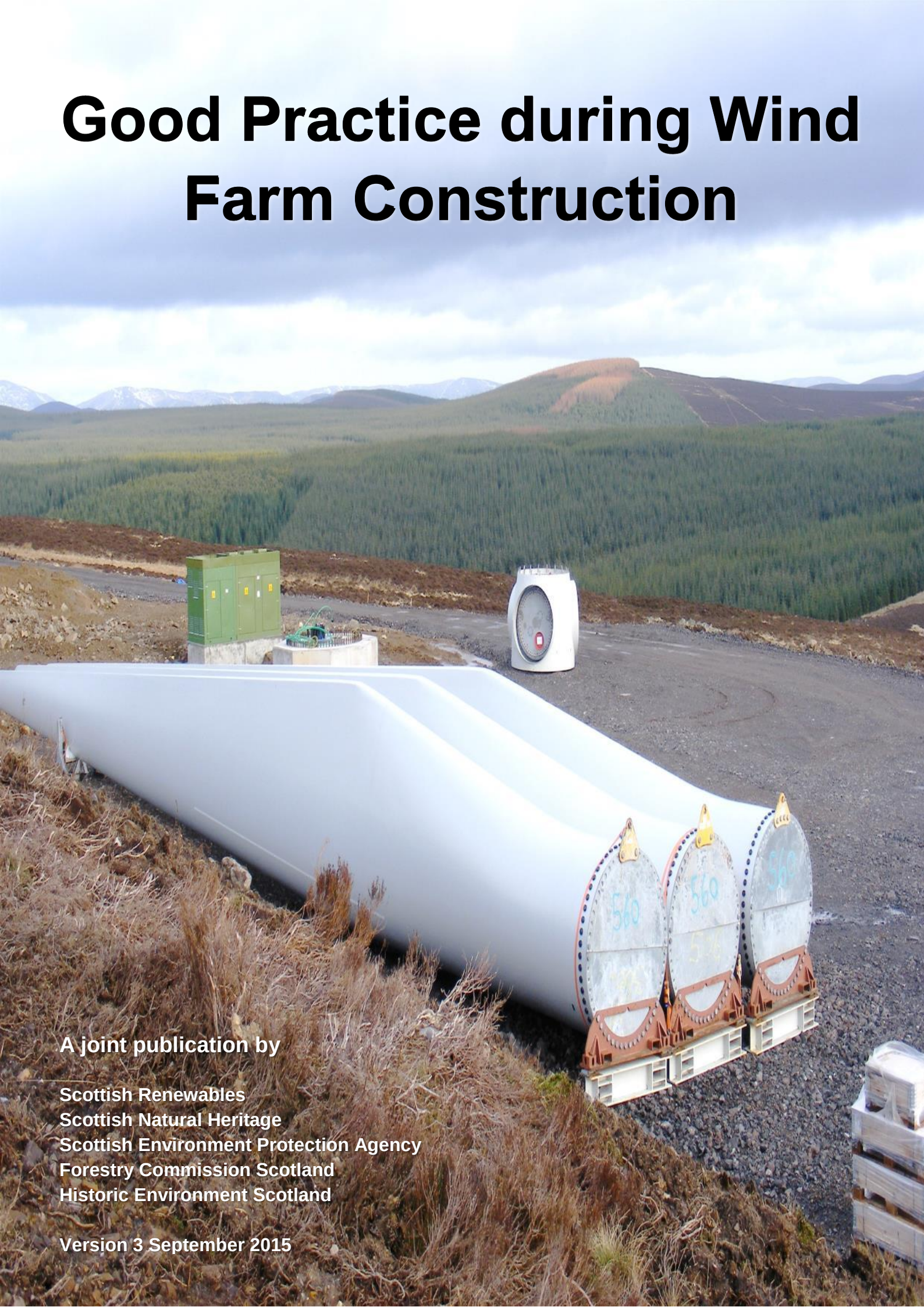
Good Practice during Wind Farm Construction



A joint publication by

Scottish Renewables
Scottish Natural Heritage
Scottish Environment Protection Agency
Forestry Commission Scotland
Historic Environment Scotland

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Part 1
Introduction

1.1 BACKGROUND

The Scottish Government and its agencies support the development of renewable energy, including wind farms, as a key means of tackling climate change.

Considerable experience has been gained from the construction and operation of wind farms across Scotland with an installed capacity totalling over 5000 Megawatts. The purpose of this guidance is to share that experience amongst the industry, planning authorities and those more broadly involved in the planning and development of wind farms. It is focused on pollution prevention, nature conservation, environment, natural resources, landscape, hydrological, biosecurity and non-native species, archaeological and related issues.

It does not offer guidance on the detailed design or erection of turbines, their components or related infrastructure. **It does not address matters of Health and Safety on site specifically. Please refer to the Health and Safety Executive for guidance on these matters.** It is aimed at the post consent, pre-construction planning and construction phase of development.

This guidance seeks to identify Good Practice, not necessarily Best Practice, which is evolving constantly. This guidance aims to 'raise the bar' and ensure that all wind farm sites are constructed in a sustainable way which respects the surrounding environment and minimises environmental risks. This means going beyond ensuring compliance with environmental legislation whilst balancing this with the practicalities of construction and commercial constraints on developers and contractors.

The guidance will be updated as more experience is gained. In particular, our understanding of issues relating to carbon emissions from wind farm sites is evolving quickly and as a result this guidance will be updated regularly. Box 1 below outlines the current approach to Good Practice when addressing issues of peat management on site and minimising carbon loss.

