Forestry and Land Scotland
Coilltearachd agus Fearann Alba

Teindland

Land Management Plan 2023-2033

East Region

Including Teindland Quary SSSI Plan

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Section A: Introduction and Background Description

- A.1 Property details
- A.2 Location and context
- A.3 Existing permissions
- A.4 External stakeholder engagement
- A.5 Long term vision and management objectives
- A.6 General Site Description
- A.7 Woodland description
- A.8 Summary of forest management proposals
- A.9 Standards and Guidance on which this LMP is based
- A.10 Meeting UKFS Requirements
- A.11 Environmental Impact Assessment
- A.12 Tolerance table

Section B: Analysis and Concept

- B.1 Survey – key Issues and challenges
- B.2 Constraints and Opportunities Analysis
- B.3 Concept

Section C: Management Proposals

- C.1 Silvicultural practice
- C.2 Woodland Management Prescriptions – select relevant headings from below
- C.2.1 Felling
- C.2.2 Thinning
- C.2.3 LISS
- C.2.4 Long Term Retentions (LTR) and Natural Reserves
- C.2.5 Restocking and Natural Regeneration
- C.2.6 Recreation and visitor zone management
- C.2.7 Protection strategy and deer management
- C.2.8 Management of Tree health
- C.3 Management of Infrastructure
- C.3.1 Forest roads
- C.4 Management of the environment and open land
- C.4.1 Historic environment
- C.4.2 Habitats and biodiversity
- C.4.3 Peatland restoration

Section D: Visualisations

- D.1 Location of viewpoint
- D.2 Felling phases
- D.3 Change in landscape between 2023 and 2033
- D.4 Landscape composition by 2043

Appendix 1: Background information

- 1.1 Topography
- 1.2 Geology and soils
- 1.3 Climate
- 1.4 Hydrology
- 1.5 Wind throw risk
- 1.6 Adjacent land use
- 1.7 Road access
- 1.8 Deer management
- 1.9 Recreation and visitor access and management
- 1.10 Landscape character and visibility
- 1.11 Historic environment
- 1.12 Biodiversity and habitat
- 1.13 Plant health
- 1.14 Fire

Appendix 2: Teindland Quarry SSSI plan
Appendix 3: Findlay's Seat experiment enclosures tour notes (1981)
Appendix 4: Peatland Restoration Plan

Section A: Introduction and Background Description

A.1 Property details

This plan sets out the strategic direction for management of Teindland with details of the operations proposed in the first 10 years.

For further information on the plan please contact:

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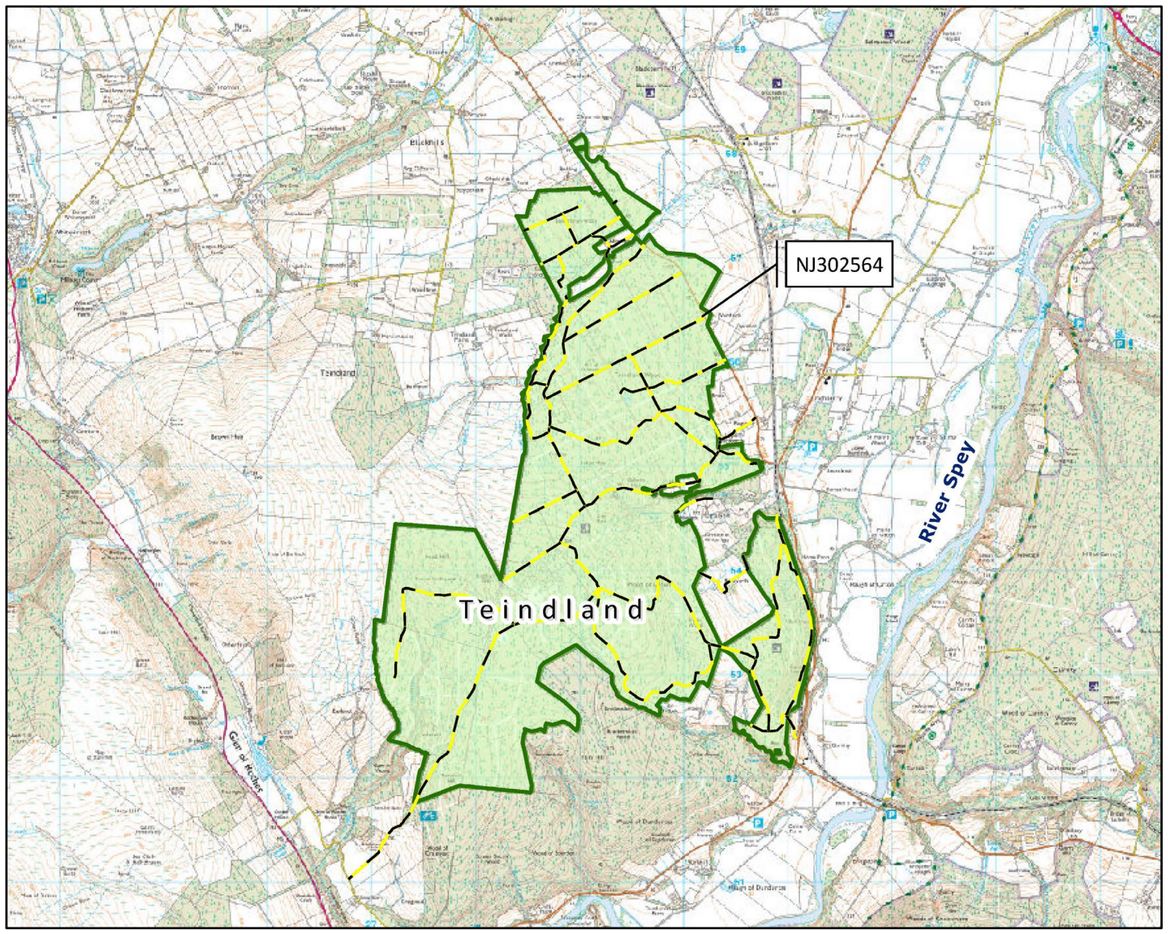
A.2 Location and context

See Map 1: Location

The plan covers the Teindland block, the main entrance to which is located off the B9103, 5km south of Lhanbryde (NJ 302 564). The forest block extends to 1218 hectares and is bounded on the west by the estates of Blackhills and Rothes Glen and to the east by Orton Estate.

In terms of designations the Teindland Quarry SSSI is located in the north east of the block. The Red burn that flows from the block is a tributary of the river Spey, an SAC and 914.2ha of the forest area is long established of plantation origin (LEPO).



A.3 Existing permissions

The previous Land Management Plan approval expired on 31st March 2021.

This plan presents in detail the management, felling, thinning and restocking proposals for the next 10 years (2023-2033). This first ten year period of the land management plan requires approval from Scottish Forestry. Longer term management of the forest is included in the plan but mainly to provide an indication of the direction of travel and to provide context.

This plan includes the SSSI plan for Teindland Quarry that requires approval from Scottish Natural Heritage. See appendix 2.

There are no other permissions or consents currently associated with this area.

A.4 External stakeholder engagement

During the development of this land management plan for Teindland we have consulted publicly including with local community representatives and stakeholders known to have an interest in the forest. The table below highlights the issues that were raised during the initial scoping process.

Consultee	Issue raised	FLS response
Moray council archaeologist	Several historic features identified which may not appear on FLS internal data.	All features identified will be investigated to check the location and whether they still exist prior to any relevant operations being carried out.
Speyside community council	No response to date.	
Scottish Environment Protection Agency (SEPA)	We have checked the most up-to-date River Basin Management Plan records and can confirm that currently there are no water bodies within or adjacent to the plan area which are at "less than good" ecological status/potential as a result of forestry activities. The Plan should ensure that all waterbodies are protected and where possible enhanced. This is particularly important given the location of the site in relation to the River Spey and its tributaries. The River Spey is a Special Area of Conservation, the qualifying interests of which include freshwater pearl mussels and salmonids etc, which are sensitive receptors with regard to pollution and run-off. In addition the River Spey has existing pressures in relation to water abstraction and diffuse pollution and therefore appropriate measures should be put in place to ensure that the forestry activities do not exacerbate those pressures. There are also a number of whisky distilleries along the River Spey which could be impacted by diffuse pollution unless best practice is followed. With regards clear-felling & restocking, there is the potential for an increase in the volume of woody debris and sediment available to the channel thereby increasing the risk of blockages within the channel or to existing structures. We therefore recommend the provision of buffer strips adjacent to watercourses and in general would advise against the planting of trees in these buffers or in functional floodplains. Similarly, during harvesting, woody material should be stored away from watercourses and out with the buffer strips so that this cannot be washed into the channel during a storm event. We are pleased to note that peat is considered and that areas for peat restoration will be identified.	All operations will be undertaken to the latest UKFS water guidelines as a minimum to ensure no diffuse pollution reaches the watercourses. We don't believe the provision of unplanted buffer zones along watercourses is the best option for riparian zones and will continue to plan for a mix of broadleaf woodland and open space with a small element of regeneration of conifers. We believe this will create a more robust riparian zone with higher biodiversity value while still addressing potential flooding issues.
Scottish Natural Heritage (SNH)	Agree with the key features and issues in the LMP brief document. The LMP for Teindland Forest should be consistent with the conservation plan for Teindland Quarry SSSI 2013 – 2023	The plan for the Teindland quarry SSSI will form an appendix to this land management plan (see appendix 2).
RSPB	We have no comments on the plan for Teindland, other than being supportive of the intention to 'maintain and monitor the UK BAP priority species and habitats and seeking opportunities to improve their status' within the forest.	
Spey fishery board	The Red Burn is a tributary of the River Spey SAC and is a very important lower tributary that supports good numbers of	Riparian zones will be the target of increased broadleaf woodland and associated open space.

	salmonids . The Spey Fishery Board supports the proposals for increased riparian cover and the removal of the coniferous zone next to the watercourse . Should the opportunity arise through harvesting the inclusion of woody material being placed strategically into the watercourse should be encouraged , this improves morphology and biodiversity within the watercourse , it also helps with natural flood management .	Inclusion of woody debris within the watercourse will need to be discussed in more detail and agreed for each with SEPA and Moray council prior to being undertaken. This will not form part of the current plan process.
Moray equestrian access group	The waymarked riding trail is still used by riders, both local and others travelling to the forest, though possibly not in the numbers originally anticipated. As it is still only one of a small number of dedicated riding trails in Moray we would obviously wish to see it retained. The parking and turning area remains important as access to many other forests is limited by the lack of parking areas suitable for lorries or trailers.	We have no plans or objective of increasing visitor numbers or equestrian use above the current level. Longer term the continued provision of the waymarked trails will need to be discussed but this is out with the process of the current plan.
Orton estate	Concerned for the deteriorating condition of the grazing blocks that we manage next to Teindland Wood. Currently there is a huge flow of water from the forestry roads and woodland following heavy rains. The Carra Burn, and the Feith and Garbity Burns that ultimately form the Burn of Garbity, carry vast amounts of water downhill from the woodland, resulting in huge deposits of gravel and silt on the lower parts of Orton Estate. The field drainage systems, especially at the farms of Burnside, Barnyards and Lintpots, have been pushed beyond their limits, and wetness and tree shading have allowed rushes to establish in the grass parks, despite Orton Estate's vast expense in engaging drainage and ditch clearing contractors annually over many years.	FLS will continue to undertake all its operation in a manner that meets all UKFS water guidelines to ensure these do not result in diffuse pollution. We will ensure to the best of our abilities that all water leaving the forest does so within a watercourse or drainage system. The ability of that watercourse or drainage system to deal with that water once it has left the forest boundary is beyond our control.
Confor	Welcome the main thrust of the plan to maintain productive softwood supplies and trust this will not be diluted by other considerations.	While timber production is the primary objective for this plan this will need to be balanced against all the other objective and requirements for the plan area leading to some level of compromise in the final proposals.
SSE	Request for felling phase of coupe 09140 to be brought forward to phase 1 if possible to help protect from potential windblow.	This coupe will be investigated to see if it can be felled at an earlier point in the plan period and moved to phase one if necessary under agreed tolerances.
Sourden estate	No response to date	
Blackhills estate	No response to date	
Rothes estate	No response to date	
Inchberry community association	Pleased to help with contributions from our Inchberry and District Community Association (IDCA) members who live in and around the forest area which is a well-used for amenity and much appreciated.	
Forest research	Details of current status of all experiment sites provided by forest research.	The LMP will ensure the status of active experiment sites will not be compromised during the plan period.
Scottish Water	Noted that much of the block falls within a Drinking Water Protected Area and that there are several Scottish Water assets in the area.	Additional protection measures are in place for any operations which are to be carried out within DWPAs and all assets will protected as per current UKFS guidance.

A.5 Long term vision and management objectives

The long term vision for Teindland is to create a forest that fully meets all UKFS requirements while maximising the production of quality timber that is suitable for the local processing mills.

The forest will be predominantly conifer based, growing species that are suitable for the site conditions and that have been thinned to improve their quality. Silvicultural systems other than clearfelling and replanting will be used where they are appropriate to meet the plan objectives.

Areas not designated for timber production will include Teindland Quarry SSSI, riparian zones and deep peat soils. These will be managed to increase the biodiversity of the forest, to meet statutory requirements and to sequester carbon.

Primary Objective	**Critical success factor**
The management of the woodland to produce a sustainable crop of quality timber suitable for the local processing mills.	Undertake the planned thinning and felling programme during the plan period in order to increase the quality of the timber and to meet the production targets.
Manage Teindland Quarry SSSI area so as to maintain its favourable condition classification.	The SSSI continues to be classified as in favourable condition by the end of the plan period.
Secondary objective	
Manage the deep peat areas to maximise their carbon sequestration and storage potential.	Peat areas are identified and a programme of restoration works have started.
Improve the riparian zones within the plan area.	Riparian zones that are felled within the plan period have been, or are planned to be, restocked with native woodland and open ground. Non-native regeneration will also be removed where feasible.
Increase the area of open ground in order to move towards the UKFS requirement to have 10% open ground within a management unit.	The area of open ground has increased by the end of the plan period.

A.6 General site description

See **Map 2: Key Features**

See **Appendix 1** for the details of the background information used to inform this plan.

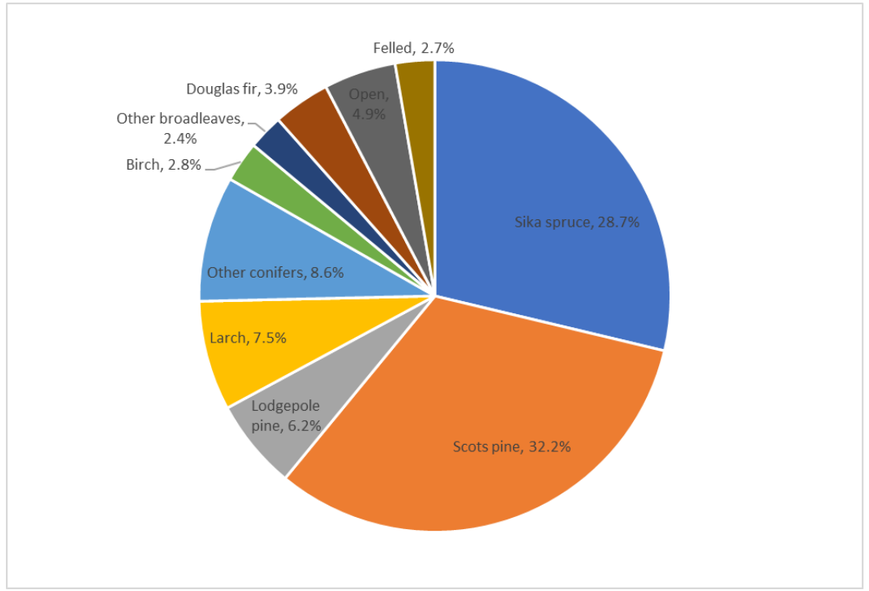
The key issues to be addressed in this plan are:

- The production of a sustainable crop of quality timber.
- Teindland quarry is designated as an SSSI due to its geological importance.
- There are a number of important experimental sites within the block. Some of which have been completed or discontinued so these areas can be brought back into regular forestry management. Others are still active and the plan should not propose operations that could negatively impact on their long term viability.
- The soils across most of the block are either poor or very poor according to soil survey results. This will impact the choice of species for restocking following felling.
- The area of open ground in below the UKFS requirement for 10%. Therefore current open ground should be retained and opportunities sought to increase the area.
- Low Impact Silvicultural Systems (LISS) are not suitable for managing some of the areas previously designated for this type of management due to the current crops and their past management.
- Most of the watercourses within the block are tributaries of the river Spey, an SSSI and SAC.
- There are areas of deep peat that may be suitable for restoration. These areas need further investigation and survey work undertaken.
- Key species are present in the block including raptors, red squirrel, badgers, crested tit and crossbills
- Several areas were badly windblown by storm Arwen

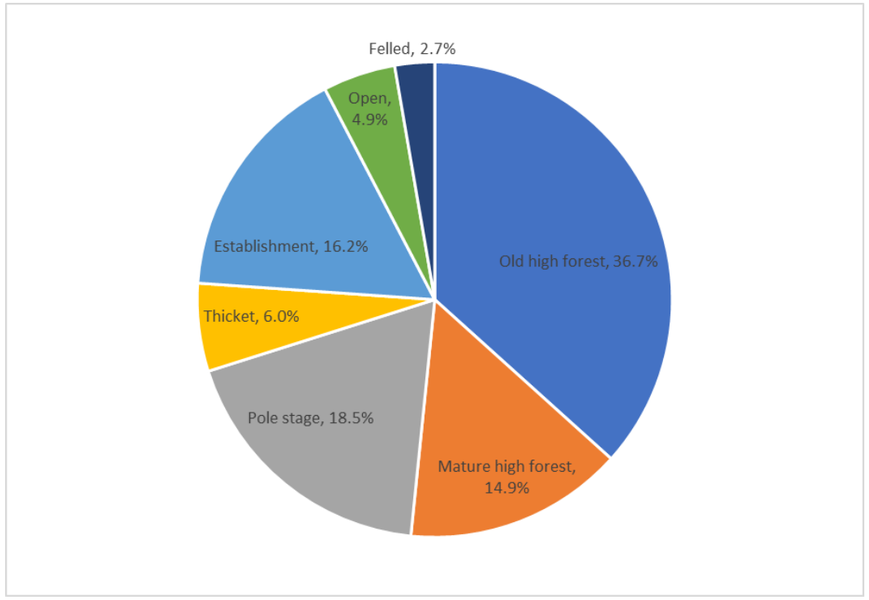
A.7 Woodland description

See **Map 3: Current Species**

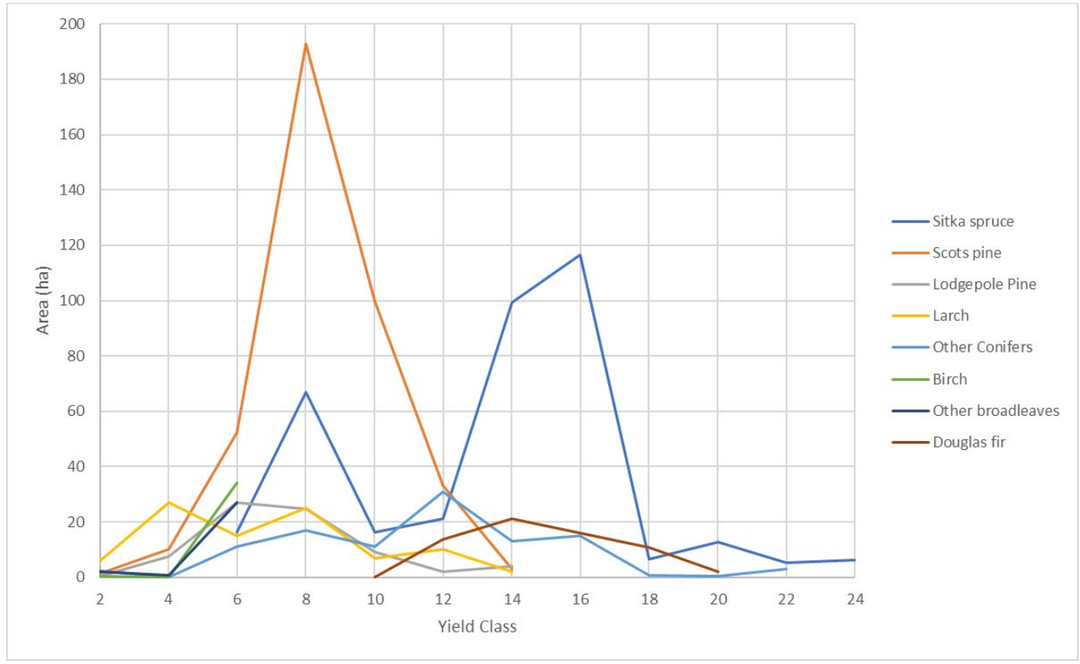
The current species composition is shown in the chart below.



The chart below shows the current age structure of the forest.



The productivity of the species currently growing within the forest is summarised in the chart below.



A.8 Summary of forest management proposals

Proposed felling, restocking and infrastructure works are shown on **Map 5: Management**, **Map 6: Thinning Approval Area, Map 7: Thinning Coupes** and **Map 8: Restock In Plan Period**.

Proposed operations	2023 - 2033
Felling	114.3ha (gross)
Thinning	1767ha (gross)
Restocking	114.6ha
Afforestation	None proposed
Deforestation	18.1ha for peat restoration
New road construction	None proposed
Road upgrade	Only routine maintenance planned

FLS will normally seek to map and identify all planned tree felling in advance through the LMP process. However, there are some circumstances requiring small scale tree felling where this may not be possible and where it may be impractical to apply for a separate felling permission due to the risks or impacts of delaying the felling.

Felling permission is therefore sought for the LMP approval period to cover the following circumstances: Individual trees, rows of trees or small groups of trees that are impacting on important infrastructure* , either because they are now encroaching on or have been destabilised or made unsafe by wind, physical damage, or impeded drainage.

*Infrastructure includes forest roads, footpaths, access (vehicle, cycle, horse walking) routes, buildings, utilities and services, and drains.

The maximum volume of felling in exceptional circumstances covered by this approval is 75 cubic metres per LMP per calendar year.

A record of the volume felled in this way will be maintained and will be considered during the five year LMP review.

Proposed Felling in Approval Period (2023 - 2033)

See **Map 5: Management**

Proposed felling year	Area to be Felled (gross ha)	Proportion of Woodland Area
2023 - 2027	73.4	6.0%
2028 – 2033	40.9	3.4%

Details of clearfell by coupe in approval period (2023-2033)

Proposed felling phase	Coupe no.	SS	SP	NS	Larch	LP	DF	Broad-leaves	Other Conifers	Total (ha)
Phase 1	09155	1.2	2						3.6	**6.8**
	09213	1.8				0.3				**2.1**
	09214	1.1	1.3							**2.4**
	09315			2.0			5.7	0.5	0.4	**8.6**
	09316		7.7		1.4					**9.1**
	09317			2.6						**2.6**
	09389	1.3	1.7							**3.0**
	09454	8.4				0.9				**9.3**
	09456	2.7				2.9				**5.6**
	09703	0.4	1.8		0.9	2.7			1.5	**7.3**
	09995	0.5	0.2			1.0				**1.7**
Phase 2	09010	1.3	8.2		1.4				3.2	**14.1**
	09094	1.8	6.5			3.5				**11.8**
	09140	3.1								**3.1**
	09318		7.2		5.1					**12.3****
Total		23.6	36.6	4.6	8.8	11.3	5.7	0.5	8.7	**99.8***

* Note the total is lower than the gross area stated above as the figure does not include areas within felling coupes registered as unproductive, streamsides, and other non-forest components.

