestry Standard Forest and Water Guidelines (5th edition) require for managing non-native stands near watercourses. Watercourses are particularly effective dispersal pathways, taking seeds out of the forest and into potentially vulnerable habitats.



Small-leaved lime coppice area

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4. Managing potentially invasive trees near a forest edge

Stands of non-native trees near the edge of a forest are the most likely source of any spread. They therefore require particular consideration.

- Where new stands are being planted up to the edge of a forest, select the species carefully to avoid invasive spread in the future. In general, species which have lower invasive potential such as pine or a larch are a wiser choice here, although current pest and disease challenges have brought restrictions which must be accounted for. Other species such as Douglas fir, Norway spruce or Noble fir are appropriate to plant at the edge under most circumstances. Species such as Western hemlock, Western red cedar or Grand fir are less appropriate to plant at the forest edge because they are more likely to spread.



- The outer edge of the plantation forest should have a buffer zone, in which stocking is with native tree species or the land used as open ground habitat. This applies particularly where the boundary abuts a vulnerable wild area with conditions that would encourage natural regeneration. Ideally the buffer zone width will be twice the mature tree height (40-60m). Buffer areas of native habitat can also contribute to habitat networks and open space, forming part of good forest landscape design and diversification practice. It is less important where there is a 'hard edge' with non-wild land such as arable or developed land because natural regeneration is unlikely to be successful here.
- Unless it is a closely-managed woodland, silvicultural systems that depend on natural regeneration of non-native species are better suited to the forest interior and not the forest edge, especially if they involve species of higher invasive potential. Beyond that, follow the advice given above about how to create barriers to dispersal.
- Stands at the forest edge should be monitored for signs of vigorous natural regeneration. Stands of species such as Sitka spruce, Western hemlock, Western red cedar and Grand fir require particular care as they can produce large volumes of natural regeneration quite rapidly. Follow the advice given above about maintaining a good recording, inspection and remediation regime.
- Regeneration in areas of windblow can be hard to assess and manage invasive regeneration. These areas may require monitoring if the windblown timber is to be left on site.
- Follow the advice given above about following the UK Forestry Standard Forest and Water Guidelines (5th edition).



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5. Forest planning to reduce the risk of other (non-tree) species becoming invasive

The invasive spread of non-tree species depends on a series of variables - some relate to the species and others relate to the receptor site. Consider them together to see how forest planning can reduce the likelihood of damaging invasive spread.

For example, if an extensive high density population is near to, upwind or upstream of a vulnerable area, then there is more risk of it spreading and causing significant impact. If such a population is near to, upwind or upstream of land that is managed for the same purpose (such as other woodland), then there may be a high risk of spread but a lower risk of significant impact. If the population is sparse and localised and adjacent to land that is wet, infertile and exposed then there is often a low risk of spread and a low risk of invasive damage.

Mobility: Some species are more likely to spread quickly and further than others. For example, grey squirrels and American mink are highly mobile whilst the seeds of plants such as *Rhododendron ponticum* and Himalayan balsam are readily dispersed over long distances by water, wind or people. Some plants spread vegetatively rather than producing seed. Different control and monitoring methods will be needed if there are different types of non-native species present.

Current extent: Well-established populations of species may expand rapidly and cause greater damage. For species which spread primarily by seed, age is an important factor because once colonies reach seed-bearing age they may spread quickly and exponentially. Well-established populations may therefore be a priority to manage.

Pathways: Where dispersal is assisted by humans, common pathways are roads, railway lines and the routeways of forest machinery. Other pathways can be consequential, e.g. creating certain kinds of broadleaved woodland habitat corridors may encourage the spread of grey squirrels. Plan woodlands and operations so that these pathways can be managed to reduce their value to invasive species.

Receptor sites: Certain sites are more prone to colonisation, which can aid invasive spread. Disturbed ground often provides a suitable seed-bed and low competition so sites such as eroding riverbanks, clearfells, waste ground, road verges and embankments are particularly receptive to potential colonisation. Invasive woodland fauna will colonise sites that offer sustainable food and shelter and fewer predators.



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Appendix 3:

Optimal regeneration conditions for commonly-grown species

Table A summarises recent research and field experience of the conditions under which commonly-grown exempt species may regenerate. Use this information to help you start planning how these species should be managed in order to comply with the UK Forestry Standard. More information about species suitability, especially in the

 context of climate change, is available on the [Forest Research website](#).