This guidance is aimed at:

- Wind farm developers
- Construction companies and contractors working on wind farm sites
- Consultants and advisers supporting the wind farm industry
- Planning officers working on wind farm applications
- Statutory consultees such as SNH, SEPA, Marine Scotland Science – Freshwater Laboratory (MSS-FL) and others with an interest in wind farm construction, Environmental and Ecological Clerks of Works

1.2 HOW TO USE THIS GUIDANCE

This is **not** a 'how to' guide – the case studies and examples used are illustrative only and they do not prescribe a specific method, technique or approach. **Better techniques and practices are evolving quickly**. It is impossible to offer generic guidance which is relevant to all wind farms. Every site is different and will require

a tailored approach.

Within each of the topics included in the guidance key considerations are identified; examples of good practice are provided and the key issues are highlighted.

1.3 HOW THIS GUIDANCE WAS PRODUCED

Recognising the mixed practice on a number of existing wind farm sites SNH approached Scottish Renewables in summer 2008 to establish a joint project to promote good practice during wind farm construction. As a result a working group was established comprising representatives from SNH, SEPA, FCS, Scottish Renewables and several member companies with extensive wind farm development experience. Members include:

Joss Blamire, Scottish Renewables
Brendan Turvey, SNH
Kenny Taylor, SNH
Carol McGinnes, SEPA
Chris Robinson, Natural Power
Ian Johnson, Morrison Construction
David MacArthur, Macarthur Green
Peter Robson, ScottishPower Renewables
James Milner-Smith, SSE Renewables
Maida Ballarini, Forestry Commission Scotland

Staff on a site visit to a completed wind farm development.

Some of the examples provided are deliberately 'disguised' and not attributed to a particular company or wind farm. The purpose of this guidance is to show what is achievable (and what can go wrong) – not to endorse or criticise a particular wind farm, developer or contractor.

1.4 CONTENTS

The aim of this guidance is to demonstrate good practice across all aspects of wind farm construction, including related infrastructure. Sections are therefore included on:

- Pre-construction planning
- The use of Environmental Management Plans and Construction Method Statements (incorporating a Site Waste Management Plan)
- Using a Clerk of Works and other specialist advisors
- Access tracks
- Site drainage
- Managing Recreational Access
- Traffic management
- Site infrastructure
- Biosecurity and non-native invasive species
- Post construction habitat management and restoration
- Seasonal considerations

Advice on how to prepare a Site Waste Management Plan (SWMP) is available on SEPA's website. Further advice on the reuse of demolition and excavation materials is available from the Waste and Resources Action programme (WRAP). Advice from SEPA should be sought at an early stage.

1.5 CARBON EMISSIONS

One of the key aims of wind farm development is to reduce carbon emissions. Wind farm developments, through the materials used, the construction processes employed and the potential emissions from disturbed soils and habitats, do result in carbon emissions. Guidance from the Scottish Government provides a methodology to explore potential carbon emission savings and losses associated with a wind farm development in forestry or on peatland.

Box 1. Good Practice approach to development on peat and carbon savings – a summary of recommendations

- Conduct a detailed peat survey
- Where possible position site infrastructure in areas of shallower peat or design an appropriate engineering solution to avoid and/or minimise excavation of peat (for example floating roads and piling solutions).
- Minimise the detriment to peat if excavation cannot be fully avoided.
- Avoid or reduce peat displacement from the development of borrow pits.
- Excavations should be prevented from drying out or desiccating as far as possible. Consideration should also be given to spraying with water.
- If stockpiling peat assess the potential loading effects for peat slide risk.
- The peat should be restored as soon as possible after disturbance.
- Consider cable trenching operations and timings.
- Floating roads should be used in areas of deeper peat.
- Minimise plant movements and haul distances in relation to any earthworks activities including peat management.
- Developers should take ancillary opportunities to improve habitats.

The report recognises that in some circumstances the payback of wind farm development could be significantly affected by the construction methods used and the degree of restoration of the site. This guidance seeks to ensure that good practice is adopted to reduce the carbon emissions associated with wind farm development.

Scottish Renewables and SEPA have produced a joint publication on 'Developments on Peatland: Guidance on the assessment of peat volumes, reuse of excavated peat and the minimisation of waste'[1].

[1] *Developments on Peatland: Guidance on the assessment of peat volumes, reuse of excavated peat and the minimisation of waste*

1.6 SOURCES OF FURTHER INFORMATION

Key sources of further information include:

www.snh.gov.uk

www.sepa.org.uk

www.scottishrenewables.com

www.scotland.forestry.gov.uk

www.historic-scotland.gov.uk

1.7 CONTACTS

For further information please contact:

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Part 2

Pre-Construction Considerations

2.1 INTRODUCTION

One of the ways in which Planning Authorities and statutory consultees can help to speed up the planning process is to make effective use of pre-application engagement. Relevant staff will participate in such dialogue, with a view to providing helpful advice at an early stage of development proposals. Where relevant, the agencies will work together to provide coordinated advice on issues of joint interest.

This joint approach is set out in the Agency Joint-Statement on Pre-application Engagement. It should also help to identify the information which will be needed, by Planning Authorities and consultees to make a proper assessment of the proposal, and to identify any potentially serious problems at an early stage.

Pre application engagement should continue through to post consent, pre-construction stage where there are issues to be resolved. Getting pre-construction right should prevent pollution of the environment, harm to human health, and unnecessary damage to nature conservation and archaeological interests. It will reduce risk, cost and programme delay, and increase stakeholder confidence in the project.