** Coupe 09318 only to be felled once adjacent coupe 09316 is successfully established to 1.5m.

Changes in age class over plan period (2023 – 2033)

Age of trees	Growth stage	2023 Area (ha)	2023 % cover	2033 Area (ha)	2033 % cover
0 - 10	Establishment	197.7	16.2	213.4	17.5
11 - 20	Thicket	72.8	6.0	180.1	14.8
21 - 40	Pole stage	225.5	18.5	99.4	8.2
41 - 60	Mature high forest	181.8	14.9	283.3	23.3
61+	Old high forest	446.6	36.7	363.1	29.8
	Open	60.2	4.9	78.3	6.4
	Felled	33	2.7	0	0
Total		**1217.6**	**100**	**1217.6**	**100**

Proposed thinning in approval period (2023-2033)

See **Map 6: Thinning Approval** & **Map 7: Thinning Coupes**.

Proposed thinning year	Area to be thinned (Gross ha)	Proportion of forest area (%)
2024	295	24.2
2025	233	19.1
2026	219	18.0
2027	273	22.4
2031	295	24.2
2032	233	19.1
2033	219	18.0

Proposed restocking in approval period (2023-2033)

See **Map 8: Restock in plan period**.

Coupe no.	SP	BI	Alder	SS	MB	MC	NMB	DF	Open	Total
09001	1.0	0.1							0.1	**1.2**
09006		0.2			0.2	0.1			0.6	**1.2**
09010	11.0	2.7		0.2						**14.0**
09094	8.2	2.2							0.9	**11.4**
09137		0.7	1.8						1.1	**3.6**
09140	0.5	0.9		0.4	0.2				1.2	**3.1**
09155	3.8			3.4						**7.2**
09213	0.6						2.9		9.2	**12.7**
09214	1.2				1.1				0.1	**2.4**
09306		0.4	1.1						0.6	**2.1**
09315		0.1	0.2			2.6		4.0	0.1	**7.0**
09316		7.6	1.9							**9.4**
09317	2.0	0.5	0.1						0.1	**2.7**
09318					2.0	9.3			1.2	**12.4**
09345	9.5	1.2		1.2						**11.8**
09389	1.0	0.8			0.5				0.7	**3.0**
09393	0.3	0.1							2.0	**2.3**
09395	0.4	0.4							1.1	**1.8**
09436	4.1	1.4	0.1						1.4	**7.0**
09454/09640	0.4						1.9		10.5	**12.9**
09456	5.9	0.7			0.7				0.9	**8.2**
09703	6.3	0.8							0.8	**7.9**

Coupe no.	SP	BI	Alder	SS	MB	MC	NMB	DF	Open	Total
09995					1.7					**1.7**
Total	**56.2**	**20.9**	**5.1**	**5.2**	**6.4**	**12.0**	**4.9**	**4.0**	**32.7**	**147.3**

No increase in open ground is proposed within the LMP unless required to achieve UKFS guidelines or for the overriding benefit to the area. This would include riparian protection or the enhancement of habitats or biodiversity such as peatland restoration. The area of permanent open space increases modestly over this LMP period, predominantly around watercourse buffer zones and in peatland restoration zones as per requirements of the UK forest standards.

Species change over approval period (2023 – 2033)

Species	2023 area (ha)	2023 % cover	2033 area (ha)	2033 % cover
Sitka spruce	349.8	28.8	331.4	27.2
Scots pine	392.4	32.2	412	33.8
Lodgepole pine	75.2	6.2	63.9	5.2
Larch	91.5	7.5	82.7	6.8
Other conifers	104.7	8.6	103.4	8.5
Birch	33.9	2.8	54.3	4.5
Other Broadleaves	29.2	2.4	45.6	3.7
Douglas fir	47.7	3.9	46	3.8
Open	60.2	4.9	78.3	6.4
Felled	33	2.7	0	0
Total	**1217.6**	**100**	**1217.6**	**100**

Access and roading proposals

There are no proposals for new or upgrades to existing roads or ATV tracks in the plan period. The only work on the existing road network will be ongoing maintenance to ensure all parts of the LMP area are accessible for planned operations.

A.9 Standards and Guidance on which this LMP is based

This land management plan has been produced in accordance with a range of government and industry standards and guidance as well as recent research outputs. A full list of these standards and guidance can be found here: https://scotland.forestry.gov.uk/managing/plans-and-strategies/land-management-plans/links

A.10 Meeting UKFS Requirements

The management of the woodland is certified and at all times seek to adhere to the UK forest standards (UKFS) and the UK woodland assurance standard (UKWAS).

A.11 Environmental Impact Assessment

An EIA screening opinion request form is included in Appendix 4 for deforestation associated with planned peat restoration.

A.12 Tolerance Table

	Adjustment to felling period	Adjustment to felling coupe boundaries	Timing of restocking	Change to species	Changes to roadlines	Designed open space	Windblow clearance
SF approval not normally required	Fell date can be moved within 5 year period and between phase 1 and phase 2 felling periods where separation or other constraints are met.	Up to 10 % of coupe area.	Normally up to 2 planting seasons after felling. Where hylobius levels are high up to four planting seasons after felling subject to the wider forest and habitat structure not being significantly compromised.	Change within species group e.g. conifers, broadleaves.		Increase by up to 5% of coupe area	
Approval by exchange of letters and map		Up to 15 % of coupe area.	Between 2 and 5 planting seasons after felling subject to the wider forest and habitat structure not being significantly compromised.		Additional felling of trees not agreed in plan. Departures of more than 60m in either direction from centre line of road.	Increase by up to 10%. Any reduction in open ground within coupe area.	Up to 5 ha
Approval by formal plan amendment may be required	Advanced felling (phase 3 or beyond) into current or 2nd 5 year period	More than 15% of coupe area	More than 5 planting seasons after felling subject to the wider forest and habitat structure not being significantly compromised.	Change from specified native species. Change between species group.	As above depending on sensitivity.	More than 10% of coupe area. Colonisation of open areas agreed as critical.	More than 5 ha

Section B: Analysis and Concept

B.1 Key Issues and challenges

Map 4: Key Features shows the features and issues that are to be addressed in this plan period and they are further described in section B.2 below.

B.2 Constraints and Opportunities Analysis

The following table details the features and issues identified and the opportunities and constraints that these present and the concepts for how they will be addressed.

Key feature/issue	Opportunities	Constraints	Concept
Commercial timber production	Provide a planned and sustainable timber supply through thinning and felling operations.	The steep ground in some of the plan area will make operations more difficult and expensive.	Prioritise the timber production to the areas where operations will be most economical.
Teindland quarry SSSI	Maintain the site in favourable condition.	Tree and shrub regeneration from adjacent woodland.	Clear encroaching tree and shrub regeneration from designated area.
Water quality	The existing watercourse provide features can be utilised to improve the biodiversity potential of the block by establishing riparian woodland.	The watercourses are tributaries of the river Spey (an SSSI and SAC).	Undertake all operations according to UKFS water guidelines. Improve the water quality of the watercourses by establishing riparian woodland.
Deep peat soils	Undertake a soil and peat condition survey to identify areas with deep peat soils.	The area was previously ground prepped and planted with trees.	Undertake peatland habitat restoration to improve the ability of deep peat soils to sequester and store the maximum amount of carbon.
Forest research experiments	Some of the experiments have been completed or discontinued so these areas can be brought back into regular forestry management.	Some experiments are still active and the plan should not propose operations that could negatively impact on their long term viability.	Designate experiments that are to continue as Long Term Retentions (LTR) in plan. Manage surrounding crops to maintain stability of the experiments in the longer term.
Soil nutrient status (mostly poor or very poor)	Selection species for restocking that are suited to the reduced nutrient availability and are still capable of producing commercial timber.	The low nutrient availability will lead to slower growth rates thus increasing the time required to establish the trees and extend the rotation required to grow a timber crop,	Select species that are suited to the soil conditions and are still capable of producing a commercial timber crop. Plan for longer establishment periods and rotation lengths.
Open ground	Areas of deep peat and riparian woodland present the opportunity to increase the area of open space within the forest.	Currently the forest does not meet the UKFS requirement of 10% open ground or other areas managed primarily for biodiversity reasons.	Identify areas within planned felling coupes where the area of ground managed for biodiversity can be increased during restocking operations. The requirement of 10% of the forest area may not be achieved in this plan period but it will work towards achieving the target.
LISS management	Some of the crops within the forest are suitable for management using LISS prescriptions due to their past management.	However there are crops that are not suitable for LISS management due to the species present, the site conditions and previous management of the crop.	Identify those areas that are not suitable for LISS management and put them into clearfell and restock management. While also identifying areas that are suitable for LISS management and can be added to the area.

B.3 Concept

The concept detailed in the previous table forms the broad framework for the detailed design and is presented graphically in **Map 4: Analysis and Concept**. A number of the concepts overlap on the same area and they will be implemented together to achieve a broader range of objectives.

Section C: Management Proposals

C.1 Silvicultural practice

This plan has been designed in accordance with sound silvicultural and environmental principles within the framework outlined by the UK Forestry Standard and the UK Woodland Assurance Scheme.
Map 5 gives details of the felling proposals, Maps 6 & 7 the thinning proposals, Maps 8 & 9 the restock and future species proposals. The tables in Section A8 summaries the proposals for this plan period and the impact they will have on the composition of the forest in the same timeframe.

C.2 Woodland Management Prescriptions

C.2.1 Felling

See **Map 5: Management.**
621.3ha (51%) of the plan area is currently managed as clearfell using harvester and forwarder working. Clearfelling (and subsequent replanting) provides the most flexibility for changing the current species towards the long term vision for the blocks. The size of the clearfells will be guided by topology and current crop status.

In the longer term as the block starts to get closer to the long term vision the area of clearfelling will decrease and it is hoped that eventually more of the commercial crops will be able to be managed under LISS prescriptions.

Felling of Trees in Exceptional Circumstances

FLS will normally seek to map and identify all planned tree felling in advance through the LMP process. However, there are some circumstances requiring small scale tree felling where this may not be possible and where it may be impractical to apply for a separate felling permission due to the risks or impacts of delaying the felling.

Felling permission is therefore sought for the LMP approval period to cover the following circumstances: Individual trees, rows of trees or small groups of trees that are impacting on important infrastructure (as defined below*), either because they are now encroaching on or have been destabilised or made unsafe by wind, physical damage, or impeded drainage.

*Infrastructure includes forest roads, footpaths, access (vehicle, cycle, horse walking) routes, buildings, utilities and services, and drains.

The maximum volume of felling in exceptional circumstances covered by this approval is 75 cubic metres per Land Management Plan per calendar year.

A record of the volume felled in this way will be maintained and will be considered during the five year Land Management Plan review.

C.2.2 Thinning

See **Maps 6 & 7.**

We will maximise the area managed through thinning in the plan area. FLS policy assumes that all productive conifer crops will be thinned except:

- Thinning is likely to significantly increase the risk of windblow.
- A single thinning operation is likely to require an unacceptably large initial investment in relation to the potential benefits due to access or market considerations.
- Thinning is unlikely to improve poorly stocked or poor quality crops.

The plan is on a seven year cycle due to the species present and their growth rates. All thinning decisions will be guided by Operational guidance Booklet No 9 ‘Managing thinning.’

Thinning will normally be carried out at, or below, the level of marginal thinning intensity (i.e. removing no more than 70% of the maximum MAI, or YC, per year). Higher intensities (no more than 140% of maximum MAI, or YC, per year) may be applied where thinning has been delayed, larger tree sizes are being sought or as part of a LISS prescription. In all cases work plans will define the detailed thinning prescription before work is carried out and operations will be monitored by checking pre and post thinning basal areas for the key crop components.

C.2.3 LISS

See **Map 5 Management**

Currently 327.5ha (27%) of the plan areas is managed with LISS prescriptions. Some of these area are not suited to this form of management due to the current crops and their past management. Some are suffering from windblow. These unsuitable areas will be returned to clearfell management in this rotation but may be able to be again managed as LISS in future rotations. Opportunities to increase the area managed under LISS will be taken where this is the most appropriate form of management to meet the plans objectives and the crops and site conditions allow.

All areas identified as under LISS management in this plan will be managed under a uniform shelterwood prescription which will involve further standard thinnings of the mature crop to allow the understory to develop further.

C.2.4 Long Term Retentions (LTR)

See **Map 5: Management**

The areas of active Forest Research experiments are being designated as LTR in this plan. Although there are no plans to manage these areas at present the LTR designation will allow us or Forest Research to undertake operations to ensure the continuity of the experiment sites according to the experiment protocols.

C.2.5 Restocking and Natural Regeneration

See **Map 9: Long term future species** and **Map 8 Restock in plan period**.

Commercial tree species will be established, after clearfell, by a combination of regeneration and planting. The riparian zones contain broadleaf species such as Alder and birch will be partially planted but may also partially regenerate naturally from seed from desirable trees already present and left after clearfell where practically possible. The restocking of felled areas is guided by the objectives of the plan and the ESC results for this climatic area and soil types.

All conifer restocking will be managed to achieve a minimum of 2500 stems per hectare at year five and all broadleaf restocking a minimum of 1600 stems per hectare.

All areas identified for restocking by natural regeneration will been recorded and programmed for inspect on a five yearly basis. At each inspection an assessment will be made to establish if the natural regeneration is, or is likely, to achieve the objectives for the site. If it is decided that the objectives are not being met then replanting with an appropriate species will be undertaken. If natural regeneration is occurring but not yet at the required density then the option to review the site in a further five years may be taken. If after two such inspections, that is ten years following felling, it is felt appropriate to wait a further period for natural regeneration then a discussion and agreement will be reached with the Conservancy woodland officer.

Enrichment planting will be used to ensure the target stocking density of 2500 stems per ha is reached if there is insufficient natural regeneration.

The broadleaf replanting, or natural regeneration, will be managed to achieve 1600 stem per ha in the fully stocked areas with up to 25% of the area being retained as open ground, moving towards the UKFS requirement for 10% open ground and other areas managed primarily for biodiversity. Details of the breakdown of the mix of broadleaves and open ground are included in the summary table in section A.8.

The fully stocked broadleaf areas will be planted in the most appropriate locations within the coupe. This decision will be taken by the operations and environment foresters once the preceding crop has been felled and the full suite of site conditions can be properly assessed. Therefore there has been no attempt to map these areas as part of this plan.

C.2.6 Recreation

Currently there is an established network of paths specifically designed for equestrian use. The level of usage is low and the continued maintenance and promotion of these routes will be reviewed in the context of the wider recreational offering across the region during the period of this plan. If the reviews conclusion that the continued maintenance of the routes is no longer appropriate given the level of use, the cost of maintenance and the availability of resources the wider forest will still remain fully open and available for informal recreational use, including walking, cycling and equestrian use.

C.2.7 Protection strategy and deer management

Wild deer on the National Forest Estate (NFE) are managed in accordance with the Scottish Government's strategy "Scotland's Wild Deer a National Approach" and under the auspices of the Code of Practice on Deer Management.

The strategy and Code of Practice takes recognition of the fact that Wild deer are an asset, an integral part of Scotland's biodiversity and provide healthy food and recreational opportunities. The challenge of managing wild deer originates in a need to balance the environmental, economic and deer welfare objectives of the Scottish nation with the objectives of private landowners for forestry, agriculture, sporting and other forms of land use.

The principal legislation governing the management of deer in Scotland and hence on the NFE is the Deer (Scotland) Act 1996.

It is therefore FLS deer policy to:

- Prevent adverse deer impacts on commercial tree crops and the wider habitat. In doing so to carry out deer culling in an exemplary and humane way.
- Work closely with relevant organisations and neighbours to make sure that there are integrated deer management plans which seek to recognise the interests of all parties.
- Take opportunities to optimise income from venison from sporting where this does not conflict with our primary objective of maintaining deer impacts at an acceptable level, in line with Quality Meat Scotland accreditation in the form of The Scottish Quality Wild Venison (SQWV) Assurance Scheme
- Take all practicable steps to slow down the expansion of deer species into areas where they are not currently present.

All deer management will be carried out in accordance with OGB 5 - Deer management. The aim is to manage deer density safely and humanely at a level which is consistent with acceptable impacts on forests and other habitats. This is likely to be at a density level of 5 deer per 100 hectares.
Deer cull plans are prepared for each Deer Management Unit and are the responsibility of the Wildlife Ranger Manager (WRM).
Within the Teindland block it is expected that conifer species will be able to be established with culling being the only means of deer control. However for the coupes to be planted/regenerated with broadleaves deer fencing may be required. This decision will be made jointly by the WRM and the

delivery forester. If deemed necessary this will be maintained for the period required to achieve successful establishment and subsequently removed.

C.2.8 Management of Tree health

The large pine weevil (Hylobius abiatis) is likely to be the only major tree health issue encountered in this plan.

The Hylobius Management Support System (MSS) will be used to determine the best way to manage clearfell sites for successful, cost effective and environmentally friendly restocking. This system will be used along with past results and experience to determine the optimal time to restock while minimising the use of chemicals. Restocking will take place as soon after felling as possible with two years being the usual period but this could be delayed up to four years.

C.3 Management of Infrastructure

C.3.1 Forest roads

No new roads are required in the plan area however a programme of maintenance will be undertaken to ensure existing roads are suitable for forest operations.

C.4 Management of the environment and open land

C.4.1 Historic environment

No scheduled sites or features of regional importance are present within the plan area. A check of both our own records and the SMR will be undertaken to establish the location of any unscheduled features which will be included in the work plan that is drawn up prior to all forestry operations being undertaken. All operations will follow UKFS and FLS guidance for the management of heritage sites.

C.4.2 Habitats and biodiversity

The table below identifies works to enhance the habitats and biodiversity in the plan area. Those items highlighted in red must be undertaken as they are designated sites. Those in orange should be done but this is dependent on the appropriate coupes being felled or the resources (human and financial) being made available to allow them to be undertaken. While those in green could be done to benefit the habitats or biodiversity but only if the work can be carried out as part of another planned operation.

Issue / Site Name	Aim/Rationale	Proposal
Teindland Quarry SSSI	Statutory Designation - Favourable status threatened by tree regeneration and scrub.	Remove regeneration and scrub from within quarry and back to a 10m buffer. See SSSI plan appendix 2.
River Spey SSSI/SAC	Statutory Designation - Protect and improve water quality.	Establish riparian buffers along key watercourses – Red Burn, Carra Burn, Sauchenbush Burn and Burn of Garbity. These will be up to 30m either side of the watercourse. Clear conifer regeneration from existing riparian zones. Up to 10% conifer coverage will be acceptable.
Blanket bog and/or deep peat areas.	Scottish Government climate change strategy, SF/FLS policy, Scottish biodiversity strategy.	Protect existing open peat habitats and restore blanket bog. Where deep peat has the capacity to be restored we will undertake works to block drains and furrows and remove regenerating non-native species. On areas where the peat cannot be restored effectively we will promote wet woodland, comprising natural regeneration adjacent tree species and native species planted at low densities.
Invasive none native species - rhododendron	FLS Strategy.	Continue the control of rhododendron.
Ponds and wetlands	General improvement in biodiversity in line with Scottish Biodiversity Strategy.	Maintain existing ponds and wetlands. Seek opportunities to link with riparian woodland and create a wider habitat network.
Habitat management for Capercaillie	Site within Capercaillie Core Area with occasional sightings.	Seek opportunities to create wet flushes and/or bog pools, retain occasional pockets of windblow and vary thinning intensity in appropriate areas.