Table A

Tree species	Scientific name	Age of the start of seed production	Shade tolerance of regeneration	Soil preference for regeneration (in ESC terms)	Notes
European silver fir, Pacific silver fir, Grand fir	<i>Abies alba</i> , <i>Abies amabilis</i> , <i>Abies grandis</i>	35-45 years	Highly shade tolerant	Freely-draining to moist, low to medium fertility	Only localised regeneration found to date. Shade-tolerant but also browsing- and frost-sensitive, which may allow regulation by silvicultural means.
Noble fir	<i>Abies procera</i>	30-40 years	Medium shade tolerance	Freely-draining to very moist, low to medium fertility	Natural regeneration starts later than Grand fir but then gains momentum. Will not compete with heather on open heaths.
European timber hardwood	<i>Acer platanoides</i>	20-30 years	Moderate to high shade tolerance	Freely-draining to moist, medium to high fertility	Widely naturalised in many native oak-ash-elm woodlands on moist, fertile soils.
Sycamore	<i>Acer pseudoplatanus</i>	20-30 years	Moderate to high shade tolerance	Freely-draining to moist, medium to high fertility	Widely naturalised in many native oak-ash-elm woodlands on moist, fertile soils.
Beech	<i>Fagus sylvatica</i>	30-40 years	Highly shade tolerant	Freely-draining, low to high fertility	Widely naturalised in native woodlands on free-draining acid soils.
Other timber hardwoods	<i>Juglans spp.</i> , <i>Nothofagus alpina</i> , <i>Nothofagus obliqua</i>	>20 years, variable	Moderate shade tolerance	Freely-draining to moist, medium to high fertility	<i>Juglans</i> is usually grown in low-risk field plantings. <i>Nothofagus</i> rarely regenerates, except <i>N. obliqua</i> under canopies.
European larch, Japanese larch, Hybrid larch	<i>Larix decidua</i> <i>Larix kaempferi</i> <i>Larix x marschlinii</i>	15-30 years	Low shade tolerance - light demanding	Freely-draining, low to moderate fertility	Seedling regeneration is only weakly competitive and is only a very localised issue in pinewoods and on open heaths, which is easily controlled by early intervention.



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Table A (continued)

Tree species	Scientific name	Age of the start of seed production	Shade tolerance of regeneration	Soil preference for regeneration (in ESC terms)	Notes
Norway spruce	<i>Picea abies</i>	30-40 years	Medium to high shade tolerance	Freely-draining to moist, medium to high fertility	Presents a lower risk than Sitka spruce on open ground due to later onset of regeneration (50-60 years) and preference for forest microclimate.
Sitka spruce	<i>Picea sitchensis</i>	25-35 years	Low to medium shade tolerance	Freely-draining to very moist, low to medium fertility	Characteristics are well-known because of its widespread planting. Regeneration can be profuse in favourable conditions – early intervention would be needed.
Lodgepole pine	<i>Pinus contorta</i>	15-20 years	Low shade tolerance - light demanding	Wide range of moisture regime, low to moderate fertility	Can spread onto adjacent wet or peaty upland sites, which other species would not tolerate, but requires high light levels.
Corsican pine, Macedonian pine	<i>Pinus nigra v maritima</i> , <i>Pinus peuce</i>	15-30 years [variable]	Low shade tolerance - light demanding	Freely-draining, low to moderate fertility	Regeneration is very rare in Scotland under the current climate. Risks might increase with wider planting and climate warming.
Scots pine	<i>Pinus sylvestris</i>	15-20 years	Low shade tolerance - light demanding	Freely-draining, low fertility	Only an invasive threat on semi-natural heathland habitats outside the Caledonian Pinewood Zone. Regeneration is relatively easy to control with early intervention.
Douglas fir	<i>Pseudotsuga menziesii</i>	30-35 years	Medium shade tolerance	Freely-draining, low to medium fertility	Might expand into native woodlands or open heath but it rarely becomes invasive because good seed years are infrequent, regeneration is difficult to secure and it is sensitive to browsing.
Coastal redwood	<i>Sequoia sempervirens</i>	25-35 years	Highly shade tolerant	Freely-draining to moist, medium to high fertility	This species can layer/ coppice.
Western red cedar, Lawson cypress, Japanese red cedar, Yellow cedar	<i>Thuja plicata</i> , <i>Chamaecyparis lawsoniana</i> , <i>Cryptomeria japonica</i> , <i>Xanthocyparis nootkatensis</i>	25-35 years	Highly shade tolerant	Freely-draining to moist, medium to high fertility	Western red cedar may be highly invasive in native woodland but regeneration is fairly easy to control.
Western hemlock	<i>Tsuga heterophylla</i>	25-30 years	Highly shade tolerant	Freely-draining to moist, low to medium fertility	Potential to be highly invasive particularly in native woodland – early intervention would be needed.