Where planning obligations are incorporated into the consent, we expect the developer to meet those obligations (e.g. need for a habitat management plan, construction management plan, monitoring) without further reference to the statutory consultees.

Please consult the Planning Authority on any application to modify or discharge (remove) a planning obligation that was applied to the planning permission. They will also be expect to be consulted on any other material changes to a development that will significantly affect the level of environmental impact, e.g. an increase in turbine height for a wind farm or a change to the route of an access track to a development.

2.2 KEY CONSIDERATIONS

Pre-construction planning involves the incorporation of construction due diligence during the Environmental Impact Assessment (EIA) stage of the project and prior to site mobilisation planning. It is about planning ahead and being proactive in your construction strategy. The key issues to be considered include:

- Contacting appropriate Planning Authorities and public bodies (key agencies)
- Relevant legislation (e.g. Construction (Design and Management) Regulations (2015), and current policies
- Water legislation, including drinking water
- Water crossings
- Environmental Protection, including habitats and wildlife legislation
- Risk of presence of invasive non-native species and/or damaging pests and diseases
- Wildlife and habitat surveys
- Archaeological surveys

- Ground risk (geotechnical risk management and the geotechnical risk register)
- Infrastructure design and integrated thinking
- Knowledge of the relevant waste legislation and incorporating waste management and site drainage strategy
- Minimisation of peat arisings
- Justifying the need for, use and location of borrow pits
- The quality of the rock available in borrow pits
- Good construction practice
- Existing services, such as public roads, grid connections and other potential constraints
- Existing and proposed wind farms in the area
- Compliance with the UK Forestry Standards
- Flood risk assessment

2.3 SITE INFRASTRUCTURE LAYOUT

Key Questions

- Are temporary works (e.g. site compound, laydown areas) and permanent works situated in areas of suitable gradient, with sufficient design separation from sensitive receptors?

- Are access track gradients and size suitable for the largest loads anticipated to be delivered to the site?

- Are site tracks following design track lines as identified in the EIA? If not, have proposed alternative track lines and other infrastructure amendments been suitably assessed by the appropriate consenting authorities, and clerks of works?

- Are critical path items (e.g. lay-down areas) easy to access at an early stage of the works?

- Are borrow pits proposed? Are they proposed in suitable locations (i.e. close to proposed construction routes, to minimise haul distances)? Is the rock suitable for purpose? Can engineering standards be applied to assess suitability?
  In line with SEPA's Regulatory Position Statements, surplus material, including forest residues and peat may under some circumstances be classified as waste and waste activities (recovery and disposal) may require authorisation from SEPA.

- Have appropriate arrangements been made for the storage of fuel and oil? Does this comply with The Water Environment (Oil Storage) (Scotland) Regulations 2006?

- Can maintenance of vehicles and plant be carried out in impermeable areas where any oil spillage can be contained?

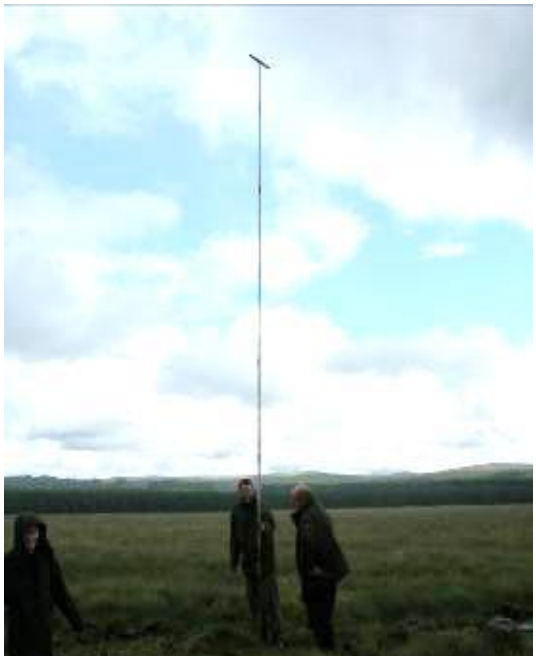
- Maximise the use of recycled material, promote the use of secondary aggregates (sand, gravel and stones etc.), and ensure sufficient production of primary materials (where excavated material is suitable for use).
  Consider the recycling of waste material originating from elsewhere such as demolition waste. This may fall under waste management legislation. It is recommended that a Site Waste Management Plan (SWMP) is developed.

- Is felling proposed? Is the area prone to acidification and diffuse pollution risks which could be exacerbated by felling, leading to potential implications for water quality? Waste legislation will need to be complied with and there may be scope to restore the felled woodland to open habitat types or re-stock. Does disposal of woodland residues comply with waste management legislation?

- Will the risk of water run-off from the site due to construction activities contribute to flooding downstream?

2.4 SITE INVESTIGATION

Good Site Investigation (SI) is essential. SI includes desk study, site walk-over surveys (see Box 2 below) and more "intrusive" methods which are termed "ground investigation" (GI). SI should begin during the early phases of the EIA design, when other surveys (ornithological, ecological, hydrological, archaeological, hydrogeological) and assessments (e.g. waste management) are undertaken, so that potential ground risk can be identified and designed for appropriately.



Thorough site investigation, such as detailed peat depth surveys, is essential at the early stages.

Ground investigation will also be required during the EIA phase (i.e. soil/peat depth surveys, including depth and general characteristics, identifying ground water dependant terrestrial ecosystems), to inform infrastructure siting (see box 3 below).

The Environmental Statement (ES) should demonstrate that the wind farm design has taken into account all environmental constraints, such as soils, site hydrology and habitats. Turbines and other infrastructure should be located on the basis of waste minimisation, ecological protection (species and habitats), hydrological / hydrogeological and archaeological survey work and balanced against the other assessments and constraints identified during the EIA.