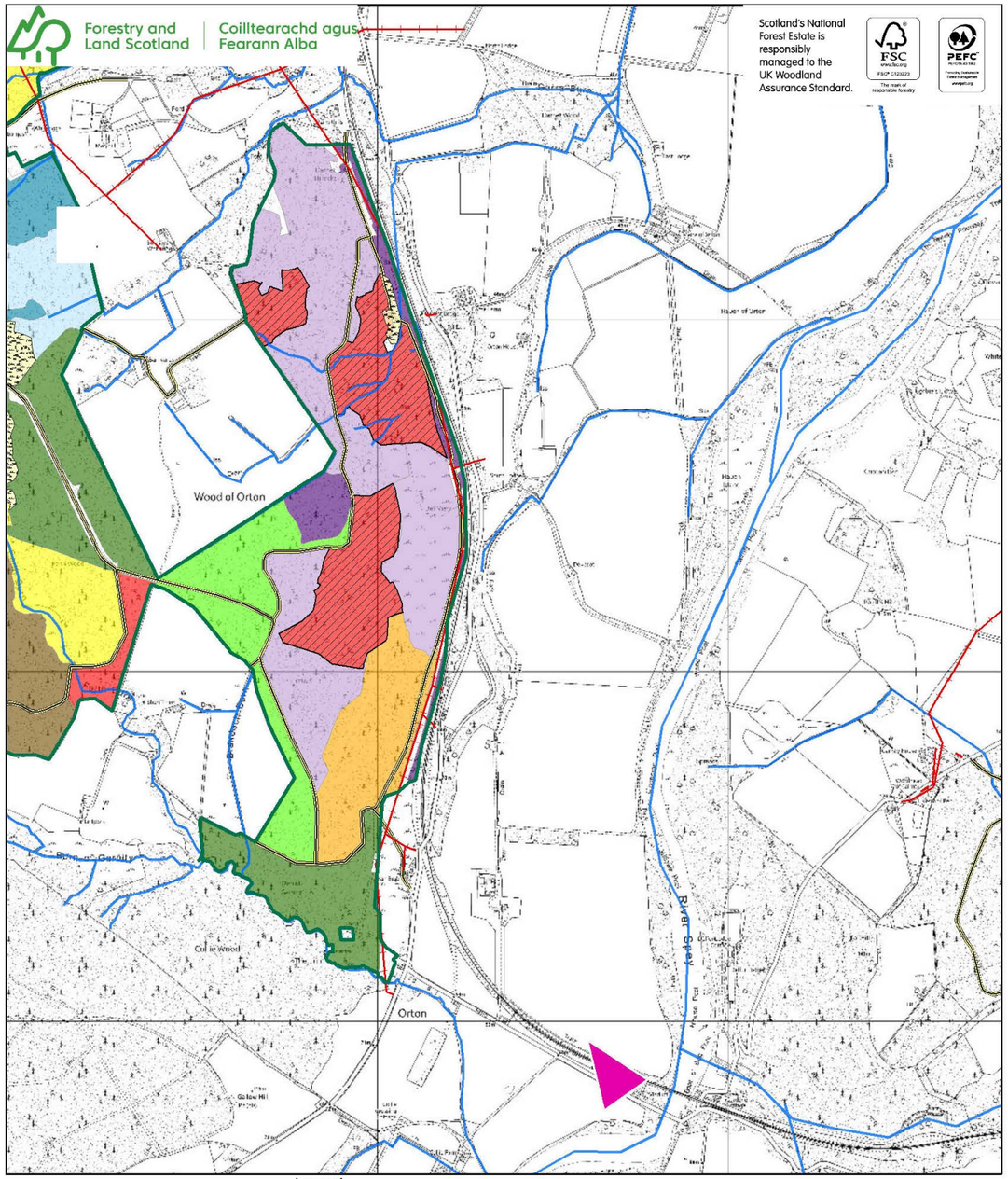
C.4.3 Peatland restoration

Please see **Appendix 4: Teindland Peatland Restoration Plan**

Section D: Visualisations

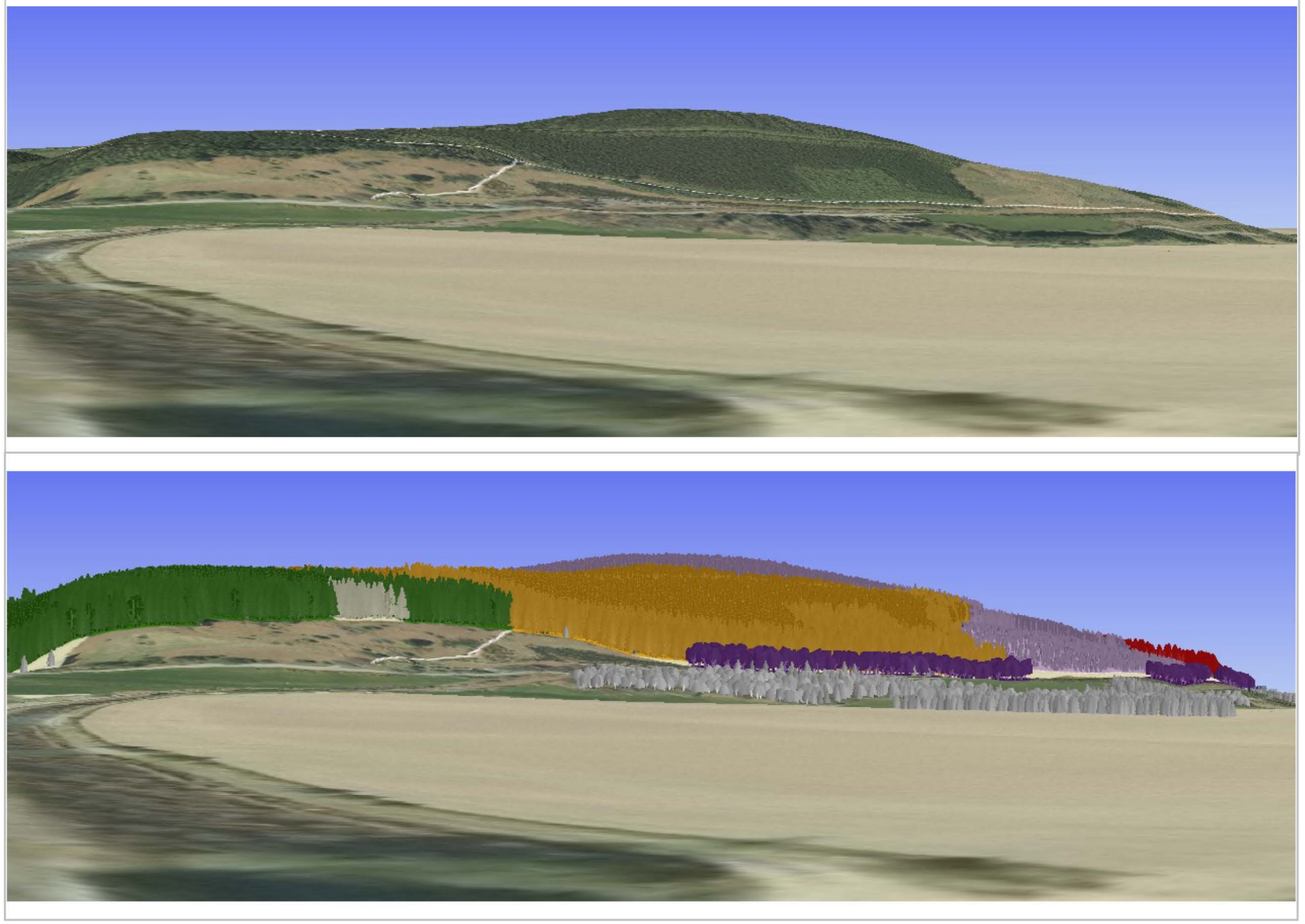
D.1 Location of viewpoint

A visibility assessment has been undertaken which found that it is mostly only the edge of the block that is visible from the surrounding landscape, with the exception of the south eastern face overlooking the river Spey. With this in mind some visualisations have been created from this point which show the view from the Aberdeen to Inverness train as it passes over Boat of Brig, near Rothes.



D.2 Felling Phases

Forestry and Land Scotland
Coilltearachd agus Fearann Alba



East Region
Teindland LMP

View 1 NW from train track
Grid Ref: NJ 3178 5182
Date: April 2023

Visualisation of Felling proposals

Visualisation year
Image 2023

Felling Phases 2023

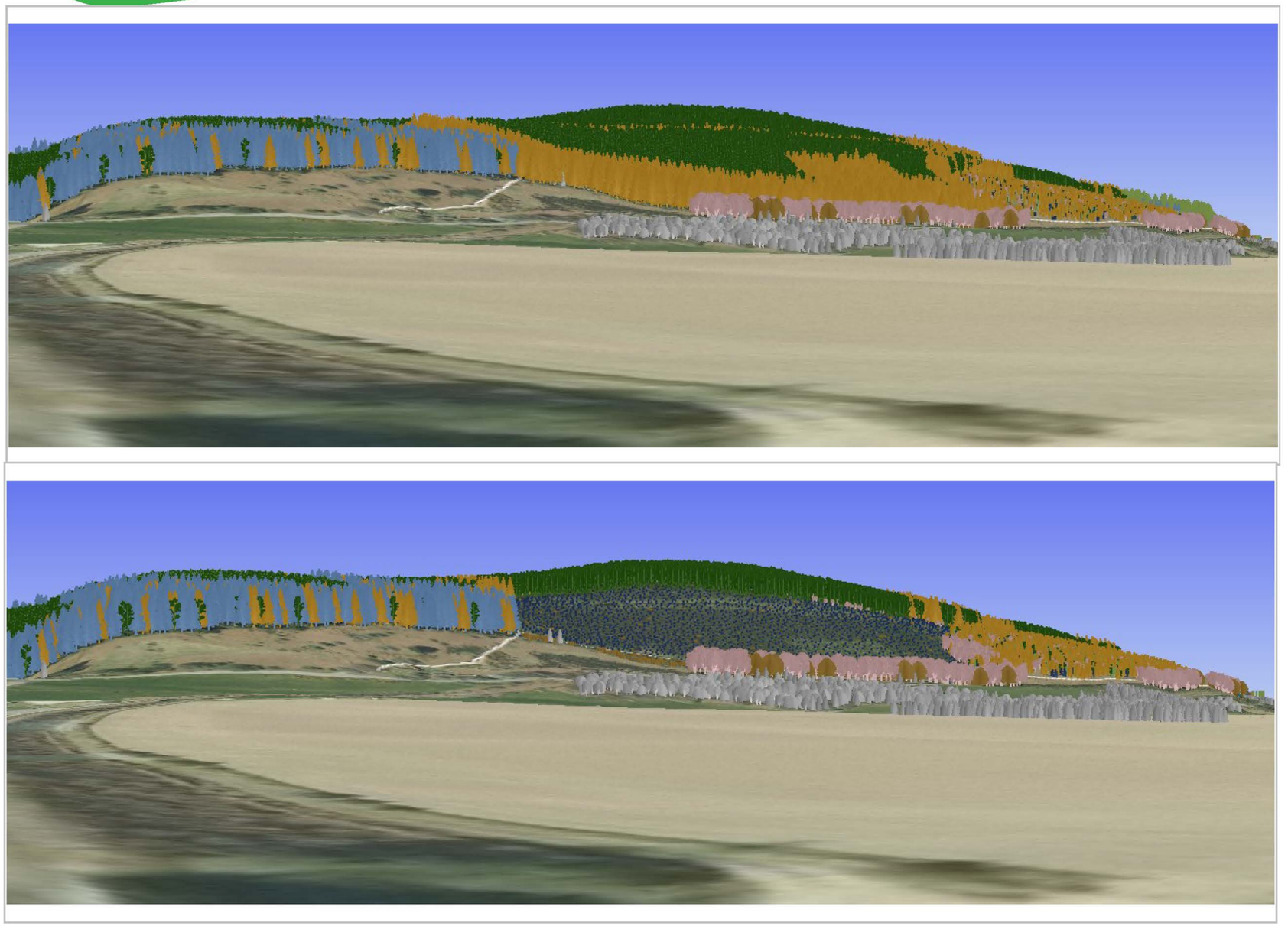
Felling Phases have a rolling 5 year period and for visualisations start on the date shown above.

- Felled or fell year requires review
- Phase 1: < 5 years
- Phase 2: between 5 and 9 years
- Phase 3: between 10 and 14 years
- Phase 4: between 15 and 19 years
- Phase 5: between 20 and 24 years
- Phase 6: between 25 and 29 years
- Phase 7: between 30 and 34 years
- Phase 8: 35 years and greater
- Clearfell with seed trees
- Low Impact Silviculture
- Minimum Intervention
- Natural Reserve
- Long Term Retention
- Other/Open land
- Neighbouring woodland

Scotland's National Forest Estate is responsibly managed to the UK Woodland Assurance Standard.

D.3 Change in landscape between 2023 and 2033

Forestry and Land Scotland
Coilltearachd agus Fearann Alba



East Region
Teindland LMP

View 1 NW from train track
Grid Ref: NJ 3178 5182
Date: April 2023

Visualisation of Future Habitat and Species

Visualisation year
Species 2023
Species 2033

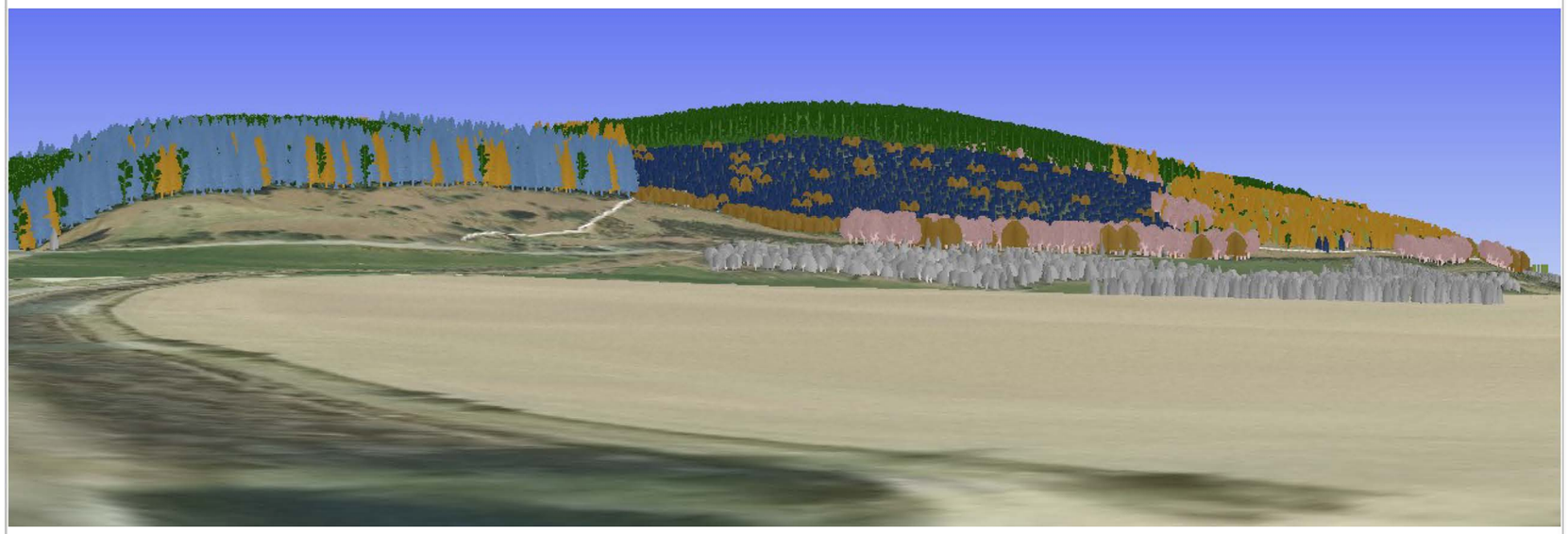
Felling Phases have a rolling 5 year period and for visualisations start on the date shown above.

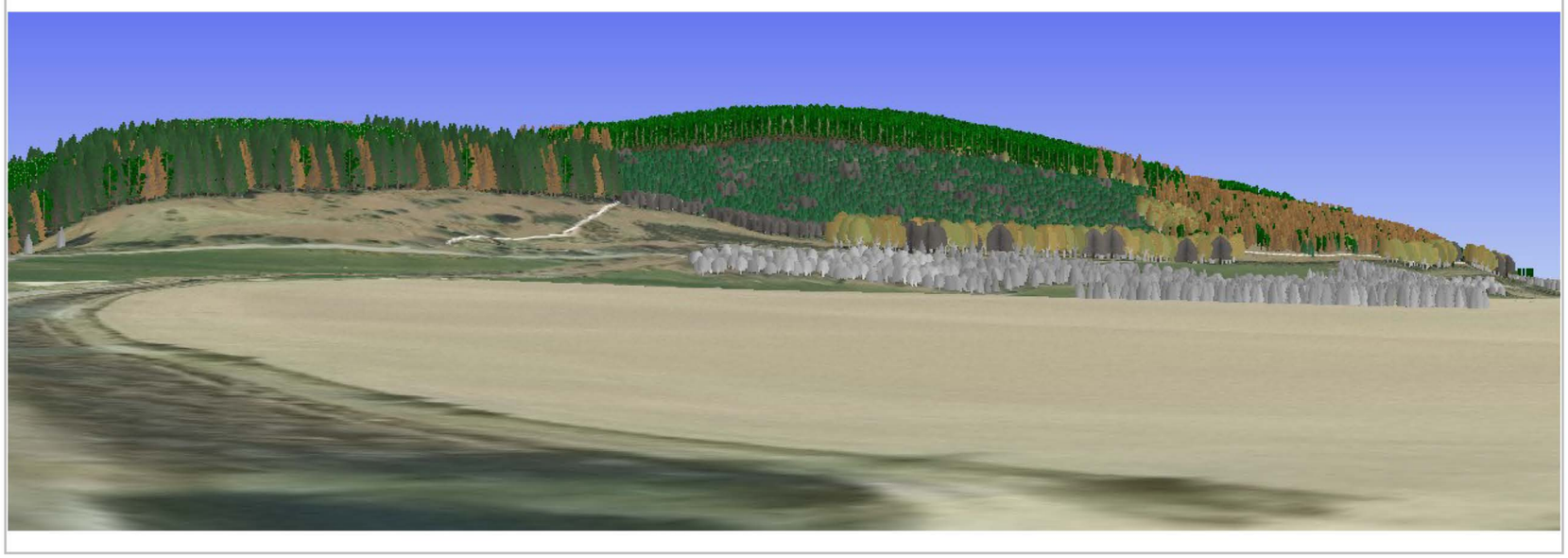
- Sitka spruce
- Norway spruce
- Scots pine
- Lodgepole pine
- Larch
- Douglas fir
- Mixed conifers
- Ash
- Oak
- Beech
- Birch
- Mixed broadleaves
- Native mixed broadleaves
- Neighbouring woodland

Scotland's National Forest Estate is responsibly managed to the UK Woodland Assurance Standard.

D.4 Landscape composition by 2043

Forestry and Land Scotland
Coilltearachd agus Fearann Alba





East Region
Teindland LMP

View 1 NW from train track
Grid Ref: NJ 3178 5182
Date: April 2023

Visualisation of Future Habitat and Species

Visualisation year
Species 2043

Autumn 2043

Felling Phases have a rolling 5 year period and for visualisations start on the date shown above.

- Sitka spruce
- Norway spruce
- Scots pine
- Lodgepole pine
- Larch
- Douglas fir
- Mixed conifers
- Ash
- Oak
- Beech
- Birch
- Mixed broadleaves
- Native mixed broadleaves
- Neighbouring woodland

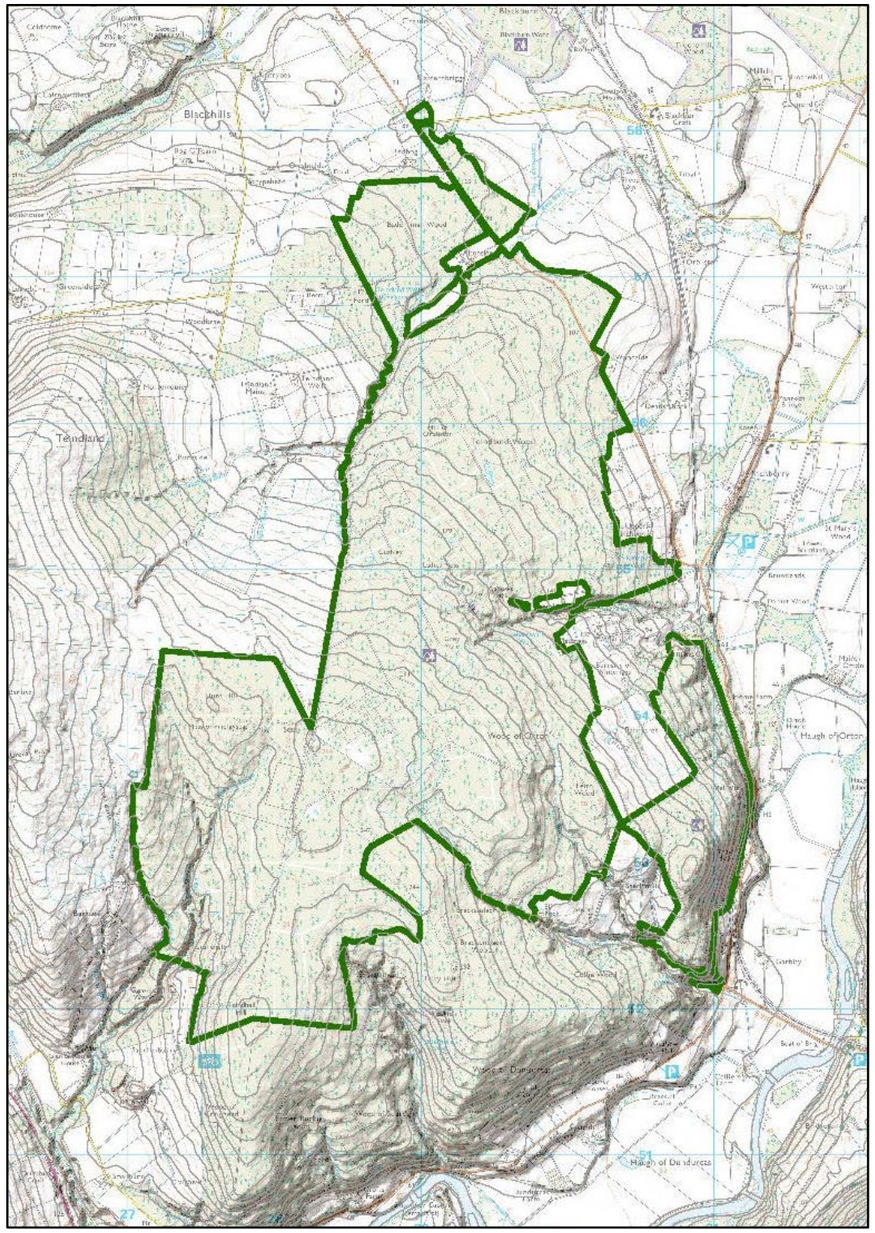
Scotland's National Forest Estate is responsibly managed to the UK Woodland Assurance Standard.

FSC www.fsc.org FSC® C123223 The mark of responsible forestry

PEFC Promoting Sustainable Forest Management www.pefc.org

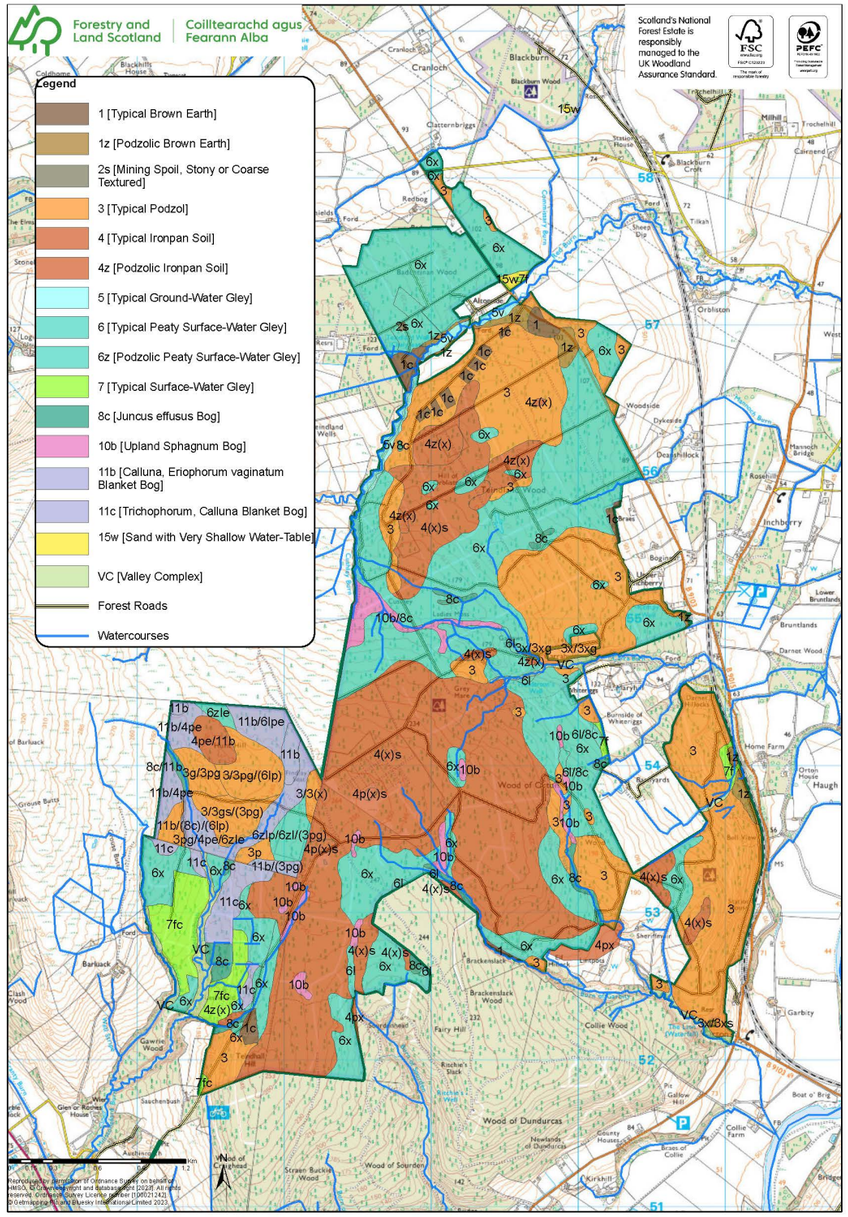
Appendix 1: Background Information

1.1 Topography



The elevation of the plan area runs from about 70m above sea level where the block runs down into the Spey valley up to 264m at the top of Finlays Seat. The forest mostly lies on a gentle north east facing slope but there is a small area of steep slope on the eastern boundary overlooking the Spey valley.