Managing invasive and non-native forestry species

Table B summarises recent research and field experience of the conditions under which commonly-grown non-exempt species may regenerate. **Use this information to help you apply for a NNS licence** from Scottish Natural Heritage. More information about species suitability, especially in the context of climate change, is available on the [Forest Research website](#).

Table B

Tree species	Scientific name	Age of the start of seed production	Shade tolerance of regeneration	Soil preference for regeneration (in ESC terms)	Notes
Caucasian fir	<i>Abies nordmanniana</i>	35-45 years	Highly shade tolerant	Freely-draining to moist, low to medium fertility	Only localised regeneration found to date. Shade-tolerant but also browsing- and frost-sensitive, which may allow regulation by silvicultural means.
Maritime pine, Monterey pine	<i>Pinus pinaster</i> , <i>Pinus radiata</i>	15-30 years [variable]	Low shade tolerance - light demanding	Freely-draining, low to moderate fertility	Regeneration is very rare in Scotland under the current climate. Risks might increase with wider planting and climate warming.
European timber hardwoods	<i>Sorbus torminalis</i> , <i>Ulmus spp</i> (not <i>U. glabra</i>)	>20 years, variable	Moderate to high shade tolerance	Freely-draining to moist, medium to high fertility	Little Scottish experience of natural regeneration due to limited planting.








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Appendix 4:

Undertaking a risk assessment for a NNS licence application

Section C of the licence application form from Scottish Natural Heritage requires a risk assessment to be carried out. In most cases it will be sufficient to provide the information outlined below:

Question on the form	FCS advice on how to fill in the form
Will the non-native species be released or planted in an area covered by a nature conservation designation (e.g. SSSI, SPA, SAC)?	 The location of nature conservation designations can be found using either the Sitelink facility on the Scottish Natural Heritage website or the wildlife map on Scotland's Environment Web . FCS staff can use the internal Map Browser. 
What threats do this non-native species pose to the wider environment?	 The UK Forestry Standard Biodiversity Guidelines explain some of the negative impacts of invasive non-native species. Other useful resources are listed in this guide.
Why do you need to use a non-native species? Detail what alternative options you have considered and why each one cannot be undertaken.	This information will be specific to the forest's management objectives but we recommend using native species or exempt non-native species wherever possible.
Please include this information with your application:	Use the same mapping style and format as for Rural Priority forestry scheme applications. Guidance on this is available from the Scottish Government webpages on woodland creation mapping guidance. 
Maps to delineate boundaries of where the licence will apply and to identify the land uses of adjacent areas and whether it is considered 'wild' or 'non-wild'.	<p>The licence will need to apply to all wild land on which the species will be planted or caused to grow. One licence can apply to different parts of one forest plan area, so long as information is submitted for each distinct part.</p> <p>There is no GIS layer that identifies the WANE Act categories of wild and non-wild land because it is defined according to its management regime. The land use (and therefore wild/ non-wild status) of adjacent areas will probably be known to the applicant and reference can be made to list 2 in the Scottish Government's Code of Practice. It could also be estimated from data published by us, Scottish Natural Heritage, the James Hutton Institute, or collated from the 'land' and 'natural resources' layers of the Scotland's Environment Web map.</p> 
Data in the form of a woodland creation or restocking table.	Data in the form of a woodland creation or restocking table should follow the format used in Rural Priority forestry scheme applications, to show the density and areas of (re-)stocking.
An identification of the risks of spread within and beyond the licensed area, taking account of, for example, vulnerable habitats, native woods, conduits such as roads, rides and rivers and designated sites.	An identification of the risks of spread, follow the advice in this guide to consider the likelihood and consequences of it happening, e.g. whether the optimal conditions for regeneration are present downstream or downwind of the site to be licensed.
A description of the actions that the owner will take to reduce the spread, their intentions to monitor spread into the wild and the opportunities for remedial action should spread occur.	To describe the actions that you will need to take to reduce the risk of invasive spread, follow the advice in this guide to consider what actions should be taken.