If the proposed wind farm is to be sited within a forest, a stand-alone chapter on 'woodland management and tree felling' needs to be included in the ES to describe the social, economic and environmental values of the existing forest and clearly indicate proposed areas of woodland for felling to accommodate new turbines, access roads and other infrastructure. The chapter should describe the changes to the forest structure, the woodland composition and describe the work programme.

The level of GI required will depend to some extent on the assumed "difficulty" of a project. A rough-guide for gauging approximate costs of the actual GI is between 1% and 3% (for a low to high risk project, respectively) of your estimated "Balance of Plant" (civil and electrical infrastructure, and likely licence and permit) costs.

SI should include all the main infrastructure – access track alignments, watercourse crossings, crane hardstandings and turbine bases, sub-station and

construction compounds, laydown areas and borrow pits. A suitably qualified professional engineering geologist/geotechnical engineer can advise on appropriate methods of GI, which may include (but not be limited to), further peat probing, trial pitting, boreholes, geophysics and appropriate sampling and laboratory testing and reporting. If as a result of GI amendments are made to the design it is important that this is carefully assessed to ensure that any new impacts are reconsidered.

Consider mobilisation and site access for GI plant – in the absence of any wind farm access tracks existing infrastructure may not permit easy access (i.e. narrow gates, bridge parapets, weak ground). Always check for environmental sensitivities and risks prior to accessing the site. Always reinstate the ground after the GI is completed.

Box 2. NVC survey method and mapping requirements

NVC surveys should only be conducted during peak months for vegetation; May to September. Phase 1 surveys may be possible to conduct outside of this period by experienced surveyors provided there is good visibility and no snow cover. As an initial survey for wetland habitats, a Phase 1 walkover survey should be used in conjunction with the Sniffer Functional Wetland Typology categories.

All mapped NVC survey information should be submitted with the following information:

Appropriate scale to show all features. Springs and flushes must be mapped and the map scale should be suitable to show these features clearly. Where this is not feasible, **all** springs and flushes should be noted with a target note and it clearly indicated how this feature with interact with any activity (development, abstraction etc.)

Site boundary clearly marked

Adjacent designations shown plus NVC information where this is relevant to the activity (i.e. designation within risk screening zones)

All watercourses mapped (not just those shown on OS 1:25,000 scale)

Contour lines. These are essential for being able to infer the direction a pressure may come from e.g. the direction of groundwater flow and how infrastructure may interact with this.

Colours: distinct colours/ shading patterns for each NVC category.

A habitat map should be overlain with the site infrastructure so that an assessment can be made of construction of the development and the environmental risk.
Surveys submitted for consideration without the above listed features and information will be returned automatically with a 'lack of information' response from consultees.

Box 3. Peat Survey

Survey normally consists of 3 stages:

A desk study to determine if peat is likely to be present on a site using existing soil survey and/or geological survey maps complemented by aerial photos. Where available detailed 1:63,360 scale soil maps should be used, in other areas only national 1:250,000 scale soil maps will be available and should be used. *A site visit will confirm the presence of peat, after which a peat survey can be designed.*

A low resolution 'first pass' to identify the broad extent and depth of peat across the site. This will identify areas that require more detailed survey prior to outline design and infrastructure location. This is likely to require a depth measurement at least every 100m across the area proposed for development. Areas of the application site which are unlikely to be developed (due to other constraints) do not need to be surveyed in any greater density.

A more detailed survey of peat depth and peat characteristics. This should focus on likely infrastructure locations particularly on sensitive areas which should be avoided where possible subject to site specific considerations. These areas need to be clearly marked on the outline design of the development. This is likely to require a depth measurement and site description every 10-50m on and around areas where infrastructure will be located.

During this survey, it is important to record whether the peat is fibrous or amorphous - based on field observation and core results - as this has an impact on future storage and re-use of this material. Site details such as slope and drainage patterns (e.g. bog pools) plus any erosion features (e.g. gullies, rills or 'hags') should also be noted and spatially referenced. Ecology expertise is also required in order to survey and assess vegetation across the site as part of the Habitat Survey.

Presenting the information
Survey-derived information should be presented on a map (or maps) at an appropriate scale covering the *whole* site (including new or upgraded access tracks leading to/from the development site), with the proposed development overlaid. Maps should be produced for peat depth (preferably using contours), vegetation cover as part of the Habitat Survey and other important site information (such as existing grips, tracks, gullies or bog pools) noted during the survey.

Data on peat depth, the carbon content and bulk density of peat, dominant vegetation cover plus some measure of the variability of peat depth across the site should be presented in a table or spreadsheet.

The plans of the proposed development should then be superimposed over any maps of peat depth to show the link between the intended location of infrastructure and how impacts on deep peat and peatland habitats have been minimised.

2.5 PLANNING CONDITIONS

Where construction activities could have a significant detrimental effect on the environment (via pollution) or nature conservation interests, these will often be carefully controlled by attaching conditions to the planning consent. While there may be restrictive conditions aimed at control, there may also be a need to apply for, obtain, and comply with other environmental permissions, licenses or consents.

It is the responsibility of the developer of the wind farm to ensure that planning conditions are adhered to. It is also the responsibility of the Planning Authority to monitor and ensure compliance. SEPA and SNH will often advise the determining

authority (either the Planning Authority or the Scottish Government Energy Consents and Deployment Unit) if conditions are required to meet pollution prevention or nature conservation objectives. Conditions should be developed in early consultation with the developer. The model conditions developed by ECDU provide a good starting point for this, though conditions should always be tailored to the specific circumstances of each proposal.