1.2 Geology and soils



Geology - According to the British Geological Surveys Geological Map of the UK the majority of the plan area is underlain with conglomerate, sandstone, siltstone and mudstone of the Middle old red sandstone (Fintona group). The remainder is mostly Psammite and Semipelite of the Grampian group with some Quartzite also of the Grampian group. This is mostly overlain with Diamicton till.

This leads to the creation of soils with low levels of nitrogen availability.

Soils – About one third of the soils in Teindland is a peaty gley (6) with another third typical ironpan soils (4). One quarter is typical podzols (3) with the remainder a wide range from typical brown earth (1) to Calluna blanket bog (11c).

These soils have a wide range of moisture regimes from very wet through to slightly dry and nutrient regimes that run from very poor to rich. These factors influence the species of trees that will grow successfully in these woodlands.

1.3 Climate

The climate data for the design plan area is obtained from the Ecological Site Classification system (ESC). The results of interrogating this system gave the following data.

AT5	DAMS	MD
974 - 1212	5 - 15	76 - 129
Cool - warm	Sheltered – moderately exposed	Wet - moist

Each tree species has tolerances for these and other factors and they can be used to identify species suitable for the site conditions. The results above will be used to help assist in the choice of tree species for restocking in this plan.

Further information on these criteria and the application of ESC can be found in FC Bulletin 124 - An Ecological Site Classification for Forestry in Great Britain.

1.4 Hydrology

The majority of the Teindland forest block is within the catchment for the river Spey with only a small area (63 ha) at the very north within the Spey Bay coastal catchment. The block makes up a very minor (<0.5%) proportion of the total Spey catchment area.

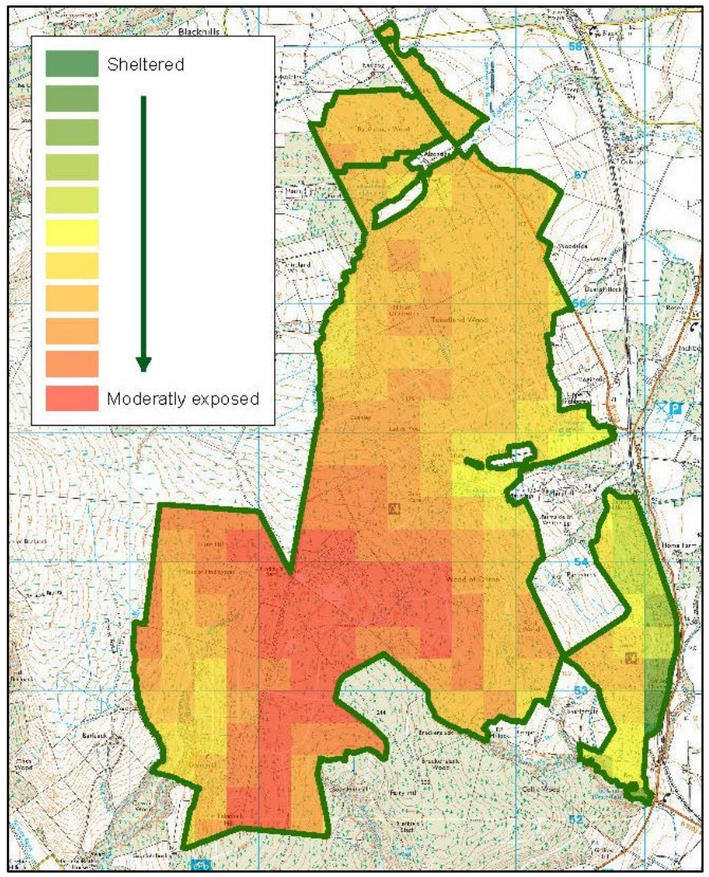
The river Spey is designated both an SSSI and SAC due to the presence of atlantic salmon (Salmo salar), sea lamprey (Petromyzon marinus), freshwater pearl mussel (Margaritifera margaritifera) and otter (Lutra lutra). The most up-to-date River Basin Management Plan records show there are no water bodies within or adjacent to the plan area which are at “less than good” ecological status/potential as a result of forestry activities. However the protection and enhancement of the riparian zones within the plan will still be an objective of this plan.

There are three private water supply points and a number of supply pipes within the woodland area. All these will be protected during any operations by following the UK forest standard guidelines for forests and water as a minimum.

Much of the block falls within a Drinking Water Protected Area (DWPA) as designated by Scottish Water. Any forest operations which take place within the DWPA will require a program of water quality monitoring to be in place during the period of the works. In addition to meeting the UKFS and Forests and Water Guidelines, the Scottish water Guidance on Forestry Activities near SW Assets should also be taken into account. Scottish water should also be contacted three months prior to any work commencing on site so that sampling can be arranged and timelines for operations can be discussed.

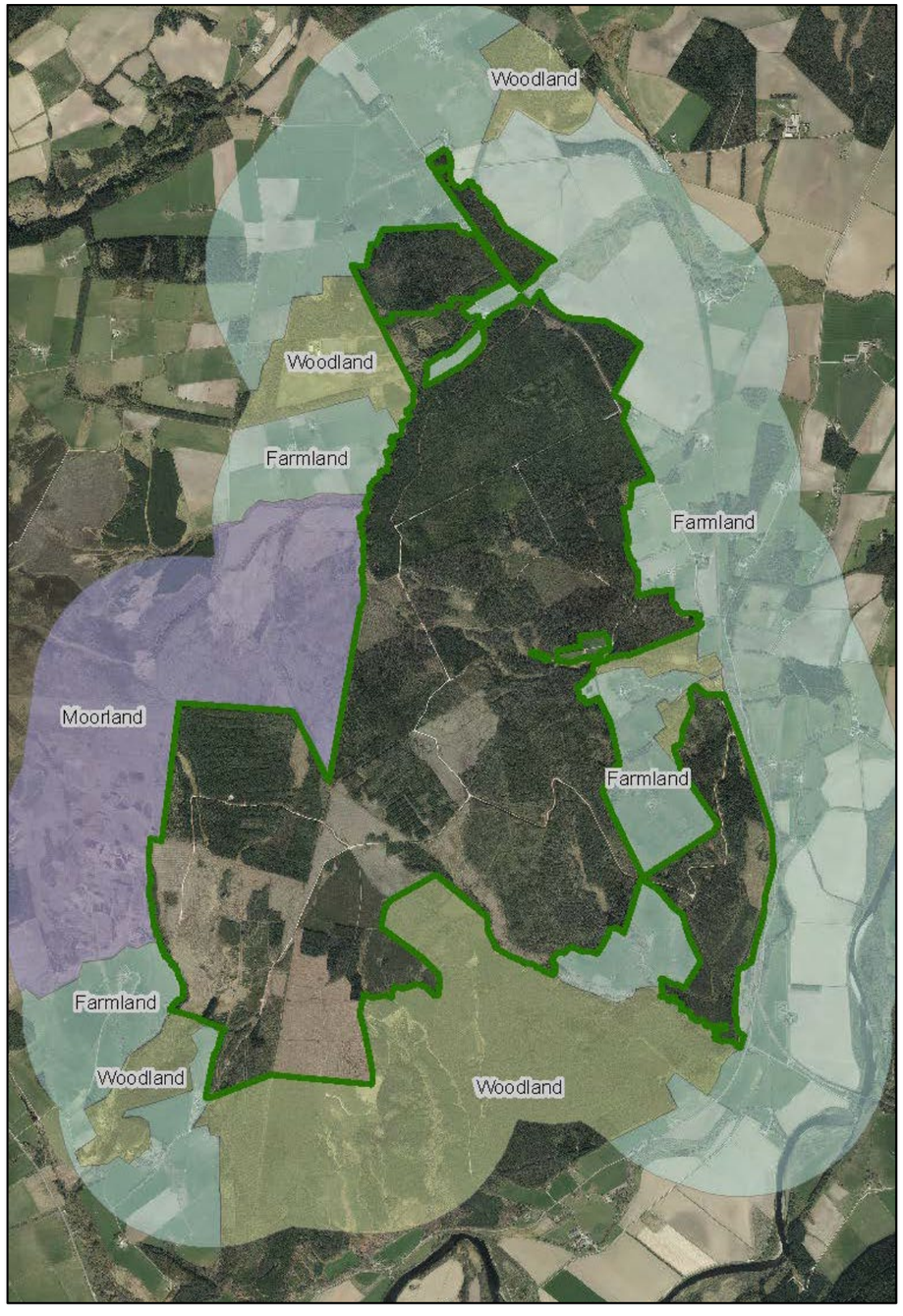
According to the SEPA flood maps the river Spey has a high likelihood of flooding therefore operations will be planned to have the minimum impact on the volumes and speed of water leaving the forest. Although as the blocks makes up less than 0.5% of the Spey catchment area in reality forest operation will have no measurable impact on the Spey catchment.

1.5 Wind throw risk



The wind throw risk is measured by the DAMS score for the forest area. The results of this are shown on the map. This indicates that, as you would expect, the areas at the tops of the blocks are most exposed and therefore more liable to wind throw. This information will be taken into account when felling coupes are planned and LISS prescriptions are to be implemented to reduce the potential impacts.

1.6 Adjacent land use



1.7 Timber transport

All access points from the Teindland block are from B roads and according to the agreed route map for the Timber Transport Forum all B-roads are classified as Consultation Routes by default unless covered by one of the other classifications, which they are not in this case. These are “recognised as key to timber extraction but which are not up to Agreed Route standard. Consultation with Local Authority is required and it may be necessary to agree limits of timing, allowable tonnage etc. before the route can be used”.

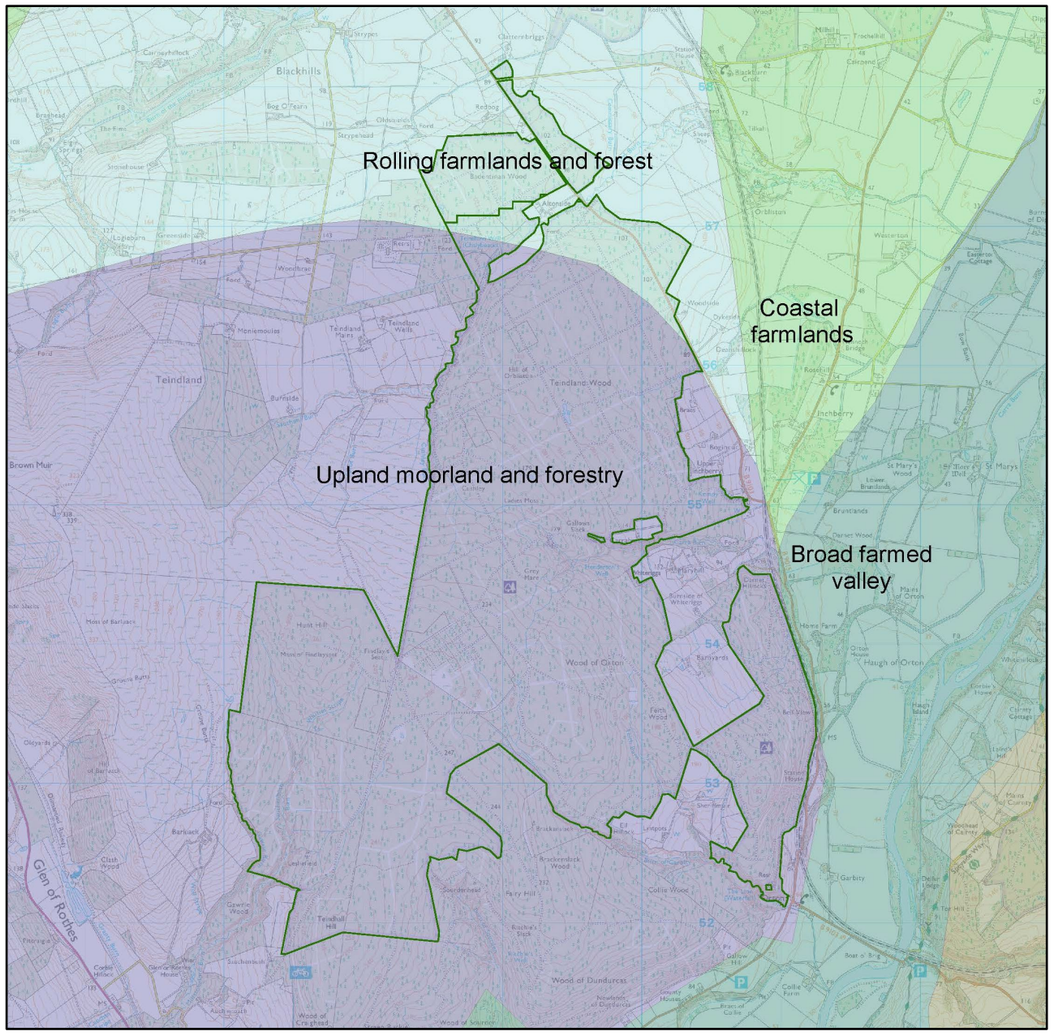
1.8 Deer management

Deer management will be carried out in line with the district strategy for deer control on a contract. Cull figures fluctuate but predicted culls are based on Estimated Deer Utilisation (EDU) carried out by independent contractors. The aim of current policy is to reduce deer densities to five deer per km2 within the woodland area in order to ensure all species including natural regeneration and associated habitats are protected from the negative impacts from over grazing.

1.9 Recreation and visitor access and management

There is a reasonable level of public use of the forest and we have no objective to increase visitor numbers or expand equestrian use. Visitor services have undertaken an audit of the site and it scored very low (1 out of 5) in terms of quality so is seen as a poor offering. It has therefore been identified as a potential trail to remove we will need to look at is deciding if and when to extract ourselves from these trails. If the waymarking is removed the trails will still be available for use for informal recreation.
There are no Core Paths within or adjacent to the block.

1.10 Landscape character



UPLAND MOORLAND AND FORESTRY

Key Characteristics:

- Widely spaced, broad, rounded hills and upland plateaux with smooth, even, gentle slopes.
- Generally simple, large scale landscape with expansive scale of interior plateau area.
- More defined, higher hills on edge of the interior plateau, forming landmark features from the adjacent lower lying landscapes to the north and south and providing a backdrop to these.
- Predominantly simple landcover of extensive, geometric conifer forests and heather moorland.
- Large scale commercial forestry blankets much of the mid and upper slopes, many of which are undergoing deforestation and restocking. The differing tree heights and open areas of landcover disturbance are prominent on the simple broad slopes, reinforced by the wider resurfaced forest roads upgraded for timber extraction.
- More intimate farmed landscapes at the margins and close to burns and roads, with farms, small holdings and marginal pastures.
- Large expanses of un-settled areas, with settlement very sparsely scattered near the very few roads.
- Largely inaccessible core area with relatively limited visibility in from surrounding landscapes.
- Regenerating native trees and lone pine trees in moorland areas.
- Windfarm development both within the Landscape Character Type and in adjacent landscapes.
- Small number of built features which are generally visually separated by distance, and do not coalesce to create visual confusion.
- Central areas away from public roads have relatively strong wild character, due to their remoteness, rugged terrain and perceived naturalness.
- Extensive views out of this landscape, through gaps in the forestry cover, to the north and to the south from elevated areas.

ROLLING FARMLAND AND FORESTS

Key Characteristics:

- Widely spaced, broad, rounded hills and upland plateaux with smooth, even, gentle slopes.
- Generally simple, large scale landscape with expansive scale of interior plateau area.
- More defined, higher hills on edge of the interior plateau, forming landmark features from the adjacent lower lying landscapes to the north and south and providing a backdrop to these.
- Predominantly simple landcover of extensive, geometric conifer forests and heather moorland.
- Large scale commercial forestry blankets much of the mid and upper slopes, many of which are undergoing deforestation and restocking. The differing tree heights and open areas of landcover disturbance are prominent on the simple broad slopes, reinforced by the wider resurfaced forest roads upgraded for timber extraction.
- More intimate farmed landscapes at the margins and close to burns and roads, with farms, small holdings and marginal pastures.
- Large expanses of un-settled areas, with settlement very sparsely scattered near the very few roads.
- Largely inaccessible core area with relatively limited visibility in from surrounding landscapes.
- Regenerating native trees and lone pine trees in moorland areas.
- Windfarm development both within the Landscape Character Type and in adjacent landscapes.
- Small number of built features which are generally visually separated by distance, and do not coalesce to create visual confusion.
- Central areas away from public roads have relatively strong wild character, due to their remoteness, rugged terrain and perceived naturalness.
- Extensive views out of this landscape, through gaps in the forestry cover, to the north and to the south from elevated areas.

1.11 Biodiversity and habitat

Teindland Quarry SSSI is within the block. It is one of only a few sites in Scotland with deposits dating from the last interglacial. It is therefore a site of outstanding importance for establishing the history of environmental changes that occurred in Scotland during the Late Quaternary. Site condition monitoring was last carried in 2005. The site was in favourable condition. The extent of the exposures and accessibility were being maintained, though some soil had fallen at base of quarry face, but is easily removed if required. The access track and the centre of the quarry were moderately overgrown by a mixture of gorse and broom but this did not seriously impede access.

914ha of the block is long established of plantation origin (LEPO).

There are a number of areas of peat across the block. These require further surveys to determine depth and ecological potential for restoration and maintaining as open ground.

The Red burn and a number of other minor watercourses are tributaries of the river Spey, which is an SSSI and SAC, so riparian habitats are key habitat areas to establish good quality riparian corridors. There are also a number of ponds, some man made, within the block.

There are a number of Scottish Biodiversity Action Plan species and FLS Key Species recorded in the Teindland block.

There are historic sightings of Capercaillie within the block. The last confirmed sighting was a female in 2012. Droppings of a female were found in 2016 but there has been no evidence in more recent years.

There have been sightings of several raptor species (osprey, goshawk, hobby, hen harriers and sparrowhawk) along with red squirrel, badgers, crested tit, crossbills, pine martin and wood ants.

There are also areas of rhododendron, an invasive non-native species (INNS), that will be controlled.

1.12 Historic environment

There are a wide range of unscheduled sites across the forest, some of which have been known of for some time and others discovered more recently through pre-operation site checks and surveys carried out by a local archaeologist.

1.13 Plant health

The **large pine weevil (Hylobius abiatis)** can cause extensive feeding damage to young trees used to restock clearfell sites but damage is often highly variable. This species lays its eggs in deadwood/stumps on clearfell sites and the emerging adults feed on the bark of young trees, often with devastating effect on newly planted conifer crops.

The Hylobius Management Support System (MSS) is based on a simple monitoring protocol using billet traps to measure Hylobius numbers on individual clearfell sites. The numbers recorded are used, with other information entered into the Hylobius MSS software, to determine the best way to manage clearfell sites for successful, cost effective and environmentally friendly restocking. This Support System will be used along with past results and experience to determine the optimal time to restock while minimising the use of chemicals.

Restocking has traditionally taken place within two years of sites being clearfelled. However, many seedlings were badly damaged or killed by the Large Pine Weevil, Hylobius abiatis. In order to "reduce the use of insecticides where feasible" restocking is planned to take place at the end of year 2. Restocking may take place up to four years following felling if monitoring, using MSS shows that it is expected that there will be a high level of Hylobius.

Ash dieback is an aggressive fungal disease and is caused by Hymenoscyphus fraxineus (previously Chalara fraxinea). The disease causes leaf loss and crown dieback in affected trees, and usually leads to tree death. There will be no planting of ash trees as there is currently a moratorium on its planting within FLS woodlands to try and help slow the spread of the disease. However as this disease is endemic to the wider environment no action will be taken regarding mature established trees that contract the disease beyond felling for safety reasons in areas with high recreation use.

Phytophthora ramorum is a fungus- like plant pathogen which attacks a wide range of tree and shrub species. European and hybrid larch are particularly susceptible to P. ramorum but current evidence indicates that the impact of the disease is greatest on Japanese larch, which can die within one to two seasons, with consequential economic, environmental and amenity impacts. Therefore there is currently a moratorium on the planting of larch within FLS woodlands to try and help slow the spread of the disease. We will try to retain existing larch stand where practical to maintain the species diversity within the Teindland blocks.

1.14 Fire

The fire risk in Teindland is presently manageable. However given the fairly high recreational use combined with predicted climate change this plan will take into account options to mitigate fire risk and facilitate fire control.

Appendix 2 Teindland quarry SSSI plan

Start Date of Plan – Same as LMP
End Date of Plan – Same as LMP

Overall Management Aims & Objectives

The key aims for the management of Teindland Quarry will be to maintain the sediment exposures within the quarry and access to the site. Forestry and Land Scotland (FLS) will also support any research and interpretation for study, education and public awareness.

Section 1: Designated Sites covered by this appendix

Designated Site Name	Site code	Site Type	Total Area of designated site (ha)	Area within this LMP (ha)	% within this LMP	% on NFE	Annex containing SNH site documentation
Teindland Quarry	1526	SSSI	2.52	2.52	100	100	Annex 2
River Spey	1699	SSSI	1486.8	0	0	0	
River Spey	8365	SAC	229.1	0	0	0	

Refer to the **Map 2 – Key features** of the Teindland LMP which highlights the location of the above designated sites on the national forest estate (NFE) and in relation to the Teindland Forest Land Management Plan (LMP) boundary.

For further detail on the designation refer to the SNH documentation in the above listed annexes, which refers to the entire designated site area. The remainder of this plan will refer in detail to the element of the above designated site/s on the NFE.

The whole 2.52 ha of the designated site is one site and is located close to the NFE boundary adjacent to the B9103 near Inchberry, Morayshire.

Teindland Forest is within the catchment of the River Spey and although the river itself is outwith the NFE, a number of tributaries including the Red Burn, Carra Burn have their sources within Teindland Forest.

Section 2: Features on the NFE and condition

Only features that exist on the NFE within this FDP are listed in the table below.

Site Type	Site code	Feature description	Feature code	SCM Condition (Date assessed)	Condition on NFE	Management Classification (if relevant)
SSSI	1526	Quaternary of Scotland		31/03/2005	Favourable	

Quartenary of Scotland

About 2.3million years ago, at the start of what was known as the Quaternary geological period, global cooling brought about the start of the Ice Age. The Ice Age did not represent a period of continuous ice coverage, but consisted of many separate glacial events which lasted until around 10,000 years ago.