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Appendix 5:

Undertaking a risk assessment as part of a long-term management programme for non-exempt forestry species

A risk assessment will help identify what action should be taken to prevent a non-exempt or unlicensed non-native species spreading into the wild. This simple approach uses three steps and a template, and is intended to show where effort and resources should be targeted over the lifetime and geographic boundaries of a forest plan.

Step 1 Survey the population

The survey should record the following information:

- accurate identification of the species. Help to identify tree species and their native ranges is on the **tree species and provenance** page of the Forest Research website. Help to identify other species and their native ranges is available from the **GB Non-Native Species Secretariat** and Scottish Natural Heritage.
- the location, extent and density of the population;
- the population's age structure; and
- the location and proximity of possible dispersal pathways and vectors, e.g. water, wind, tracks and roads, railway lines and forest machinery.

Step 2 Assess the likelihood of the species spreading into the wild

Evidence that the population is spreading can include old records, photographs or anecdotal evidence. The information given in this practice guide will help you assess if significant future spread is likely.

Step 3 Assess the likely impact of the species spreading into the wild

- The **UK Forestry Standard Biodiversity Guidelines** explain some of the negative environmental, economic and social impacts of invasive non-native species, but they will vary from site to site and any assessment will be subjective to a degree. It is important that you can demonstrate that your risk assessment was rigorous and impartial, with a clear connection between findings and subsequent action.

The template of information for the risk assessment is similar to the one required for a NNS licence, but with some differences to reflect that the non-native species is already present on site, possibly in large numbers. The information generated can then be used to develop a long-term management programme for managing non-native species that are not exempt or licensed.

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Information that will help create a risk assessment	How to get that information
<p>Map showing the location of the non-native species, its proximity to an area covered by a nature conservation designation or a vulnerable habitat, its proximity to dispersal corridors, and to identify whether adjacent areas are 'wild' or 'non-wild'.</p>	<p>Use the same mapping style and format as for Rural Priority forestry scheme applications. Guidance on this is available from the Scottish Government webpages on woodland creation mapping guidance.</p> <p>There is no GIS layer that identifies the WANE Act categories of wild and non-wild land because it is defined according to its management regime. The land use (and therefore wild/ non-wild status) of adjacent areas will probably be known to the applicant and reference can be made to the list of indicative non-wild areas given in this guide and in the Scottish Government's Code of Practice. It could also be estimated from data published by us, Scottish Natural Heritage, the James Hutton Institute, or collated from the 'land' and 'natural resources' layers of the Scotland's Environment Web map).</p> <p>The location of nature conservation designations can be found using either the Sitelink facility on the Scottish Natural Heritage website, the wildlife map on Scotland's Environment Web. FCS staff can use the internal Map Browser.</p> <p>Dispersal corridors will include receptor sites such as those recently clearfelled.</p>
<p>Threats posed by this non-native species to the wider environment, and the risk of it spreading. This should take account of, for example, vulnerable habitats, native woods, conduits such as roads, rides and rivers and designated sites.</p>	<p>The UK Forestry Standard Biodiversity Guidelines explain some of the negative impacts of invasive non-native species. Other useful resources are discussed in this guide.</p> <p>Also follow the advice in this guide to consider the likelihood and consequences of the species spreading into the wild, e.g. whether the optimal conditions for regeneration are present downstream or down-wind of the site to be licensed.</p>
<p>Assessment of different option(s) to manage this non-native species.</p>	<p>Use this section to show how the three-tier hierarchy for managing non-native species (prevent; respond rapidly; control and contain) can be employed as part of the management objectives for the forest.</p>
<p>Proposed management programme, describing the actions that will be taken to reduce spread into the wild, monitor spread, and remedial action should spread occur.</p>	<p>Follow the advice in this guide to consider what actions should be taken.</p>

Forestry Commission Scotland serves as the forestry directorate of the Scottish Government and is responsible to Scottish Ministers.

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