SNH are happy to advise on any non-standard conditions relevant to issue within their remit, particularly where the conditions are required to avoid impacts that could raise issues of national interest. There may also be a requirement to obtain other permissions such as a permit or authorisation from SEPA, which will be monitored and enforced by SEPA.

Woodland areas proposed to be removed and compensated (as identified and quantified in the Environmental Statement), must mirror what is stated in the planning conditions. Where full planning permission authorises the felling of trees on a development site, both on-site restocking and off-site compensatory planting must be secured by a condition as part of the planning consent. FCS provides advice and facilitates compliance with the policy on Control of Woodland Removal, as well as offering help to developers with regards to the delivery of compensatory planting requirements.

Historic Environment Scotland will advise where conditions are required for the protection of scheduled monuments. Local Authority Archaeologists will provide advice on conditions for issues including unscheduled archaeology and the nature and extent of any archaeological surveys required.

2.6 THE CONSTRUCTION (DESIGN AND MANAGEMENT) REGULATIONS 2015

As part of fulfilling a Client's (the Developer's) responsibilities under the CDM Regulations 2015, a pre-construction information pack (PCIP) should be prepared for contractors involved in the project. In addition, sufficient time should be allowed for the appointed contractor to complete any detailed design and mobilisation to the site with sufficient welfare facilities in place for site staff.

2.7 TIMING OF PRE-CONSTRUCTION SURVEYS

It is important that surveys are commenced prior (6-12 months typically, depending on monitoring parameter) to the on-set of the Site Works to establish suitable baseline conditions for such factors as: Water Quality; Protected Species and Habitat Surveys (flora and fauna); archaeological potential, background landfill soil/gas, noise and dust levels.

2.8 MICRO-SITING

Micro-siting of wind turbine locations and ancillary infrastructure is commonly undertaken at this stage. A variety of considerations need to be taken into account, such as:

- Results of detailed habitat, species and vegetation surveys,
- Results of soil/peat surveys (depth and characteristics)
- Geotechnical assessment
- Hydrology
- Archaeology

- Wind turbine requirements

Care is required to ensure that the overall effects of micro-siting are taken into account. For example, extensive micro-siting may affect the landscape and visual impact of the development. A level of re-assessment may be required at this stage to ensure that any negative impacts are minimised. Further consultation may be required.

2.9 REPOWERING AND DECOMMISSIONING

Decommissioning and post-operational restoration should be considered during the initial design phase of the development, ensuring that decommissioning of infrastructure and the restoration of habitats is achievable and practical once the development has ceased operating.

It is good practice to include an outline Decommissioning and Repowering Plan (DRP) based on a decommissioning, restoration and aftercare statement in the Environmental Statement. However, as there would commonly be 25 years between construction and decommissioning of a wind farm, the outline DRP should be sufficiently flexible. An understanding of the impact of restoration proposals on the natural heritage should be described so that any potential mitigation measures can be identified. The draft DRP should at least consider the main infrastructure on the site and the likely aims of the restoration process.

The developer should review the DRP at least every 3-5 years throughout the lifetime of the development, and more frequently should the need arise. This is to ensure that site conditions, maintenance requirements and unexpected events do not compromise the objectives of the DRP. For example, unexpected impacts may arise during/following construction that affects the initial objectives of the DRP. Consultation with the statutory bodies should be considered at these review stages, as appropriate.

The advice here will be refined and updated as we and the industry gain experience and will develop good practice to ensure the best outcome is delivered at the end of a wind farm's operational life. For further information please see SNH Commissioned Report on Restoration and Decommissioning of onshore wind farms (2013).

2.10 LINKS/FURTHER INFORMATION/CONTACTS

SNH Environmental Impact Assessment guidance

BS 5930 "the code of practice for site investigations"

Scottish Government "Peat Landslide Hazard and Risk Assessments"

The Construction (Design and Management) Regulations 2015

Protecting Scotland's Nature

Part 3

Seasonal Considerations

3.1 INTRODUCTION

The current turbine supply market and the availability of specialist contractors may limit the opportunities for a developer to fundamentally alter a construction schedule to take account of these issues. Nonetheless, it is important to consider the time of year and scheduling of wind farm construction to minimise impacts on the surrounding environment.

Winter conditions pose a significant challenge in all stages of construction

Careful scheduling is required, particularly when planning for drainage and the impact of flood events or borrow pits.

3.2 KEY CONSIDERATIONS

- Weather - the winter months are generally windier and wetter, making the scheduling of turbine lifts difficult and creating additional challenges in terms of managing run off and storm events. Flood, snow, and ice cover will restrict access and increase risks on site;

- Site drainage (during construction, and then for the operational stage) should be designed to take account of the likely Storm Event Intensity for an area and infrastructure appropriately designed for a 1:200 year event (see section 9). Failure to adequately plan for flood events can result in considerable damage on site, construction delays and pollution of watercourses, lochs, sensitive wetlands, and groundwater;[2]

- The design and maintenance of drainage/silt traps to prevent heavy silt runoff during rainfall;

- Any reductions in base flows or an increased risk of flooding as a result of construction activities can be important to water quality;

- There is an increased risk of peat slides in very wet weather and from the additional weight of a snow pack;

- In wet weather some excavated materials (particularly peat) can quickly turn to sludge making it more difficult to excavate, transport and store;

- Low visibility in blizzard conditions or heavy fog can increase the risk of

[2] *Further information is highlighted within Planning Advice Note PAN 69: Planning and Building Standards Advice on Flooding. The assessment should take account of the expected impact of climate change. The Flood Estimation Handbook (FEH) published by the Centre for Ecology and Hydrology (CEH) should be used to calculate flood values. CIRIA and SEPA guidance should also be referred to.*

accidents on site;

- Forestry – seasonal timing of tree felling should be considered according to the UK Forestry Standard and associated guidelines; to avoid disturbance to protected species; and to meet market demand for timber.