Between the glaciations, during the interglacial periods, temperatures rose to levels similar, or slightly higher, than those today. This led to the development of woodland and the formation of soils. The exposure at Teindland Quarry illustrates an ancient soil layer (palaeosol), that was formed before, and survived through the last glaciation. This palaeosol is made up of different horizons and has yielded pollen of interglacial affinity. Sites which preserve such evidence are rare. An additional feature of interest and environmental indicator, preserved within the deposits at Teindland is a structure known as an ice wedge cast. This would have formed over many years by the repeated action of ice expanding a crack in the ground and sediment being washed down the crack following the yearly melting of the ice.

Fossil pollen have been used to relate vegetation changes with changes in the environment and climate, and radiocarbon dating of organic matter and luminescence dating of mineral sediments has been used to age the sediments. The site has significant value and potential for further research in the long-term as new methods and techniques are developed.

Teindland Quarry is one of a few known sites on the Scottish mainland where organic deposits from the last interglacial period have been found. It is a key location for further research into the Quaternary history of Scotland and may provide evidence for the presence of glaciers in Scotland after the last interglacial but before the last widespread glaciation during the late Devansian (about 25 000 years ago). Consequently the site is important for interpreting the changes in both the landscape and climate of Scotland during the Quaternary.

Knowledge of Quaternary history is also important in that it provides direct evidence for the rate at which natural processes can occur, in particular the response of geomorphological processes and plant communities to major climatic changes. Such information becomes increasingly important as attempts are made to predict the likely effect of future natural or man-induced climatic changes and to separate the two influences.

The term “crucial area”, as used in SNH’s Site Documentation Series, encompasses a very important geological feature or set of features and which is/are vital in conveying the scientific value of the site. The crucial area within Teindland Quarry SSSI corresponds to the quarry pit itself. The “context area” which corresponds to the surrounding area of plantation, part of which was felled 10 years ago, may overlie below-ground extensions of the fossil soil and therefore neither regarded as being of limited scientific value, nor indispensable.

Section 3: Pressures and proposed actions

Site Type	Feature description	Feature code	Pressures	Proposed action	Timescale
SSSI	Quarternary of Scotland		Tree and Scrub regeneration*	Clear all tree and scrub from crucial and context area	By October 2019
				Monitor and remove as required	Three-yearly commencing 2022

* This pressure is not noted on Remedies Database but is an on-going threat to the site, obscuring the exposed sediment and therefore FLS have added it here.

Section 4: Operations within the LMP that could impact on the designated features on the NFE

Operation Type	Detailed description of operation and method	Mitigation measures to be applied	Timing
Removal of scrub and tree regeneration	Gorse, broom and tree regeneration will be cleared using chainsaws and clearing saws from the designated site. Cut material will be chipped and removed from the crucial area. The chipper will be positioned outside the main quarry area.	Care will be taken not to damage the soil exposures. A pre-commencement meeting will be held with staff to ensure that the importance of the site is well communicated. No vehicles or machinery will be parked/used within the quarry or within 3m of the quarry lip. This buffer will be marked on the ground with tape ahead of any operations.	Sept/Oct 2019 and three yearly as required
Restocking	Mechanised cultivation and hand planting or natural regeneration	No regeneration will be accepted or tree planting carried out within the crucial area or context area. No machinery within 3m of quarry lip. This buffer will be marked on the ground with tape ahead of any operations.	On-going
Fencing	Maintenance of existing stock fence		On-going
Felling and Thinning	Mechanised harvesting machines for felling and harvesting	No machinery to operate within 3m of quarry lip. No timber to be processed or stacked within quarry or within 3m of quarry lip. This buffer will be marked on the ground with tape ahead of any operations.	On-going

Quarrying		No quarrying activity will be undertaken in the quarry	
Public Access		No formal trails, but access to the quarry will be maintained for education and research purposes	On-going

Section 5: Operations within the LMP or aspects of the national forest estate within the LMP that could impact on designated sites adjacent to national forest estate

Operation type / Aspect of forest	Detailed description of issue or operation	Proposed action &/or mitigation	Timing
Mechanised Harvesting	Use of harvester forwarder to undertake programme (as per felling and thinning maps) of thinning and felling	Strict adherence to Forest and Water Guidelines. Sites planned carefully to protect the water environment. Minimal stream crossings and where these are required, pipes must be used. Forest drains disconnected from natural watercourses. Extraction routes maintained. Maintenance of silt traps. Appropriate buffer zones applied to watercourses with no fuelling, storage of oils/fuel/chemical or machine traffic within these zones	Ongoing throughout the plan period
Chemical Application	- application of urea + PG suspension to cut stumps - treated trees - foliar or cut stump application of Glyphosate to Rhododendron	Strict compliance with Forest and Water Guidelines. Pesticides only applied when weather & ground conditions suitable. Chemical storage and mixing outwith buffer areas, chemical waste removed from site and disposed via licenced carrier. Chemical does as per product label. No chemical application within buffer zones.	Ongoing throughout the plan period
Ground Preparation & Drainage	Mechanised cultivation using tracked excavator	Avoid creating linear channels on steep slopes or on fragile soils. Plan adequate buffer zones around water features and incorporate wet flushes and boggy ground in buffers. Identify and redesign old drainage on restock sites. Ensure forest drains are disconnected and do not discharge directly into the natural water environment	Ongoing throughout the plan period
Species Choice and restocking	Establishment of riparian buffers following clearance of conifers and maintenance of buffers. Site suitable broadleaves to be planted or regenerated.	Riparian buffers zones to be established in line with the Forest and Water guidelines to provide dappled shade. These zones will be kept clear from conifers – up to 10% conifers will be accepted.	

Section 6: Appropriate Assessment/s undertaken on work contained within the LMP

Appropriate assessment of forestry proposals which are likely to have a significant effect on a European site under the Conservation of Natural Habitats, &c.) Regulations 1994. Regulation 48.

1. Name of European site affected by the application and current designation status, including name of component SSSI (if relevant).

River Spey Special Area of Conservation (SAC) – includes the River Spey and several tributaries

2. Features of European qualifying interest, whether priority or non-priority; and conservation objectives for qualifying interests.

SAC – qualifying interests

Freshwater Riverine Habitat for the following qualifying interests (non-priority):

1. Atlantic salmon (Salmo salar)
2. Sea lamprey (Petromyzon marinus)
3. Otter (Lutra lutra)
4. Freshwater pearl mussel (Margaritifera margaritifera)

The forests that make up the Teindland LMP area fall within the River Spey catchment and there are several smaller watercourses within the forest area that are tributaries of the River Spey. These watercourses provide habitats for Atlantic salmon and otters. Freshwater pearl mussels and sea lamprey have only been recorded within the main stem of the River Spey. Any activity affecting watercourses has the potential to impact on these 4 species and needs to be considered carefully.

Additional Proposed interests

None.

Conservation objectives for qualifying interests

To avoid deterioration of the habitats of the qualifying species (above) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained

and the site makes an appropriate contribution to achieving favourable conservation status for the qualifying features.

To ensure for the qualifying species that the following are maintained in the long term:

- Population of the species (including range of genetic types for Salmo salar only)as a viable component of the site.
- Distribution of the species within the site.
- Distribution and extent of habitats supporting the species.
- Structure, function and supporting processes of habitats supporting the species.
- No significant disturbance of the species.
- Distribution and viability of the species' host species (for Margaritifera margaritifera and Petromyzon marinus).
- Structure, function and supporting processes of habitats supporting the species' host species (for Margaritifera margaritifera and Petromyzon marinus).

3. Details of proposal.

Name: Teindland LMP — Location: Morayshire
Applicant: Forestry & Land Scotland – East Region, Huntly — Reference: FM1/2/9

Description of proposal:
The restructuring of approximately 1290ha of coniferous forest primarily by clearfell, thinning and replanting, within the catchment of the River Spey, in line with the UK Forestry Standard.

Within the riparian areas of the watercourses in the forest, work will concentrate on the enhancement of the riparian habitat, through the clearance of heavy shading exotic conifers. The trees will be removed during felling and the edges scalloped and feathered at replanting. Dappled shade will be created in these buffers through the acceptance of the regeneration of broadleaves, supplementary planting of broadleaves and an acceptance of up to 10% conifer regeneration – further conifer regeneration will be cleared.

The proposal is in the form of a land management plan, as such reference to the plan maps and text should be made, as they form part of this assessment.

Operations:

- Clearfelling ('one-off' operations within riparian zones)
- Clearfell (outwith riparian zones)
- Thinning (outwith riparian zones)
- Mechanical mounding and drainage (outwith riparian zones)
- Manual planting
- Forest road construction (potentially crossing watercourses)
- Knapsack application of chemicals (outwith riparian buffer as per Forest & Water Guidelines)

4. Appraisal of impact on European interest.

4.1 Is the proposal directly connected with or necessary to the management of the site?
Yes /No (if Yes go to 5.)
No

4.2 Is the proposal likely to have a significant effect on the European interest on the designated site?
Yes/No (if yes assess impact on site)
Yes

Atlantic salmon
Atlantic salmon are present in the River Spey and many of its tributaries, and are very vulnerable to barriers to migration and impacts on the river bed habitats. These could be caused by blockage of watercourses with felling material, pollution of watercourses from machinery or the release of sediment into the watercourses.

Otter
Otters may use the burns and surrounding vegetation for foraging or shelter. As otters are mainly nocturnal in Moray, they should not be disturbed by daytime operations. Holts and resting places could potentially be affected by machinery through the construction of temporary or permanent water crossings. Uncovered holes, equipment and excavations could cause otters to be trapped.

Sea lamprey
Sea lamprey are only present within the River Spey, and not its tributaries. Sea lamprey are most susceptible to barriers to migration and habitat disturbance. This could be caused by blockage of watercourses with felling material, pollution of watercourses from machinery or the release of sediment into the watercourses as a result of harvesting and road building/maintenance operations.

Freshwater pearl mussel
Freshwater pearl mussels have been recorded in the River Spey, but not its tributaries. Mussels could be affected by pollution of watercourses or silt/sediment into watercourses, which could be washed down into the River Spey.

4.3 Summary of assessment in relation to possible impacts

The conservation objectives for the qualifying interests will be met by avoiding deterioration of the habitats for the qualifying species by:

- minimising the possibility of sedimentation and pollution by adherence to operational guidance as described in section 6 ('Conditions Required');
- planning and implementation of all operations with due regard to all relevant forest management environmental guidelines and best practice;
- processing and positioning of felling residues to minimise the potential of these residues entering watercourses during normal flooding / spate events (see also section 6, 'Conditions Required');
- restocking riparian areas by natural regeneration of native wet woodland species such as alder, birch, willow etc.);
- considering the need for small-scale planting of native species where natural regeneration is found to be insufficient.

4.4 Any other comments

4.5 What would be the outcome on the site if the proposal is not approved?

- No immediate significant impact.
- Reduction in aquatic habitat quality over time due to:
- Significant shading of large sections of the watercourse from thickly foliated conifers.
- Acid needle fall into the watercourse from conifers.
- Gradual loss of riparian habitat over sections of the watercourse.

- No fuel or chemical storage or application within 10m of any watercourse
- Direct FCS supervision and planning of all operations
- All operations adjacent to watercourses will be timed to minimise the possibility of siltation (i.e. summer working), accumulation of felling debris and to avoid breeding seasons of key species.

Qualifying interests:

- Otter surveys will be carried out as part of the environmental assessment of sites prior to operations to identify any holts and their status, so any forest operations can be planned to avoid disturbance.
- Plans will be, or have been discussed with the Spey Fisheries Board with regard to any impact on Atlantic Salmon. Further liaison will be undertaken with any works to enhance biodiversity further in riparian zones – placement of large woody debris etc

5. Conclusions.

Will the proposal adversely affect the integrity of the European site?

No.
With reference to the Assessment in section 4 and subject to the Conditions in section 6, the proposal should not have any adverse impact on the integrity of the site.

6. Conditions required (if any).

Operations:

- All operations to comply with the Forest and Water Guidelines and Forests and Soils Guidelines as a minimum.
- No machinery within buffer zones and motor manual felling to be undertaken within riparian zones, where timber cannot be reached by machinery from outwith the buffer zone

Section 7 Approvals, agreements & signatures

I confirm that the above management plan which covers the section of SSSI Teindland Quarry (Site code 1526) within the Land Management Plan "Teindland" contains the necessary detail, content and mitigation measures to comply with the statutory requirements contained within the Nature Conservation (Scotland) Act 2004 and in particular in relation to Part 2, Chapter 1, Section 14 (d), which covers consents via an agreed management plan (i.e. "SNH's consent under section 13 is not required in relation to carrying out an operation of the type described in subsection (1) of that section – .....(d) in accordance with the terms of a management agreement between SNH and the public body or office-holder carrying out the operation").

SNH Signature ..... Date .....

SNH Name .....

SNH Job Title .....

Address.....

Email .....

Contact telephone number .....

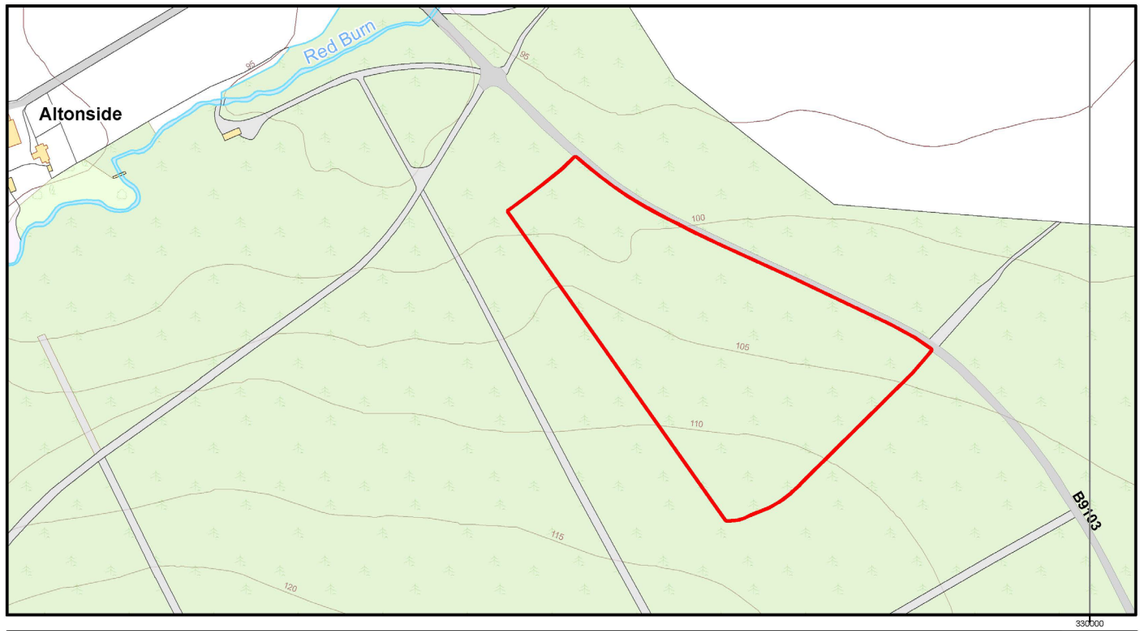
FLS has a corporate requirement under UKWAS (4th edition) to manage all designated sites in accordance with plans approved by the statutory authority, I therefore sign below to approve the contents of this plan in relation to the designated sites Teindland SSSI and River Spey SAC/SSSI that fall within its boundary on the NFE.

SNH Signature ..... Date .....

SNH Name .....

Annex 1

Map highlighting the location of the designated sites in relation to the LMP boundary and the NFE management area.



Annex 2

Teindland quarry
Site of Special Scientific Interest
SITE MANAGEMENT STATEMENT
Site code: 1526

Purpose

This is a public statement prepared by SNH for owners and occupiers of the SSSI. It outlines the reasons it is designated as an SSSI and provides guidance on how its special natural features should be conserved or enhanced. This statement does not affect or form part of the statutory notification and does not remove the need to apply for consent for operations requiring consent.

Description of the site

Teindland Quarry is a key site for interpreting and dating events and environmental change in Scotland during the later part of the Quaternary period. This period began about 2.6 million years ago when global cooling brought about the onset of the Ice Age. During the Ice Age there were many separate glacial events interrupted by warmer episodes (interglacials) when temperatures reached as high as, or above,

those of today. The sequence of deposits in the quarry includes a unique fossil podzol (a type of soil) that formed towards the end of the Last Interglacial (around 120 000 years ago). The soil is developed in outwash gravels deposited at the end of an earlier glaciation. Pollen grains preserved in the soil reveal the presence of pine and alder woodland, followed by heath and grassland. The upper part of the soil has been disturbed by frost-action, which, together with the vegetation changes, indicates a deteriorating climate and the onset of the last glacial period (the Devensian – about 115 000 to 11 500 years ago). The overlying glacial deposits, and related deposits nearby, indicate a complex history of glaciation during the Devensian.

Teindland Quarry is one of only a few sites in Scotland with deposits dating from the Last Interglacial. It is therefore a site of outstanding importance for establishing the history of environmental changes that occurred in Scotland during the Late Quaternary.

A comprehensive description of the site can be found in the Scottish Natural Heritage Earth Science Documentation Series, The Teindland Quarry (MacFadyen 1995). However, note that the scientific interpretation of the deposits in this report is out of date. For an update, see A.M. Hall et al. (1995) Transactions of the Royal Society of Edinburgh: Earth Sciences, 85, 253-273.

Natural Features of Teindland Quarry SSSI	Feature Condition (date monitored)
Quaternary of Scotland	Favourable, maintained (February 1999)

Site condition monitoring was last carried in 1999. The site was in favourable condition. The extent of the exposures and accessibility were being maintained, though some soil had fallen at base of quarry face, but is easily removed if required. The access track and the centre of the quarry were moderately overgrown by a mixture of gorse and broom but this did not seriously impede access.

Past and present management

The site is owned and managed by the Forestry Commission. The quarry exposures lie on the edge of a spruce plantation, but the general area of interest extends within the forested area. The plantation is relatively young and, at some future date, timber is likely to be extracted. The current Conservation Management Plan runs from March 2007 to March 2012. Under this plan, gorse & shrubs are to be removed from quarry face, and saplings and conifers from the crucial area, top edge of faces and from within 10 m of quarry face. In addition, heavy machinery will not operate within 3 m of quarry faces (crucial area) and trees will not to be planted closer than 10 m from quarry faces (crucial area).

Objectives for management (and key factors influencing the condition of natural features)

We wish to work with the owner to protect the site and to maintain and where necessary enhance its features of special interest. SNH aims to carry out site survey, monitoring and research as appropriate, to increase our knowledge and understanding of the site and its natural features.

1. To maintain the sediment exposures within the quarry and access to the site

The main factors affecting the site are those which would damage or obscure the quarry exposures. These are most likely to be natural falls of sediment, removal of sediments, infilling or dumping, forestry operations and growth of vegetation. Natural degeneration results in loose material obscuring the face, but this can easily be removed.

Extraction of minerals would provide fresh faces, but although the important fossil soil may extend beneath the plantation, the quality may not be as good as the exposure already present and its extent is unknown. Infilling, dumping and materials storage could obscure the exposures and make access difficult.

Vegetation growth, especially the more deep-rooting species such as trees and shrubs, is likely to occur over time and may obscure or damage the faces and is likely to require further control.

The exclusion of heavy machinery and planting close to and around the quarry should continue. The quarry should not be used for storage of machinery or materials.

2. To encourage research and interpretation for scientific study, education and public awareness

Date last reviewed: 4 August 2011.

CITATION

TEINDLAND QUARRY
SITE OF SPECIAL SCIENTIFIC INTEREST
Moray

Site code: 1526

NATIONAL GRID REFERENCE: NJ297570
OS 1: 50,000 SHEET NO: Landranger Series 28
OS 1: 25,000 SHEET NO: Explorer Series 424
AREA: 2.52 hectares
NOTIFIED NATURAL FEATURES

Geological : Quaternary geology and geomorphology : Quaternary of Scotland

DESCRIPTION
The Teindland Quarry, located 10 km south-east of Elgin, is a key site for interpreting and dating Quaternary events and environmental change in Scotland.

The sequence of deposits includes a unique fossil podzol (type of soil) that formed towards the end of the Last (Ipswichian) Interglacial (around 120 000 years ago). The soil is developed in outwash gravels associated with an earlier glaciation. The upper part of the soil has been disturbed by frost-related processes and is overlain by younger glacial deposits. Pollen grains preserved in the soil reveal the presence of pine and alder woodland, followed by heath and grassland, indicating a deteriorating climate and the onset of the last glacial period (the Devensian). The overlying glacial deposits, and related deposits nearby, indicate a complex history of glaciation during the Devensian.

Teindland Quarry is one of only a few sites in Scotland with deposits dating from the Last Interglacial. It is therefore a site of outstanding importance for establishing the sequence of events and environmental changes that occurred in Scotland during the Late Quaternary.

NOTIFICATION HISTORY
First notified under the under the 1981 Act: 5 January 1984.
Notification reviewed under the 2004 Act: 4 August 2011.

REMARKS
Measured area corrected (from 2.9 ha).

TEINDLAND QUARRY SITE OF SPECIAL SCIENTIFIC INTEREST
4 August 2011

OPERATIONS REQUIRING CONSENT FROM SCOTTISH NATURAL HERITAGE
If you propose to carry out, or permit to be carried out, any of the operations listed below, you must first obtain consent from SNH unless a local authority has granted you planning permission (under Part III of the Town and Country Planning (Scotland) Act 1997) or a designated regulatory authority has given you written permission (under s.15 of the Nature Conservation (Scotland) Act 2004). If you have such a permission, you may proceed without obtaining consent from SNH for the same operation.

Standard Ref. No.	Type of operation
7	Dumping, spreading or discharge of any materials.
12	Woodland management including planting.
15	Infilling of pit.
20	Extraction of minerals, including sand, gravel and sub-soil.
21	Construction, removal or destruction of roads, tracks, walls, fences, hardstands, banks, ditches or other earthworks, or the laying, maintenance or removal of pipelines and cables, above or below ground.
22	Storage of materials against outcrops of sands and gravels.
23	Erection of permanent or temporary structures, or the undertaking of engineering works, including drilling.
24	Modification of man-made features including battering or grading rock-faces.
26	Use of vehicles or craft within 3m of the quarry face.