- Dust – dry weather can make it difficult to manage dust from vehicles and tracks. Vehicle movements may be constrained and suitable mitigation put in place e.g. spraying;

- Traffic – patterns of road use change throughout the year and may influence the scheduling of deliveries;

- Snow cover and frost – during the winter months snow cover and frost will inhibit activities such as re-vegetation, restoration work and identification of sensitive flora/ habitats on site;

Early nightfall in winter bringing dark, difficult working conditions

- Seasonal use of watercourses – many species are particularly sensitive / vulnerable to watercourse pollution during certain seasons (Oct-May). As a general rule in-stream or near stream works/activities should be avoided as much as practicable. Further guidance is provided in the Forests and Water Guidelines and in the SNH Guidance for Competent Authorities;

- Water crossings – Water crossings authorised under the Water Environment (Controlled Activities)(Scotland) Regulations 2011 are issued with the condition that the activity shall not be undertaken during periods in which fish are likely to be spawning nor in the period between spawning and emergence of juvenile fish, this can vary from watercourse to watercourse across the country;

- Breeding bird season – many species of birds will only be present/most at risk during the main part of the breeding bird season (March-August); while other species may be present throughout the year. A Bird Protection Plan should consider the specific risks to each species on each site. On most sites, a walkover of track routes and the locations of site infrastructure by a qualified ornithologist is recommended prior to construction and at any key stages during the construction process;

- Other protected species, such as badger, red squirrel, otter and bats are also more active at different times of year and may require consideration if present on site. If species licenses are required then timing and phasing of construction needs careful planning;

- Deer – managing deer may not be possible at certain times of year (for example in closed seasons), and the impact of deer grazing on restoration work should be considered. Further information is available in the SNH Deer Management guidance;

- Habitat management – the effectiveness of restoration work and habitat management is often highly dependent on the time of year, especially if livestock are present. Temporary fencing may be required;

- Working hours will be restricted at certain times of year and careful consideration of site health and safety will be required. The impacts of lighting should be considered;

- Waste management options (which may require authorisation from SEPA) associated with any wind farm development may also involve hazards and nuisances arising from waste movement, use of waste, and waste disposal.

3.3 KEY THINGS TO ADDRESS IN CONSTRUCTION METHOD STATEMENT

- Produce a construction timetable and illustrate seasonal considerations.

- What measures will be put in place to deal with weather related events (flash floods, peat slide, snow melt, dust)?

- Track and road material, and other hard-standing material to minimise pollution.

- How will sediment management be adapted in emergency situations to cope with high rainfall and runoff?

- How will construction be scheduled around key site constraints (such as the breeding or migration seasons for bird and fish)? Where scheduling is not practical, what other mitigation can be put in place?

- How will construction be scheduled to benefit site restoration?

3.4 LINKS/FURTHER INFORMATION/CONTACTS

SEPA's CAR practical guide

Pollution Prevention Guidelines relevant to construction (published by SEPA)

Forestry Commission: Forests and Water Guidelines (Fifth edition)

CIRIA Control of water pollution from linear construction projects. Technical guidance (C648) (2006).

SNH Guidance for Competent Authorities

Part 4

Construction Method Statements and Management Plans

4.1 INTRODUCTION

The use of Construction Environment Management Plans (CEMP), and more specific task based Construction Method Statements (CMS), to guide a development is common practice across the construction industry. With the ability to cover a wide range of subjects, including environmental, archaeological, hydrological and ecological considerations, Health and Safety[3] on site and build procedures, the CEMP ensures consistency across the site for the duration of a build.

4.2 KEY CONSIDERATIONS FOR A CEMP

- What is required within the Planning Permission?
- Timely submission and distribution of the Statements will depend on the requirement and level of consultation and the particular stage of the development. For instance, a more generic CEMP may be submitted at a pre-construction whereas specific build CEMPs may be required during the build.
- CEMPs should be available on site, and used on a daily basis.
- Is legislation on environmental issues included in CEMP where relevant and all environmental aspects associated with a particular construction topic considered?
- Avoid setting unachievable aims, procedures and details within the CEMP.
- Site Waste Management Plans and Accident Management Plans (spillages, etc.), should also form part of the CEMP.
- Do method statement timings match 'work on the ground' timings? Will the content/subject of the CEMP be affected by seasonality?
- Has the temporary storage of excavated materials on site been planned for, where relevant/appropriate? And has SEPA advice been followed?
- Generally SNH and SEPA will only comment on those aspects of a CEMP on which they have specifically requested to be consulted or which have significant consequences for their statutory responsibilities.

Details on Peat Management Plans can be found in the Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and the Minimisation of Waste.

[3] ***Health and safety considerations are not addressed in detail within this guidance, please refer to the HSE website for further guidance - www.hse.gov.uk***

Part 5
Clerks of Works

5.1 INTRODUCTION

During wind farm construction the developer and contractor have to comply with a number of obligations under both the conditions of the planning consent and environmental legislation. To ensure effective auditing, implementation and monitoring of these obligations, Clerks of Works (of varying disciplines relevant to the site) are commonly requested as a condition of planning consent. The Clerk of Works (CoW) role is focused on providing environmental / heritage advice and monitoring compliance – **not** implementing measures. They will also advise on relevant wildlife/heritage legislation and aid in the development of practical solutions.

It may be appropriate for an onsite CoW to have the authority to temporarily stop works over a small part of the site for example to avoid a crime being committed.

This section provides details on:
1. The likely scope of works for the CoW;
2. Additional resources required to support the CoW; and

5.2 KEY CONSIDERATIONS

1. The scope of works and level of resource commitment required of the CoW needs to be commensurate with the scale of the development, and the complexity of the archaeological and ecological and/or environmental issues at a site. For this reason it is often the case the CoW position represents a broad multidisciplinary resource. The scope of the CoW position is likely to include the following aspects:

An ECoW can provide on-site advice on protected habitats and species, such as this water vole colony.

a) <u>Construction Activities</u>

Installation of site tracks, compounds, hard standings, borrow pits, electrical cable installation, turbine foundations, vehicle movements, micro-siting of infrastructure and fuel and chemical storage. Monitoring should be undertaken before, during and after construction on many of these activities.

b) <u>Monitoring of Pollution Prevention and Mitigation undertaken by a developer</u>

This may include: monitoring site pollution prevention plan, water quality monitoring, advising on the protection of public and private water supplies, advising on required pollution prevention measures, and monitoring their effectiveness. This will also involve liaison with SEPA via the appropriate

Local Planning Authority, to whom they would be expected to report pollution events.

c) Breeding bird protection and other protected species

This may include: monitoring of buffers around nest sites identified by pre-construction surveys, spot checks for nesting birds (or liaison with site ornithological consultants), and advice on mitigation measures and monitoring their effectiveness.

For other protected species, activities include monitoring buffers around protected species structures (such as nests or holts) identified during pre-construction surveys and spot checks for mammals, reptiles and amphibians, and providing advice if protected species are found that were not recorded during previous site investigations.

d) Environmental Register

The CoW should maintain a register of issues, advice given and action taken by contractors.

e) Reporting

A monthly report should be produced providing a summary of issues on site and their status during the relevant month. The report should be issued to the Local Authority and relevant statutory consultees, as agreed at the consenting stage.

f) Environmental Induction and Tool Box Talks to contractors and sub-contractors

The CoW may contribute towards environmental inductions held by the infrastructure contractor. These may cover sites of archaeological sensitivity, protected species to be aware of on site, exclusion zones and sensitive habitats.

g) Skills

As the above scope suggests, the range of skills required by the CoW is diverse. For this reason, it may be necessary to employ specialist Clerks of Works for particular tasks that may arise.

The ECoW is likely to be involved in advising on habitat management measures such as drain blocking

2. The role of a CoW will focus on providing advice relating to their specialism, and monitoring compliance – not implementing the measures. Generally, for the CoW's advice to be effective, appropriate capacity needs to be allocated to environmental protection by the infrastructure contractor. This may involve a dedicated 'environmental team' on site whose core responsibility is to maintain and monitor environmental protection measures, with regular liaison with the CoW.

5.3 BENEFITS

In general, ensuring that the project has appropriate CoW resource allows construction to progress more smoothly. Common issues, including those of protected species, habitats and water pollution, can be addressed effectively at an early stage avoiding unnecessary delays to project completion. The key is well written Conditions to set good foundations for the development process, using a well-qualified and experienced CoW, and maintaining good lines of communication between all parties. The findings of baseline surveys, mitigation plans and monitoring programmes should be incorporated into site management, overseen by the CoW to ensure efficient and prompt site management actions and minimal impacts of development.

5.4 LINKS/FURTHER INFORMATION/CONTACTS

The Association of Environmental and Ecological Clerks of Work's 'Good Practice Guidance'

Part 6
Traffic Management

6.1 INTRODUCTION

Good traffic management is vital to a successful wind farm construction project, particularly in light of the intensity of public highway usage at key periods during the construction phase, and the presence of abnormal loads on the roads. This document identifies good construction practice relating to traffic management, and includes key items that should be considered in the preparation of a Traffic Management Plan (TMP).

Good traffic management improves road safety for all users, minimises congestion and "severance", reduces environmental risk and promotes positive dialogue with local communities.

6.2 KEY CONSIDERATIONS

- Relevant legislation/permits
- Key stakeholders
- Transport Route(s)
- Site Access(es)
- Health and Safety
- Signage
- Traffic Management Plan

Careful planning of turbine component delivery is essential

6.3 EXAMPLES OF GOOD PRACTICE

Speed limits

Prevailing speed limits on public highways may not always be suitable for wind farm construction traffic. Alternative, lower, speed limits should sometimes be set for all site traffic on public highways to increase road safety and minimise nuisance to the general public. Consideration should be given to how this is policed, perhaps introducing a "zero tolerance" policy for all site drivers who exceed the lower limit introduced. Speed limits on the wind farm site require careful consideration and should be set at a level relevant to the risks on the site.

Road cleaning

Although wheel wash facilities are often introduced on-site to clean vehicles as they exit onto the public highway, it is inevitable that some dirt will make it onto the public roads. Arranging for the regular use of a "street sweeper" vehicle to clean the public highway is a positive demonstration of commitment to a clean project.

Closed wheel wash systems are unlikely to need SEPA authorisation though arrangements should be made to dispose of waste water through a properly licenced waste operator. It is unlikely that any proposal for the use of jet washing facilities on unmade ground without foul drainage would be approved by SEPA. Further guidance can be found in PPG13 "Vehicle Washing and cleaning".