Appendix 3: Findlay's Seat experiment enclosures tour notes (1981)

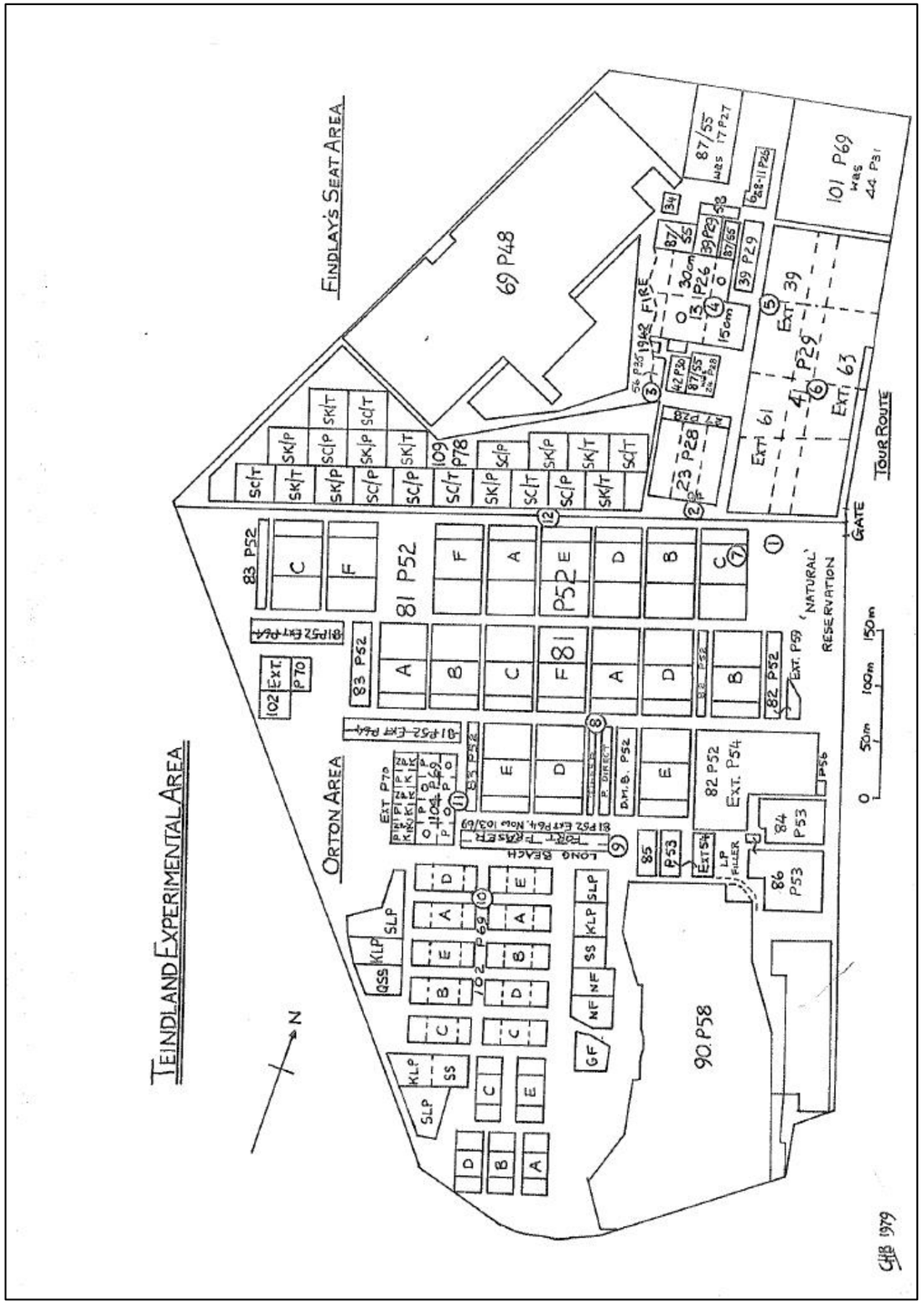
File Teindland General

FORESTRY COMMISSION

TEINDLAND EXPERIMENTAL RESERVE

TOUR NOTES

4/81



Part I

LOCALITY NOTES.

Teindland forest, covers an area of 1214 hectares on the western slopes of the lower Spey valley. The forest lies on the hill shoulder at the point where the Spey valley widens out to the coastal plain. At this point the distance to the Moray Firth is only 13km., so that the plateau which rises to 260m and the north facing slopes suffer fairly severe exposure. Rainfall in the area is approx 750 - 900mm per year.

The underlying rock is conglomerate of the Middle Old Red Sandstone, consisting of well rounded purplish or reddish grey pebbles mainly of quartzite in a matrix of red sandy loam. In many parts of Teindland and the surrounding areas the rock is deeply weathered and can be subject to severe gully erosion on steep slopes.

On the middle slopes of the forest, approximately between the 150 and 200m contours, the bedrock is mantled by glacial till which is very dense and firm (indurated), very stony and of a sandy loam texture. This material gives rise to soils with impeded drainage, both gleys and ironpan soils. On the lower slopes the till also occurs, giving rise to gleys, but in many places it is overlain by a veneer of fluvioglacial sand up to 1m in thickness. The soils here are freely drained podzols.

On the summits such as Findlays Seat experimental area, a drift cover is largely absent and the soils are developed in frost-heaved deeply weathered conglomerate. The main soil type is an ironpan soil with podzol affinities in which a definite but fairly thin indurated layer occurs (the BCx horizon). For detailed description see page 4.

For further details, the following should be consulted:-

MUIR, A.	The soils of Teindland State Forest, Forestry VIII, No.1, 1934.
YEATMAN, C.W.	Tree root development on Upland Heaths. F.C. Bulletin 21, 1955.
ZEHETMAYR, J.W.L.	Afforestation of Upland Heaths. F.C. Bulletin No.32, 1960.
PYATT, D.G.	Physical properties of soils with indurated material. Unpub. Ph.D. thesis available on loan from either Aberdeen University library or Alice Holt Research Station library.

Geo System - ORS
Lithology - conglomerate
Soil - Iron Pan over induration Pan 15-60cm depth
veg - Calluna dominated (Cladonia, trichophorum Sphagnum, Carex, Etc)
Elevation - 240-250m
Rainfall - 760-890mm
Exposure - Severe.

Part II

SUMMARY OF EXPERIMENTAL WORK AND MAIN RESULTS.

The Findlay's Seat area is typical of large areas of heaths which are found principally in the east and north-east of Scotland and England, and offer a great potential for forest use if a satisfactory and economical way can be found to ensure successful afforestation with continued health and growth.

For this reason the first experiments were started here in 1925 when it was recognised from the evidence of the circa P. 1810 Scots pine scrub that the ground was unplantable by normal methods.

Three lines of research were initiated:-

1. Assuming the underlying drift was more fertile than the leached surface, trials of pan breaking, subsoiling and spreading of sub-soil were laid out. These were successful.
2. Assuming pan breakage was not essential a second series testing surface cultivation by hand and plough was begun. This was also successful, but as initial growth was slow, fertilising started at an early stage.
3. An area was set aside for direct sowing trials which however proved abortive.

Results of the heath afforestation experiments at Teindland can therefore be conveniently considered under three heads:-

1. Ground preparation.
2. Species and provenance.
3. Fertilising.

1. Ground preparation.

Soil disturbance is essential for successful establishment, firstly to break up the surface sealing layer of tough peat and allow water to percolate through the soil. Removal of excess water via drains is seldom needed. In fact it is not yet certain that water may not become a limiting factor at a later stage for some species. Secondly soil disturbance is required to aerate the compact subsurface layers, to allow roots to penetrate them and to initiate a slow release of available nutrients, particularly nitrogen, from the inverted vegetation and humus. Most of the earlier experiments illustrating the benefits of even rudimentary hand cultivation at the planting spot were destroyed by fire in 1942, but one example remains in Experiment 41.P.29.

Cultivation experiments progressed in step with the mechanical means at the disposal of the forester, beginning with strengthened agricultural type shallow ploughs (10 - 18 cm) drawn by horses. Then moderately deep ploughs (20 - 28 cm) pulled by wheel and tracked tractors. By about 1950 using specially designed forest ploughs, ploughing had reached depths of 30 - 41 cm. Such ploughing was a great strain on the then equipment and between 1950 and 1960 shallower ploughing with subsoiling became standard practice. Investigation of rooting behaviour revealed that even when trees were planted in the furrow, roots did not readily occupy the subsoiled channel.

Trees planted in the furrow also suffered from basal bowing; this fact and results from earlier experiments led to increased interest in complete ploughing.

Finally the recognition of an indurated layer which impeded both water and root penetration below the ironpan instigated work with the prototype deep tine plough. From 1969 ploughing with this plough, with and without a sub-soiler, was directed to achieving disruption of the induration to depths of 83 - 94cm with a soil turnover to depths of 48 - 58cm.

2. Species.

Scots pine (Pinus sylvestris) is native to the northern upland heaths and has been the natural choice for afforesting these areas and for use as controls in all trials of alternative species. It is exceeded in early height growth by Lodgepole pine (Pinus contorta) under almost all conditions and, once intensive soil cultivation has been undertaken, by Japanese and European larch (Larix kaempferi and Larix decidua). In later life Scots pine can exceed the larches in volume production but will if present indications are a guide produce approximately 25% less volume than Lodgepole pine. In high exposed conditions Scots pine suffers from blast damage.

Lodgepole pine was first used in 1922, but in spite of promising growth in heath conditions, there was early reluctance to use it pure on a large scale because of the uncertainty about its relatively unknown timber qualities. Results of timber tests have been such as to justufy fully its fast increasing use. Until the late 1950's it was used mainly in mixtures to nurse other species, especially Sitka spruce (Picea sitchensis). The provenance of Lodgepole pine is of the utmost importance due to the variation in growth habit of different origins. Coastal provenances from Washington and Oregon grow the faster, those from further north and east more slowly. Associated with the fast early growth of the South coastals is course branching, sabre butts and early instability. At Teindland, inland provenances of much better form grow well, but they are less well adapted to conditions of infertility and exposure. A balance between the extremes is desirable and an answer may be found in hybridisation.

Because Sitka spruce is known to be very productive on many poor sites, and because of its known resistance and good form under conditions of severe exposure, a feature of many heathland forests, much research has gone into the establishment of this species. It has been found that intensive cultivation with good suppression of heather can give successful early initial growth. The rapid revival of heather before the Sitka spruce closes canopy can severely reduce growth or even give a state of complete 'check'. In early years an admixture of a nurse species, especially Japanese larch, was used to assist heather suppression and accelerate nutrient cycling. In recent years with the advent of herbicide treatments it has been possible to plant pure plots of Sitka spruce in the sure knowledge that the heather problem can be eliminated by such means. Experience in older crops suggests that although pole stage crops of Sitka spruce may be satisfactorily achieved, there is some doubt about continued health and vigour in areas where rainfall is much below 1000mm per annum, unless it is growing in moisture receiving hollows or regions of high atmospheric humidity. The hope that modern deeper cultivation methods will offset this, has yet to be proved.

3. Fertilising

The earliest trials showed that phosphatic fertiliser (basic slag) was beneficial on most heaths and that the effect varied with the species, being most marked with larches but also worth while with the other major species.

Thereafter experiments were designed to compare various types of phosphatic fertiliser and to develop a technique of application, latterly to quantify the benefits from the various rates.

Of the other nutrients only Nitrogen has given marked response, but with existing materials only a short term effect is produced. Trials with potash and trace elements have given no improvement in growth. Foliar analysis is now used as a means of diagnosing nutrient deficiencies.

DETAILED SOIL DESCRIPTION.

STOP 1. Soil pit - Ironpan soil, podzol derivation.
Parent material - frost heaved, rather deeply weathered bedrock. Not transported. Middle Old Red Sandstone.
Vegetation - Calluna (d), Cladonia (a), Trichophorum (f), Sphagnum (f), Carex (a), Erica tetralix (o).

Typical soil profile.

Horizon	Thickness cm	Colour & mottling	Stoniness	Texture	Structure	Consistence
Ol	2	Lichen and heather litter				
Of	4	Dark reddish brown fibrous material				
Oh	10	Black amorphous peat, shrinking to blocky structure when dry				
E	5	Pale brown, abundant white bleached grains	Extremely stony pavement, angular quartzite	S.L.	probably structureless	friable
Bh	10	Black humus coatings in yellow/brown material	Mod. stony	SL - L	Mod.platy	friable
Eg	7	Pale olive. Brown humus in dead root channels	Mod. stony	SL - L	Mod.platy	firm
Bi	2-4 mm	Strong continuous ironpan, undulating through about 15cm. Can drop to 60cm engulfing C horizon material.				
BCx	18	Reddish/yellow down to weak red	Very stony, angular/rounded Silt cappings	L	Strongly platy	friable to firm. very fi & brittle
C(x) to C	120 +	Weak red	Extremely stony. Rounded quartzite Silt cappings	L.S.	Weakly platy.	Friable to firm. Very fragile.

Part III

DETAILS OF THE EXPERIMENTS TO BE SEEN ON TOUR.

Stop 2. Experiment 23.P.28.

Trial of species on shallow complete ploughing (15cm) with and without basic slag. Rate of slag sufficient to give approx 100kg P/ha.

The effects of mixing of species and of phosphate are striking. Plot interaction due to small plot size - no further assessments. The slagged SS is currently the fastest growing species.

Dominant height (m) - 600 trees/ha at 35 years.

Species	No slag	Slag	Difference
Pure SP	6.7	8.8	2.1
NS	failed	4.7	-
SS	5.1	10.2	5.1
Mixed LP)	9.1	9.3	0.2
NS)	failed	5.4	-
Mixed MP)	5.9	7.2	1.3
NS)	failed	5.6	-
Mixed LP)	9.6	10.0	0.4
SS)	failed	9.2	-
Mixed MP)	5.3	6.5	1.2
SS)	failed	8.8	-

Stop 3. Experiment 56.P.35.

Turf planted Japanese larch - with phosphate. A small remnant which survived the fire in 1942. Illustrates the potential of JL with only rudimentary cultivation.

Stop 4. Experiment 13.P.26.

Designed to test the effect of different surface drainage intensities on the growth of Scots pine. No fertilisers applied.

Treatments: Control - no drains
15 - 15cm drains at 4.9m spacing.
30 - 30cm drains at 4.9m spacing.

Five wells opened in each plot to a depth of 60cm. Water level assessed every two weeks during 1951 and 1952. Survival, height and water results are:

Treatment	Survival %	Dominant ht @ 40yrs	Height increment 35-40yrs	Mean depth of wells 1951 (cm)	1952
Control	75	3.3m	0.95m	25	28
15	92	7.2m	1.45m	30	30
30	93	8.7m	0.90m	52	52

Depth to surface wate

The conclusions to be reached here are that growth is improved by breaking the surface peat, but the drainage response has diminished with time.

1979 Assessment.

	Dom. Ht.	Top Ht.	LYC.	GYC
Control	6.34	-	-	-
15	11.13	10.4	5	4
30	12.62	12.6	6	4

Control has grown as much in the last 12 years as the previous 40, reflecting plot interaction - shelter, drainage etc.. 15 cm drains. Still unthinned. Over 10 years, from 1956-66 grew faster than 30 cm drains, rates have since equalised. 30 cm drains. Thinned 1970.

Stop 5. Experiment 41.P.29. Extension P.39.

Theintroduction of other species in mixture between the original ploughed strips planted in 1929 with Lodgepole pine. Introductions were LP, SS, DF, WH, Beech and Grey alder, The unploughed ground (3m strips) between the established LP was completely ploughed and planted with 2 rows of the introduction @ 1.2 x 1.2m spacing. Allintroductions fertilised with 85g G.M.P. equivalent to 73kg P/ha. By 1964 all the introductions had failed with the exception of the WH and a few LP. The pioneer LP was then 10.9m tall, the introduced WH 9.1m even though 10 years younger.

Stop 6. Experiment 41.P.29.

Designed to test three planting treatments with and without basic slag. Treatments not replicated and the whole planted with LP. (Alberta origin). Results:

Treatment	Dom.Ht.25yrs Control	Slag	Top Ht.41yrs. Control	Slag
A. Ploughed at 3m intervals in 3m bands Planted in spaced groups	5.3	7.0	not assessed	
B. Not ploughed Planted on mounds at 1.5 x 0.9m	6.1	7.2	not assessed	
C. Ploughed at 1.5m intervals in 3 furrow bands Planted at 1.5 x 0.9m in the centre furrow	6.4	7.7	12.1	13.4

Volume plots in Treatment C have supplied the following basal area data:

m^2/ha

Treatment	27 yrs	30 yrs	33 yrs	41 yrs
No phosphate	29.2	34.2	37.7	49.0
phosphate	43.6	49.4	52.9	70.0
Effect of phosphate %	+ 50	+ 44	+ 40	+ 43
Effect of phosphate % on 100 largest trees	+ 7	+ 14	+ 13	not done

The above data shows:-
a) Initial phosphate improved both height and basal area in the early years, (probably only about 15) thereafter the difference was only maintained.
b) Additional growth was concentrated on the middle size classes and NOT on the biggest trees.

Experiment 41.P.29. Extension 1963.

In 1963 at 34 years old phosphate was re-applied to certain plots. This had an immediate effect on foliage nutrient levels and basal area increment has shown a steady improvement since then. Potash was applied in 1970 and Nitrogen in 1973 to certain plots. Assessments are still being done to evaluate the effect of these later top dressings. The onset of windthrow is making results difficult to interpret.

Stop 7. Experiment 81.P.52.

A comparison of 6 types and intensities of ploughing on the growth of Scots pine and lodgepole pine mixed with Japanese larch. Subsidiary plots of SS, NS, DF and WH nursed by JL.
Fertiliser application of 42g per plant of C.M.P. (Approx 28kg P/ha).
3 randomised blocks of 6 plough treatments split for species.
Ploughing treatments, average depths, volumes of disturbed spoil, and % of windloosening relative to planting position are given below.
On single furrow treatments (A & B) planting position was the bottom of the furrow on the side nearest the ridge.

Treatment	Average depth of ploughing cm.	Volume of disturbed soil m^3	% LP wind loosened 1960
A. Deep single furrow at 1.4m.	30	0.19	37.1
B. Tine single furrow at 1.4m.	42	0.22	30.7
C. Shallow complete	17	0.31	5.7
D. Shallow complete + subsoiling to 43cm	19(43)	0.43	8.1
E. Deep complete	33	0.70	6.2
F. Deep complete + rototilling	31	0.68	10.6

The effect of planting on complete ploughing compared to furrow bottom planting on spaced ploughing is quite clearly reducing windsway in the early years.

Results for the first 15 years showed:-
a) Survival over 95% for all species in all treatments.
b) Highly significant differences in height between spaced furrow and deep complete, still widening at 15 years in favour of the latter.
c) Poorer growth in treatment F compared to treatment E is ascribed to the faster reinvasion of heather on the rototilled surface.

The 20 year assessment showed the following:-

Treatment	Top height m.			Mean height m.				Basal Area m^2/ha				Est.vol.m^3/ha	
	SP	LP	JL	SS	NS	DF	WH	SP	LP/JL	SS	WH	SP	LP/JL
A	6.2	7.4	8.0	2.2	1.4	2.8	4.6	-	31.8	-	8.1	-	-
B	6.1	7.8	8.5	5.5	2.8	4.0	4.6	23.0	32.6	14.1	7.9	50	94
C	6.4	8.1	8.5	6.8	3.7	3.4	5.9	24.0	35.9	18.8	11.9	56	104
D	6.5	8.1	8.3	5.7	2.8	3.2	5.7	-	33.0	16.6	11.4	-	-
E	6.7	8.2	8.6	7.6	4.4	4.1	6.5	27.9	36.4	23.9	13.4	69	117
F	6.7	7.9	8.2	7.1	3.8	3.8	5.8	-	36.4	21.8	12.5	-	-

Those figures suggest the site is capable of yielding the following Yield classes: JL - 6, SP - 8, LP - 10, WH - 12, SS - 14.

Comparison of growth rates show that though complete ploughing is still significantly better than spaced furrow ploughing, the latter is catching up in height growth in all species except spruce. This may be attributable to temporary factors e.g.
a) Closure of canopy with subsequent growth surge. (later in spaced furrow and will be a levelling off at the next assessment).
b) Shelter effect from the surrounding taller plots.
c) The complete ploughed plots may be suffering from an induced water deficit which restricts development during the growing season. (different thinning regimes will give the answer if this hypothesis is correct).
d) Competition for available nutrients. (If this is so thinning will again show differences). Top dressing of PK at 18 years though showing increase in foliage nutrients did not appear to affect growth rates.

One very important fact is that the experiment has proved that Sitka spruce will grow vigorously on dry heathland ta at least 20 years of age. Modern silvicultural methods can supplant the more laborious nursing techniques used here.

Current research.

Investigations into possible reasons for the decline of the deep complete ploughing due to water availability are being done:
a) Water shortage. More rapid mineralisation of organic matter occurs as a result of complete ploughing, thereby reducing soil moisture retention capacity.
b) Water logging. The ironpan was largely undisturbed in the deep complete plots and periodic water logging may occur, but observations of bore holes and tensiometers in two winters (1973/74 and 1974/75) suggest that winter water logging is unlikely to occur for sighificant periods in most years beneath pole stage canopies.

25 year assessment.

December 1977

Treatment	Top height m					Basal Area m^2/ha				Est.volume m^3/ha			
	SP	LP	JL	SS	WH	SP	LP/JL	SS	WH	SP	LP/JL	NS	WH
A	8.5	10.1	10.3	-	8.4	36.2	41.8	-	11.4	139	166	-	43
B	8.5	10.0	10.4	10.3	8.5	34.2	42.7	19.2	13.9	107	169	82	42
C	8.8	10.5	10.4	11.0	9.3	35.1	44.6	23.9	15.8	115	135	109	67
D	8.9	10.7	10.0	10.3	8.9	34.3	43.6	22.2	15.0	112	131	95	61
E	8.8	10.6	10.6	11.4	9.2	38.3	45.0	29.7	17.4	128	191	141	77
F	9.0	10.5	10.5	11.2	8.7	39.4	45.2	27.3	15.1	131	139	127	63

The SS in treatment A and all the DF and NS are classed as failed.

Examination of the above table shows that the shallow complete treatments (C & D) are from -1 to + 39% better than spaced ploughing (A & B) for Basal area and 5 to 49% better for estimated volume.
Similarly the deep complete treatments (E & F) are better by 10 to 50% for Basal area and 20 to 65% for estimated volume than the spaced treatments.
Despite the closing height differences, the better basal area in the deep complete plots keeps them ahead. The more responsive species ie. SS and WH show the differences better than the less responsive species.

STOP 8 Experiment 81 1982.

Comparison of growth between no cultivation with phosphate and deep complete cultivation with phosphate, (Treatment E).

STOP 9 Shelterbelt P64.

Comparison of two provenances of Lodgepole pine. A South coastal from Long Beach, Washington - Latitude 46° 20' N, a Central interior from Fort Fraser, British Columbia - Latitude 54° 2' N. Teindland research area is Latitude 57° 34', the equivalent to SW Alaska.

STOP 10 Experiment 102 P69.

Post war experiments on cultivation have shown a progressive response to the intensity of cultivation. This experiment brings in the era of modern DEEP cultivation. Because of the high costs of such treatment more productive species must be grown. Sitka spruce can be tried in the knowledge that protection from 'Calluna check' can be afforded by either Scots pine nursing or by herbicide.

The objects of the experiment are to compare the effects of a range of cultivations on growth and stability. To compare the growth and yield of Sitka spruce nursed by Scots pine, Sitka spruce pure and Lodgepole pine pure. Finally to compare the optimum form and intensity of soil cultivation for forest use. A randomised block design with three replications was used, treatment plots split for species, basal fertilizer at the current standard rate of 375kg rock phosphate/ha, equivalent to 50kg P/ha. Filler species are planted in plots round the edge of the experiment using. SLP, KLP, QSS, NF and GF.

Treatments	Tine penetration depths cm	Plough share turnover depths cm	Cultivation cost relativities
A. Standard tine	59	40	100
B. Standard tine + deep ripping in line	71	43	194
C. Standard tine + deep ripping at right angles	67	42	201
D. Deep tine	88	52	238
E. Deep tine + deep ripping at right angles	90	55	340

Blackgame and seagull damage have been very severe in the early years so the early assessment data is somewhat unreliable in relation to undamaged areas. Assessments of vegetation re-invasion were done and the data from this is as follows:

Treatment	Cover % @ 3 years		Cover % @ 5 years	
	All vegetation	calluna	All vegetation	calluna
A	26	8	48	31
B	36	5	55	23
C	45	5	51	21
D	23	6	45	23
E	21	3	45	16

JAN.1979 Treatments to date.

Main Expt.	QSS (Pure)	QSS/SP (Mixture)	KLP (Pure)
1969 @ planting	P50	P50	P50
1973	2,4-D	-	-
1975	P50/2,4-D	P50/N150	-
1976	2,4-D	-	-
1978	-	N150	-
1979	N150	-	-

At 6 yrs heights of pine seriously affected by blackgame damage.

Foliage analysis in 1976 showed that N levels of SS pure were low in all treatments (P and K were high). In 1977 N levels were very low in the SS in mixture (P and K were high). Hence N has been applied to all SS - mixed in '78, pure in '79.

		6yr Mean ht (m)	10yr Mean ht (m)	PYC at 10yrs
SS pure	A	1.18	2.49	16
	B	1.32	3.18	20
	C	1.30	3.11	20
	D	1.25	2.76	16
	E	1.20	2.77	16
mean		1.25	2.86	18
SS in mixture	A	1.11	2.61	16
	B	1.29	3.11	20
	C	1.23	3.00	18
	D	1.23	2.83	18
	E	1.15	2.85	18
mean		1.20	2.88	18
SP in mixture	A	1.03	2.68	10
	B	0.77	2.28	8
	C	0.75	2.08	8
	D	0.93	2.53	10
	E	1.00	2.70	10
mean		0.90	2.46	10
LP pure	A	0.79	2.37	10
	B	0.91	2.60	10
	C	0.83	2.50	10
	D	0.78	2.44	10
	E	0.91	2.61	10
mean		0.85	2.50	10

PYC = provisional yield class

SS mean heights at 10 yrs. showed no significant differences between treatments or blocks or between pure and mixed split plot means.

Stop 11. Experiment 104 P.69.

Experiment 102, the adjacent cultivation experiment was phosphated at planting because the site is known to be responsive to phosphate application. However it is not known whether the deep complete cultivation as practised now will affect nutrient availability in the early years. It may well be that phosphate application could be postponed for some years, the saving in cost being offset against the increased ploughing costs. This experiment is to test the response of Sitka spruce to phosphate and no phosphate at planting on the modern type deep cultivation. Fertiliser was Unground Rock Phosphate at 375kg/ha, equivalent to 50kg P/ha. Design four randomised blocks. Subsequently the plots were split for the application of 2,4-D applied in July 1973 at 7 litres/ha.

1979 -

Treatment to Date.

Date of Application	Treatments			
	OPN	OPH	PPN	PPH
1969	-	-	P 50	P 50
1973	-	2,4-D	-	2,4-D
1975	N 160/P 50	P 50/2,4-D	N 160/P 50	P 50/2,4-D
1976	-	2,4-D	-	2,4-D
1978	N 150	-	N 150	-
1980	-	-	-	N 150

Results

Mean Ht.(m) at 6 and 10 years.

			Increment	% Increment	
	6 years	10 years	6-10	6-10	PYC
O-P-N	0.68	1.73	1.05	154	12
O-P-2,4-D	0.70	1.95	1.25	179	12
P-P-N	1.04	2.33	1.29	124	14
P-P-2,4-D	1.23	2.61	1.38	112	16

Best treatment for height and PYC is P-P-2,4-D, poorest is O-P-N, but O treatments show greatest % increase over 6-10 years period.

Stop 12. Experiment 109 P.78

There are indications from earlier experiments that South Coastal LP produced in containers will grow with less basal sweep than conventional transplant stock. The objects of this experiment are:- 1. To compare basal sweep, height growth, root formation and survival of paper pot with 1+1 transplant stock of 2 provenances of LP - South coastal and Skeena River. 2. To compare growth rates of paper pot stock and transplants over a long period and 3. To compare long term stability of paper pots and transplants.

Results

Survival after one year is 100 % in transplants and 98 % in paper pots.

Dec.'80

3 year Assessment. Pots have improved lean and bend in SK and SC, but have not improved SC to the standard of SKT or SKP.
1980 Increment SKT - 24.94 cm, SKP - 18.78, SCT - 27.54, SCP - 19.28.

11

Appendix 4 - Peatland Restoration Plan

The purpose of this Appendix is to provide supplementary information to support the EIA screening determination (see section A.) for deforestation in the Teindland LMP submission for the purpose of initiating peatland restoration within the Teindland LMP area. This includes a description of the conservation importance and potential for furthering this through restoration and a plan for the restoration operations, on-going maintenance and monitoring.

This Appendix demonstrates alignment with the following key Scottish Government and Scottish Forestry and practice:

Forestry Commission Scotland (2009). Scottish Government's policy on control of woodland removal: implementation guidance: Annex 3 woodland removal without the requirement for compensatory planting
Forestry Commission Scotland (2015). Deciding future management operations for afforested deep peatland
Forest Research (2000). Forests and Peatland Habitats
Forestry Commission (2017). UK Forestry Standard
Scottish Government (2015). Biodiversity Strategy: Route Map to 2020

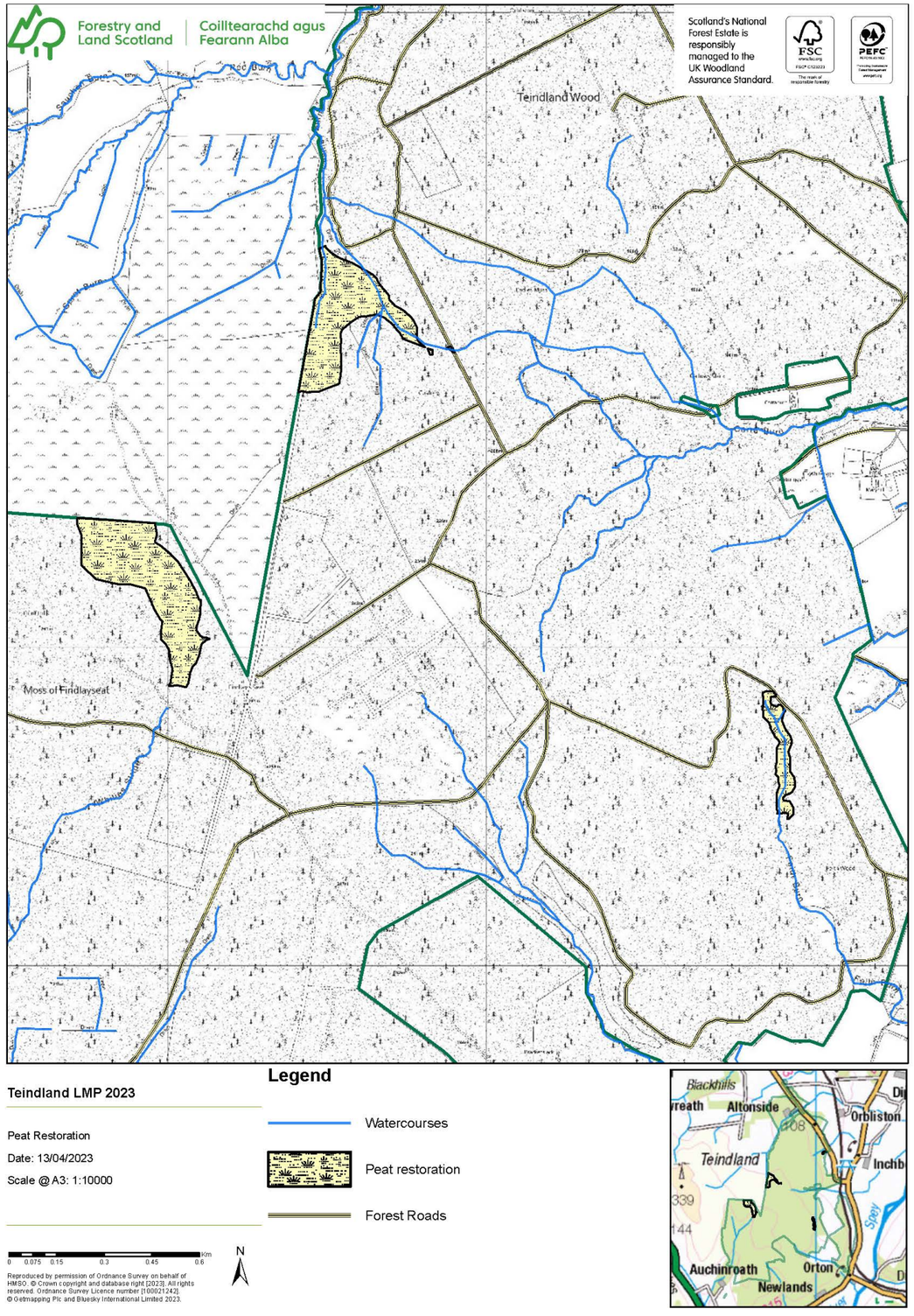


Figure 1: extent of the planned peat restoration activities within the Teindland LMP area.

Long term vision

The long term vision for the areas of peatland identified in Teindland is to restore these afforested peat sites to priority habitat blanket bog, securing the carbon source and protecting existing areas of blanket bog. Key peat-forming species, such as sphagnum mosses and cotton grass, become the dominant ground flora, and wildlife thrives in this priority habitat. Upland heath, smaller areas of native woodland and peatland edge woodland compliment this habitat and further increase the biodiversity value of the area.

Management objectives

1. Systematically restore the deep peat areas to a functioning peatland system which will act as a long term carbon store and increase its value for biodiversity and water quality.
2. Produce timber products from the current conifer crop while balancing this with the primary objective of peatland habitat restoration.
3. Protect the existing bog habitat, future peatland areas and upland heath areas, by the control of regeneration of non-native conifers.

Critical success factors

- Utilise appropriate harvesting techniques to minimise ground impacts and so protect to the carbon storage potential of the blanket bog habitat.
- Where practical realise the biomass potential of all scrub and harvesting waste, leaving as clean a site as possible to help facilitate peatland restoration.
- Minimise road or track construction and utilise low impact forwarding track methods to minimise surface damage.
- Apply current best practice and expertise in peatland restoration operations and use suitably experienced contractors with the appropriate machinery.
- Maintain a level of deer browsing conducive to regeneration of native species.

Management of afforested deep peat

Summary

There are existing areas of Blanket Bog which have been identified through survey that are listed on the Scottish Biodiversity List and the UK BAP as Priority Habitats. Therefore the sites are a priority for restoration on ecological grounds.

Afforestation is listed as one of the key threats to Blanket Bog and Upland Heath having a significant impact on their conservation status at a national level (Control of Woodland Removal Policy – Annex 3: woodland removal without a requirement for compensatory planting).

Restoration of Blanket Bog is a key action of the Scottish Biodiversity Strategy. FLS as a Scottish Government agency has a duty to further the protection and enhancement of these habitats under the Nature Conservation Scotland Act (2004).

The areas to be restored to blanket bog within Teindland will connect to adjacent open moorland and bog habitat and form a network with riparian corridors and peatland edge woodland.

Remnant bog vegetation is abundant on rides and open areas within the Findlay's seat and Cushley areas of Teindland indicating good potential for restoration.

Forest-to-bog restoration techniques have advanced over the last few years and FLS is regarded as one of the leading organisations in developing best practice and delivering positive restoration programmes. Using current best practice we anticipate a more rapid recovery of the water table and successful establishment of bog vegetation on restoration sites than has been experienced previously.

Existing 1st and 2nd rotation tree crops on deep peat in Teindland are showing signs of poor growth and survey has identified some good examples of existing blanket bog.

Recent advances in restoration techniques indicates that the site has very good potential for restoration thus turning this carbon source into a moderate carbon sink with long term secure carbon storage.

FLS approach to peatland management

Restoration of blanket bogs and lowland raised bogs is a key action from the Scottish Biodiversity Strategy, both habitats are included on the Scottish Biodiversity List. Beyond its value as a carbon store, peatlands contain a huge diversity of organisms. Planting trees on peat leads to a fundamental change in the ecosystem[1].

FLS's approach to peatland management is different to the rest of the forest industry. FLS's objectives and legislative framework has an added dimension. Being a Scottish Government agency, FLS has an added 'Biodiversity Duty', as stated in the Nature Conservation Scotland Act (2004). Protection of conservation values is required as part of UKWAS certification and principles of sustainability are required under the UKFS. This means that for afforested peatlands restoration is considered before deciding if replanting is appropriate.

This is set out in Making future management decisions of afforested peatlands Practice Guide. This practice guide outlines how to manage afforested peatlands that are not going to be restored for biodiversity reasons. It states that replanting must be justified by considering if the crop will achieve YC 8 or more for Sitka Spruce. The default is to not replant unless there is evidence it will achieve a good growth rate of harvestable timber. If YC 8 or above is not achievable then restocking peatlands is unsustainable. A slow growing crop will not result in a profit, it will be acting as a carbon source thus contributing to climate change and so society would be disadvantaged or threatened based on current scientific information.

The restoration potential of the identified areas in Teindland is considered to be moderate to high due to the very wet ground conditions and abundant remnant bog vegetation that persists in rides and other

[1] Payne et al., 2018: The future of peatland forestry in Scotland : balancing economics, carbon and biodiversity. Scottish Forestry. pp. 34-40.

open areas especially where planted conifers have gone into check. FLS are committed to a long-term restoration programme of Blanket Bog and Upland Heath priority habitats.

Objectives for the restoration of the Teindland sites are:

- Expand the area of peatland habitat by applying restoration treatments, restoring it to a functioning peatland within 30 years.
- Protect the storage of carbon within the soil (peats).
- Maximise the sequestration of carbon by the peatland in the future.
- Improve the water quality leaving the site and help regulate its flow.
- Monitor the impacts of treatments on the water quality to establish if it been improved over the long term.

The following tables present current and future management of afforested peatlands for the Teindland forest block. Set out in Making future management decisions of afforested peatlands Practice Guide are three Scenarios detailing peat types, characteristic habitat and vegetation. For the purpose of the tables below, Scenario A peat types are considered as 'presumption to restore' peatlands and Scenario B and C peat types are considered as 'assessed peatlands'.

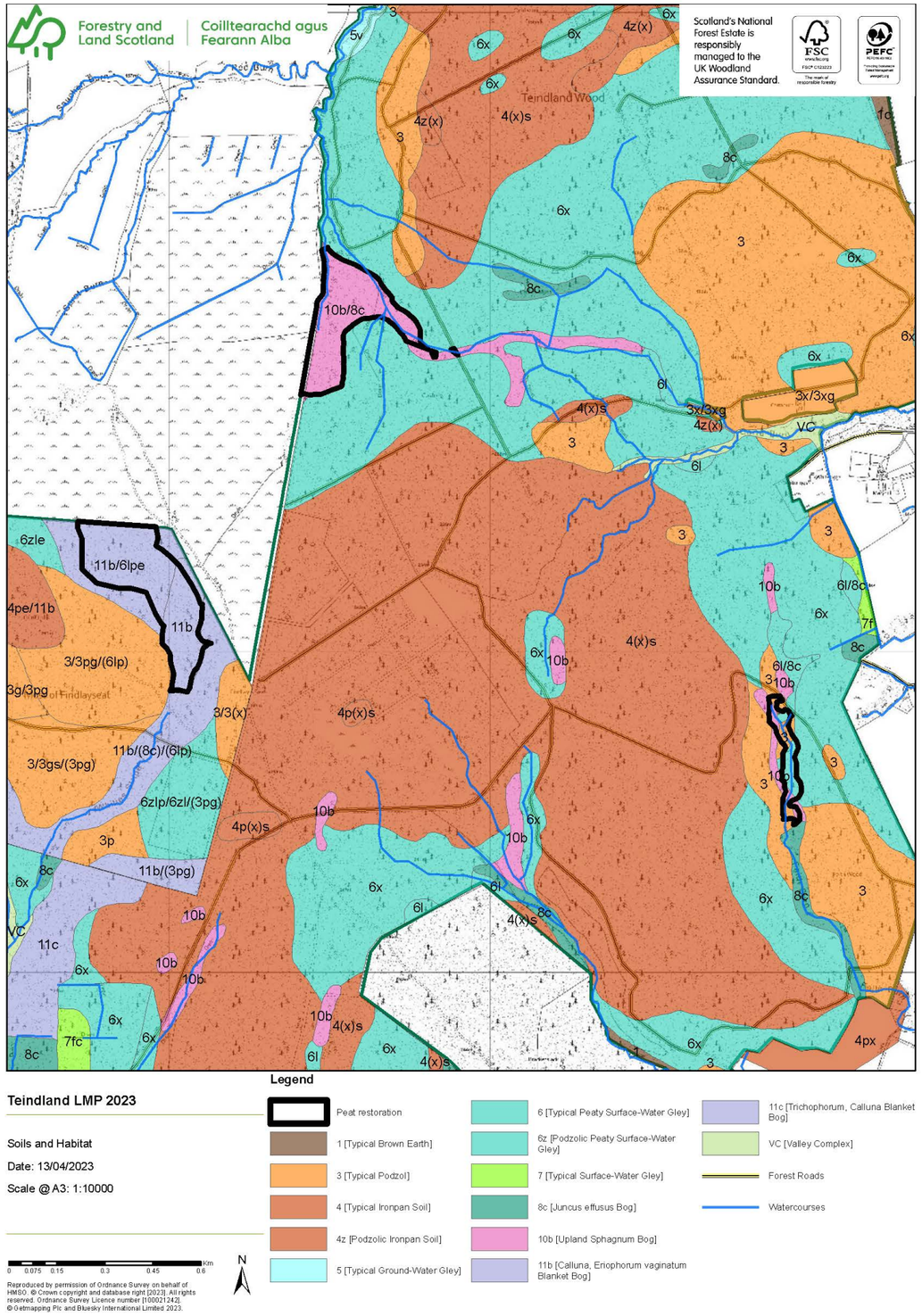


Figure 2: habitats and soil types found in Teindland.

Table 1: summary current management of peatlands in the LMP.

Current management of peatlands in the LMP	Hectares (ha)	Comments
Afforested deep peatland	77.0	Total area size of afforested peatlands based on analysis of aerial images and site surveys.
Existing open habitat on deep peat	15.8	Total area of open peatland (ha).
TOTAL - All deep peat soils	92.8	Total area size (ha) of deep peat soils within the forest block area based on the soils data. Deep peat soils are defined as per the SF Practice Guide: Scenario A, B and C soils. Presence of peat soils confirmed via peat surveys.

Table 2: summary of future management of afforested peatlands within this plan period.

Future management of afforested peatlands	Hectares (ha)	Comments
'Presumption to restore' peatlands. Forest-to-bog restoration of afforested peatlands including the hydrological catchment	9.1	Only includes afforested peatlands which lie next to open existing peatlands, or Scenario A peatland types, as per the SF Practice Guide. The area of their hydrological units is also included (Figure 3).
'Assessed' peatlands. Forest-to-bog restoration to secure carbon store and sequestration, and maximize ecosystem services.	9.0	Only includes Scenario B and C peatland types, as per the SF Practice Guide. Total area of afforested peatlands that will be restored following an assessment of predicted growth (YC). This is where no evidence found to support the conclusion that the next rotation stand would grow Sitka spruce YC8 or more with minimal disturbance and low level of peatland modifications. The areas of the hydrological units are also included.
Peatland to be restocked	3.9	Total area of afforested peatlands that will be restocked because evidence was found to support the conclusion that the second rotation will clearly be YC8 or more with minimal disturbance and with a low level of peatland modifications.

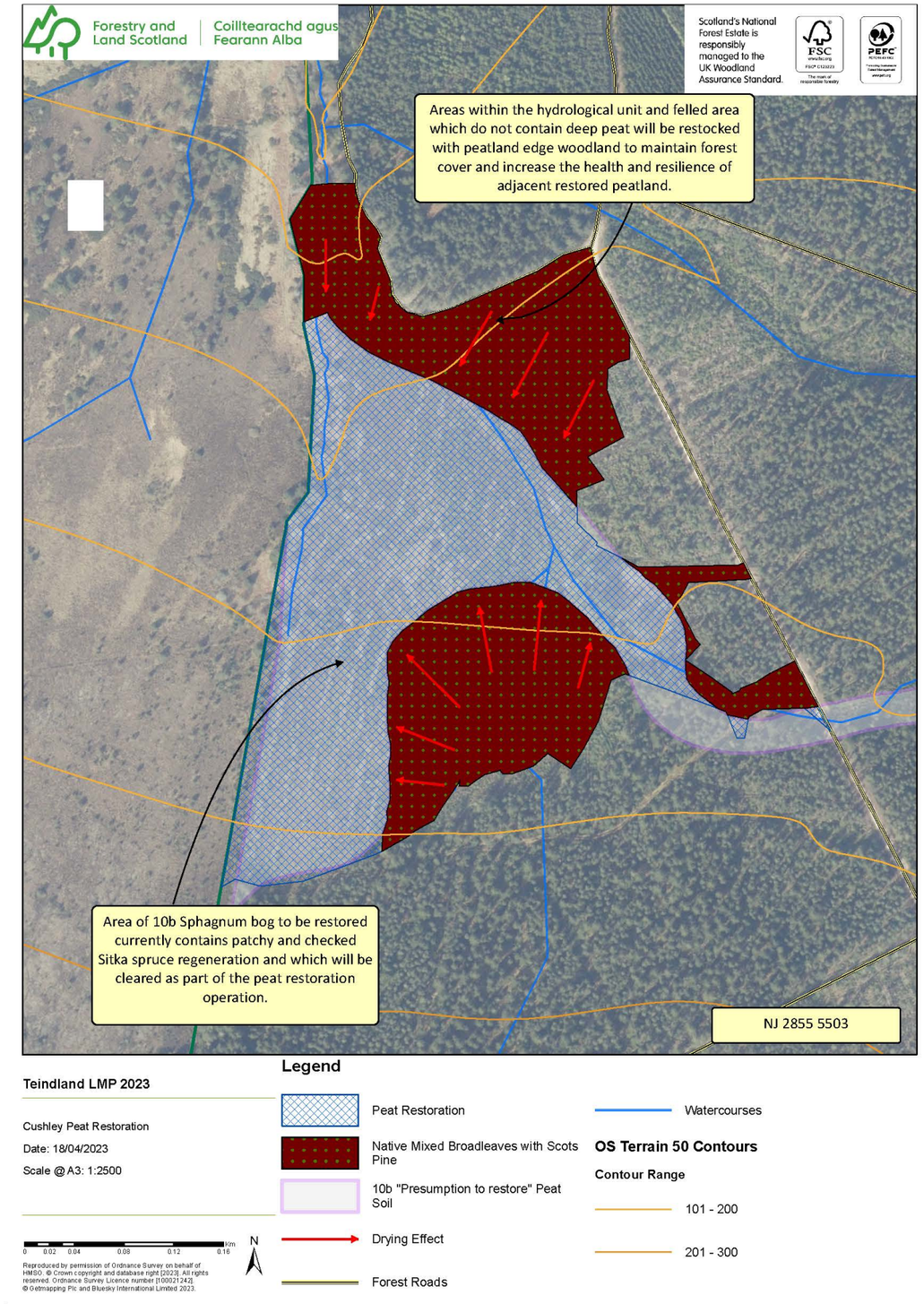


Figure 3.1: location of 'presumption to restore' peatland restoration at Cushley, demonstrating forest-to-bog restorations (7.4ha) and surrounding peatland edge woodland restock (5.8ha).

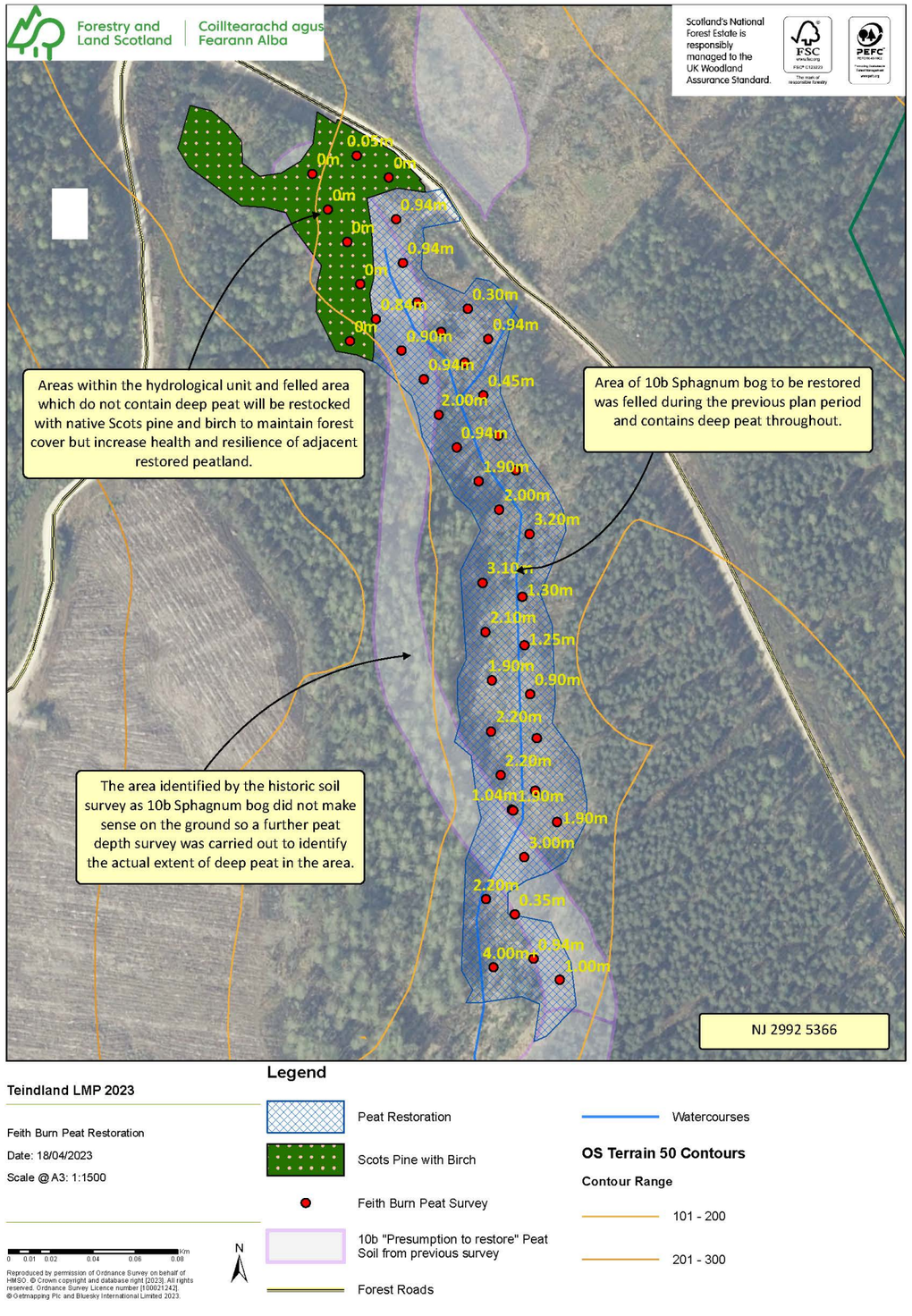


Figure 25.2: location of 'presumption to restore' peatland restoration at Feith Burn, demonstrating forest-to-bog restorations (1.7ha) and surrounding native Scots pine woodland restock (0.5ha).

Table 3: Presumption to restore, description of key features. Only relevant for Presumption to Restore peatlands (Scenario A peat types) where deforestation would prevent the significant net release of greenhouse gases.

	Description	Location of described attribute
Description of any designated sites, priority peatland habitats needing to be protected and enhanced.	Cushley: An area of Upland Sphagnum Bog. Feith Burn: An area of Upland Sphagnum Bog.	Illustrated by Figure 2 (habitat and soils) and 25.2 (Feith Burn presumption to restore)
Description of the Scenario peat types present to be restored in this plan and any characteristics of interest.	Cushley: 10b Upland Sphagnum bog covers entire forest to bog restoration area. (7.4ha) Feith Burn: 10b Upland Sphagnum bog covers entire forest to bog restoration area. (1.7ha)	Illustrated by Figure 2 (habitat and soils) and 25.2 (Feith Burn presumption to restore)
Description of hydrological units, extent, relation to peatlands to be restored and the topography.	Cushley: The Upland Sphagnum Bog exists in a gently sloping to flat area downhill from the high point in the forest block. The area to be restored was felled around 10 years ago and left open. It has since regenerated with patchy coverage of checked Sitka spruce with a small component of lodgepole pine. There are drains present which are currently dropping the water table slightly. All drains and ploughing ruts have sphagnum moss present and appear to be permanently wet, indicating that forest-to-bog restoration has a high likelihood of success. Feith Burn: The Upland Sphagnum Bog exists in a gently sloping gulley between two areas of mixed commercial conifer crop. The area to be restored was felled around 12 years ago. It has since regenerated with patchy coverage of larch and Sitka spruce with a small component of Norway spruce, all regen is currently under 1 meter high and demonstrating signs of check. There is a single drain cut through the flushed peat area which is full of Sphagnum moss, indicating that if the water table was raised slightly,	Illustrated by Figure 3.1 (Cushley presumption to restore) and 25.2 (Feith Burn presumption to restore)

	Description	Location of described attribute
	restoration to a functioning peat habitat has a high likelihood of success.	
State any points of note from survey	The area of 10b Upland Sphagnum Bog found at Feith Burn did not match the are identified and mapped as part of a previous soil survey. A further survey of the area to be restored was carried out to correctly map the extent of the deep peat present.	Illustrated by Figure 25.2 (Feith Burn presumption to restore)

Image 1: Previously felled area at Findlayseat showing high water table and Sphagnum bog

Image 2: Afforested area showing extremely poor growth in 45 year old Sitka spruce crop.

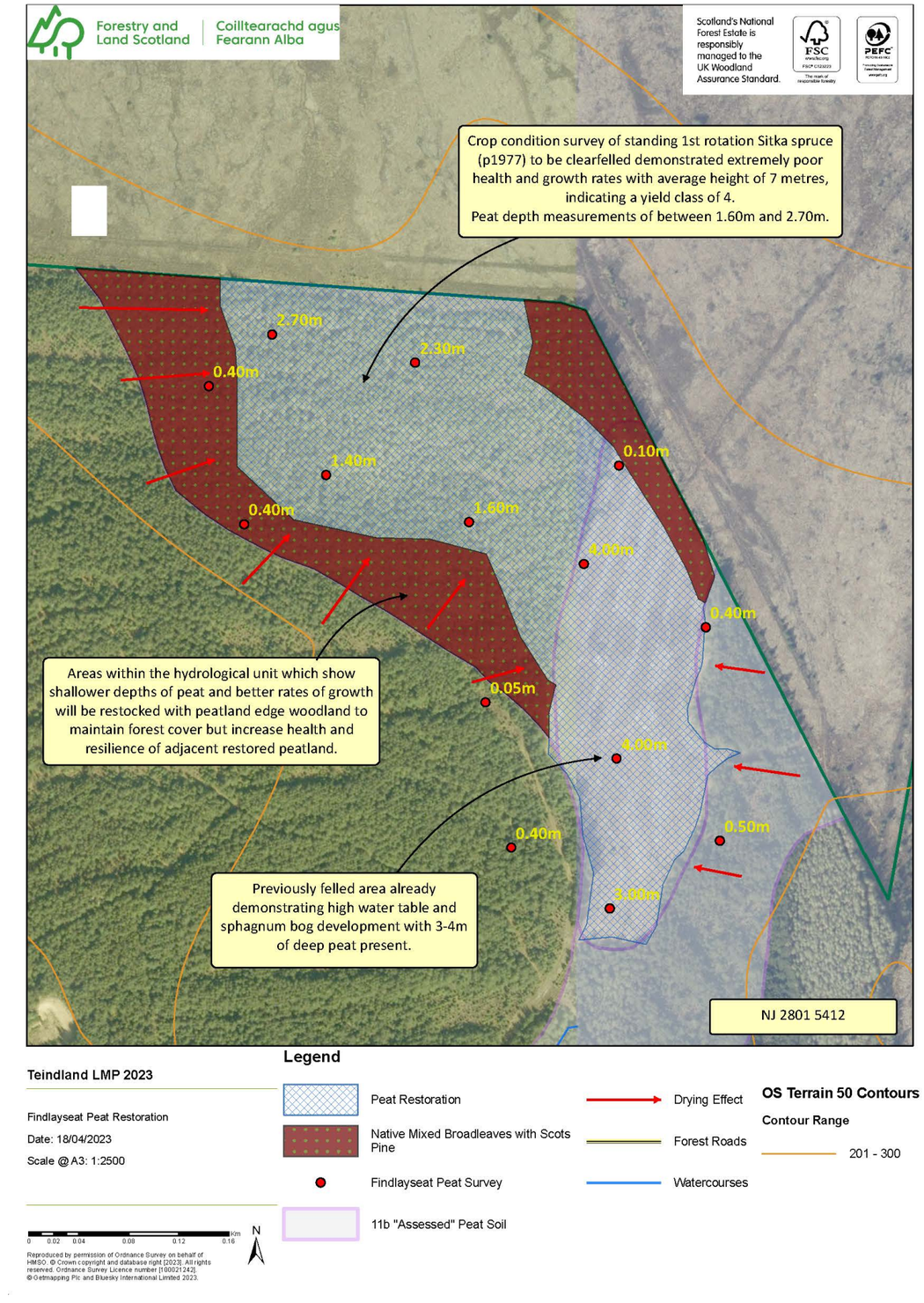


Figure 27: location of 'assessed' peatland restoration at Findlayseat, demonstrating forest-to-bog restorations (9ha) and surrounding peatland edge woodland restock (3.9ha)

Table 4: only relevant for Assessed Peatlands (Scenario B and C peat types) where there needs to be clear evidence that restocking on peat soils will produce a yield class equivalent to Sitka spruce 8 or more.

Attribute described	Description	Location of described attribute
ESC statement, respective to peat types (range)	11b [Calluna, Eriophorum vaginatum Blanket Bog]	Entire Findlayseat restoration area
Accumulated Annual Temperature (range)	986	Within Findlayseat restoration area
DAMs score (range)	15	Within Findlayseat restoration area
Crop deficiencies (needles, colour, leader length)	Very short needles, yellow colour, leader length of 2-4cm. See Image 2 below for example.	Within afforested area of proposed restoration area
Location and extent, proportion of healthy crops (no signs of deficiencies) and reason	Some more healthy Sitka spruce crop noted, indicating a productive yield class.	These areas removed from forest-to-bog restoration and will be restock with peatland edge woodland as per Figure 27.
Statement of correction factors used to predict of next rotation from ESC outputs (drainage, fertilising, flushing, heather control, peat compaction, and the combination of all of these per peat type)	Widespread heather growth, high water table, blocked drains, well established Sphagnum moss in drains and furrows all present. See Image 1 above. First rotation using fertiliser, ploughing and drainage only achieved YC4 spruce.	Findlayseat restoration area.
Statement of actions required to limit carbon loss from peatland soil. For example, partial re-wetting, referencing average water table height and density of drains.	Partial re-wetting required, water table is visible at surface across most of the site but affect of drains and furrows is lowering water table elsewhere.	Findlayseat restoration area.
Where Peat Edge Woodland is proposed, confirm and explain why restoration of deep peatland is not possible	Areas proposed for peatland edge woodland are within the Findlayseat restoration hydrological unit but show peat depths of under 50cm and have Sitka spruce of over YC8 present.	Peatland edge woodland areas shown adjacent to Findlayseat restoration area in Figure 27.

Table 5: restoration proposals. Describes the restoration techniques to be applied to the proposed restoration areas.

Attribute described	Description	Location of described attribute
Treatments used to restore the hydrology	Site specific specifications or alterations of the approach: Where drains are present, they will be blocked or dammed to raise the water table. There are plough furrows present in some areas which will also require smoothing. Any conifer regeneration present will be mulched and removed to prevent further drying of the restoration areas.	Across all restoration areas.
Treatments used to restore the topography (remove afforestation modifications, and previously hagged sites)	Site specific specifications or alterations of the approach: A 'light' touch ground smoothing specification will be used, simply because the existing vegetation is very impressive and desirable to retain in existing felled areas. Furrows will have the vegetation reserved, then ridges pushed into the furrows, and the reserved vegetation replaced on top of the site of the ridges (which will be bare). The tree stumps are of a small size, and most may not even need to be flipped, but rather slid sideways into the excavated furrow.	Across all restoration areas.
Treatments used to counter-act peat cracking or other modifications caused by the afforestation of the peatland	No peat cracking noted on the survey.	N/A

Environmental Impact Assessment risk assessment

Forest-to-bog peatland restoration is classified as a forestry project under the Forestry (Environmental Impact Assessment) (Scotland) Regulations 2017. To obtain consent from Scottish Forestry, an assessment of potential environmental risks as a result of the proposed forestry project is required to allow the determination of whether it is likely to have significant effects on the environment.

A total of 18.1ha of Forest-to-bog restoration is being proposed, this is the total area of deforestation to take place within the plan period.

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Environmental Impact Assessment
Screening Opinion Request Form

Please complete this form to find out if you need consent from Scottish Forestry, under the **Forestry (Environmental Impact Assessment) (Scotland) Regulations 2017**, to carry out your proposed forestry project. Please refer to Schedule 2 Selection Criteria for Screening Forestry Projects under Applying for an opinion. If you are not sure about what information to include on this form please contact your local Conservancy office.

Proposed Work

Please put a cross in the box to indicate the type of work you are proposing to carry out. Give the area in hectares and where appropriate the percentage of conifers and broadleaves

Proposed Work	select	Area in hectares	% Conifer	% Broad-leaves	Proposed work	select	Area in hectares
Afforestation	☐				Forest roads	☐	
Deforestation	☒	18.1 ha	100%		Forest quarry	☐	
Location of work		Three sites within Teindland LMP area as per Figure 24 in LMP text.					

Description of Forestry Project and Location

Provide details of the forestry project (size, design, use of natural resources such as soil, and the cumulative effect if relevant).
Please attach map(s) showing the boundary of the proposed work and other known details.

See Appendix 4 of LMP for details of the proposed deforestation, peatland restoration plans and assocated maps. Figure 24 shows a map of the areas which this screening opinion relates to. Figures 25.1, 25.2 and 27 show the areas in closer detail.

Provide details on the existing land use and the environmental sensitivity of the area that is likely to be affected by the forestry project.

The existing land use is a combination of commercial conifer plantation of Sitka Spruce planted on deep peat soils or the associated hydrological unit and some areas where a mix of checked conifers has self seeded onto deep peat soils. The proposed works will restore the deep peat areas to a functioning peatland system which will act as a long term carbon store and increase its value for biodiversity and water quality.

Description of Likely Significant Effects

Provide details on any likely significant effects that the project will have on the environment (resulting from the project itself or the use of natural resources) and the extent of the information available to assist you with this assessment.

There will be significant positive effects on the environment as a result of this project. See Appendix 4 of LMP for details of the positive effects this project will have.
The main positive effects will be:

- Returning the areas of peaty soils to functioning peatland ecosystems
- Returning peat areas to carbon sinks and supporting a higher variety of plant and animal species than the current areas of plantation spruce

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Environmental Impact Assessment
Screening Opinion Request Form

- Creating a more open, biodiverse and visually varied habitat throughout the restoration areas
- Reduced flood risk further downstream by slowing the rate of flow into watercourses via drain blocking and ground smooting

Other significant effects to be noted:

- Although the deforestation is a significant alteration to the habitat present on the sites currently, the scale of the block means that these changes are reasonable and are more akin to restoring the natural habitats of the sites before plantation forestry was added using drainage, ground cultivation and fertilisation in the past.
- The changes proposed will not be unusual in this location, which already has open moorland adjacent to two of the restoration sites and open valleys present elsewhere in the block.
- Effects across boundaries should be minimal, with the Findlayseat and Cushley proposals providing greater connectivity with the adjacent moorland land uses.
- There may be short term impacts on people using the forest for recreational use in terms of path and road closures, these impacts will be no more that those of standard forestry operations. The long term impact on people visiting the forest will be positive by creating a more biodiverse, open and visually varied setting in the areas to be restored.
- Poorly managed forestry operations on peaty and gleyed soils are likely to cause soil disturbance and, in the damp conditions here, there is the potential for sediment to enter watercourses. Protecting the soil structure and avoiding diffuse polution will be key concerns during these operations. Mitigations listed below.
- The impacts on soils and knock on effects of ground disturbance will be short term as the areas earmarked for deforestation will be subject to a variety of peatland restoration techniques immediately after felling.

Include details of any consultees or stakeholders that you have contacted in order to make this assessment. Please include any relevant correspondence you have received from them.

Statutory consultees will be consulted as part of LMP approval process.

Mitigation of Likely Significant Effects

If you believe there are likely significant effects that the project will have on the environment, provide information on the opportunities you have taken to mitigate these effects.

The long term significant effects of the project are expected to be positive so no mitigation measures are required. However Appendix 4 includes details of the environmental protection measures that will be undertaken during works on site to ensure there are no short-term detrimental impacts on the environment while the habitat restoration and deforestation operations occur.

The key mitigations required relate to protecting soils and water habitats during operations:

- UKFS forestry and water guidelines will be adhered to at all times with enhanced measures taken where needed including the use of silt traps, enlarged buffer zones and any other mitigations required.
- Regular monitoring of all watercourses in vicinity of operations will take place to ensure water quality is not being adversely affected.
- Approriate harvesting techniques will be applied to minimise the ground impacts and protect carbon storage potential of soils. This may include utilising low ground pressure machines for harvesting and forwarding operations and completing operations at a suitable time of year.
- We will apply current best practice and expertise in peatland restoration operations and use suitibly experienced contractors with the appropriate machinery.
- We will removing as much scrub and waste materials from peat restoration sites as possible to maintain nutrient balance on peaty soils and help facilitate restoration activities.

Short term impacts on the general public during operations will be minimised by signposting operations well in advance and providing alternative recreation routes where possible.

Sensitive Areas	
Please indicate if any of the proposed forestry project is within a sensitive area. Choose the sensitive area from the drop down below and give the area of the proposal within it.	
Sensitive Area	Area
Deep peat soil	18.1ha
Select...	
Select...	
Select...	
Select...	

Property Details			
Property Name:	Teindland Forest		
Business Reference Number:		Main Location Code:	
Grid Reference: (e.g. NH 234 567)	NJ 3015 5642	Nearest town or locality:	Fochabers
Local Authority:		Moray Council	

Owner's Details			
Title:		Forename:	
Surname:			
Organisation:	FLS, East region.	Position:	
Primary Contact Number:		Alternative Contact Number:	
Email:			
Address:	Portsoy Road, Huntly, Aberdeenshire.		
Postcode:	AB54 4SJ	Country:	
Is this the correspondence address?		Yes	

Agent's Details			
Title:	Mr	Forename:	Euan
Surname:	Stewart		
Organisation:	FLS	Position:	Forest Planner
Primary Contact Number:	0300 067 6200	Alternative Contact Number:	
Email:	enquiries.east@forestryandland.gov.scot		
Address:	Portsoy Road, Huntly, Aberdeenshire.		
Postcode:	AB54 4SJ	Country:	Scotland
Is this the correspondence address?	Yes		

Office Use Only	
GLS Ref number:	

Table 6: summary of main risks associated with forest-to-bog peatland restoration.

Main risks to assess	Impact assessment
Population and Human Health	No impact. There are no core paths or public/private water supplies within the proposed area. In general, the restoration areas are not used by members of the public.
Biodiversity (habitats, species)	Positive. Restoration of a degraded peatland will restore a priority open habitat (Blanket Bog) and compliment adjacent upland heath, benefitting both habitat and its associated species. Pre-operational surveys will identify any protected or breeding species to ensure suitable mitigation is in place to avoid any disturbance.
Land	No impact. Where the restoration project is adjacent to agricultural land, boundary drains will not be blocked to ensure neighbouring land is not compromised by re-wetting and increased potential to flooding.
Soil – and geology, geomorphology	Positive. Re-wetting the site will benefit the peat soils as forestry modifications will be reversed to stop oxidisation and further degradation and erosion of the peat.
Water	Positive. Re-wetting techniques have shown to have no significant adverse effect on water quality. Ultimately, the water quality of the local area will be improved by reducing run-off from the exposed peat and degraded peatland. Any water courses will be suitably protected and buffered as per the UKFS Guidelines.
Air	No impact.
Climate	Positive. Afforested peatlands have the potential to emit more Green House Gas (GHG) emissions than can be absorbed by a woodland. Restoration of afforested peatlands, especially 'presumption to restore' peatlands, will prevent the significant net release of GHGs, ultimately benefitting the local climate.
Material Assets	No impact.
Cultural Heritage	No impact. Pre-operational surveys will identify any cultural heritage features to ensure suitable mitigation is in place to avoid any disturbance.
Landscape	Positive. Peatland restoration will create more open space within the forest blocks and their local area. This will add more diversity to the forest structure by creating open and associated native woodland habitats.

Monitoring

All restored areas will be monitored on a regular basis to assess the change in surface vegetation (also a proxy indicator of water table level) and to check for non-native regeneration. It is envisaged that more monitoring will be undertaken by drone-based aerial photography at least bi-yearly. A full review of the peatland restoration will take place 5 years after completion and at the LMP mid-term review.

FLS continues to work closely with Forest Research on the effects of peatland restoration on water quality and will follow the best practice recommendations made in a recent publication by Shah and Nisbett based on 10 years of data collected from Flanders Moss. More details can be found at Forest Research.