Site Access

Consideration should be given to sufficient “sight-lines”, and appropriate modification of existing fabric/roadside vegetation to give clear vision for all road users. Bell-mouths at the entrance to sites, or onto approaching minor roads toward site, should be sufficiently wide to permit the largest abnormal loads to turn off (and onto) the public highway safely. Entrance control points/gates should be sufficiently set back from the road to prevent accessing vehicles having to “wait” on the public road.

An example of the scale of improvements which can be required on the public road network

Traffic Management

Managing traffic flows on approach to the site is a key consideration. The type of road (trunk road, B-Class, or minor), the typical traffic flows (peak times, local domestic, agricultural or industrial use), and, often most significant, proximity to local schools, should all be considered. The use of traffic lights, stop go signals, road closures and diversions are all possible options, though minimising disruption and inconvenience to the general public, particularly local residents or tourists, is of importance. Consider time of year (holiday periods), time of day (rush-hour, school drop-off/pick-up times), and typical weather (snow and ice) in your traffic management preparations. Plan ahead. Check local dates, such as agricultural/ village fairs and avoid these periods.

Use of road signs to inform other road users as well as drivers approaching site

Information

Keep local communities informed of your proposed works, key delivery dates and times. Consider door-to-door visits, letter drops, notices in village post office, dissemination via community councils, and newspaper notices. Provide contact details for your Site Manager/Community Liaison Officer so that concerned individuals can speak to an informed individual.

Dry-runs
Always undertake a “dry-run” before abnormal load deliveries commence. Plan this as far in advance as is practical. Keep communities informed.

Driving Skills
Always ensure that there is a banksman present at site entrance(s) to advise departing site vehicles when the “coast is clear”. Never expect public road users to stop for you. Always be courteous and respectful of other road users and the Highway Code.

Reinstatement
Prior to the on-set of works undertake a pre-condition survey with the local roads departments. Agree areas of existing degradation/damage. Ensure that the public highway is maintained during your works (either through the use of the local Roads Department contractors, or approved sub-contractors), and ensure prompt reinstatement of damaged verges and infrastructure. Consider the need for landscaping/planting.

6.4 KEY THINGS TO ADDRESS IN TRAFFIC MANAGEMENT PLAN

- Continued dialogue with local communities, including advance notice of abnormal load deliveries.
- Avoiding school opening and closing times, peak times, holiday periods.
- Road sweepers to clear any residue off public highway.
- A pre-condition survey may be necessary.
- Include key contacts (Police, Trunk Roads, Local Roads Department and other key stakeholders, including local schools/institutions along the proposed transport route(s)).
- Identify any specific environmental risks.

Part 7

Recreation and Access

7.1 INTRODUCTION

Sites chosen for wind farm development are often used for outdoor recreation, both by local residents and, in some cases, visitors from further afield. The number of users will often be small, but some sites may be visited more frequently, depending on existing access arrangements, the attractiveness of the site and its proximity to where people live. The development is an opportunity to create a legacy of improved provision for outdoor recreation. Most developers and landowners will therefore gain significant benefits, including better relations with local communities, from positive management and provision for public access both during construction and operation.

Public access to the outdoors in Scotland is largely based on the Land Reform (Scotland) Act 2003 (LRSA), which establishes statutory rights of responsible access (referred to as Scottish access rights) that apply to most land. These are accompanied by rights of way which apply to particular routes and are established under common law.

Site maps can be produced to aid access and reduce risks to the public

Scottish access rights include crossing over land and non-motorised recreational activities like walking, cycling, angling and horse riding, and will normally apply across the whole area of a planned wind farm development.

The basis of access rights over land is of shared responsibilities, in that those exercising such rights have to act responsibly, following the Scottish Outdoor Access Code, while land owners/managers have a reciprocal responsibility in respecting the interests of those who exercise their rights

The LRSA and SOAC provide the context for access management both during construction and once the wind farm is operational, and this framework is fully integrated with the requirements of other legislation, including health & safety. The HSE were consulted and have helped steer the content of this section.

7.2 PLANNING FOR PUBLIC ACCESS

Arrangements for access provision and management should be set out in an Access Management Plan, which should:

- Identify and map existing patterns of access, including any core paths (designated under the LRSA), rights of way or other well-used paths, and the range of users involved - which might include walkers, cyclists, horse-riders and water-based users.

- Can impacts on access be minimised during construction through a proportionate and dynamic approach to site management (see 7.3).

- Address any specific conditions relating to access in the planning consent.

- Identify any opportunities for improved access provision once the development is in place, such as cycle routes, car parking, new circular routes, routes to particular features of interest within or adjacent to the site (such as viewpoints, hill summits or lochs) or connections to external paths.

- The plan should also consider related design issues, for example path surfaces and any new access infrastructure. New gates should be designed to allow access for all, including cyclists, horse-riders and people with disabilities.

Local authority access officers can advise on access provision and management both during and after construction. This process should also be informed by consultation with relevant local groups and user-representative bodies, which can be identified in conjunction with the access officer.

7.3 MANAGING ACCESS DURING THE CONSTRUCTION PHASE

In addition to the obligations arising from LRSA and SOAC, developers also have obligations relating to the safety of the public under the Health and Safety at Work etc. Act 1974 and the Construction (Design and Management) Regulation 2015 (CDM). These public access and safety requirements work together and should be addressed in an integrated way.

Advisory sign at farm entrance

Access rights may be suspended on land on which construction work is being carried out, except for routes that are core paths or rights of way. This suspension applies to areas where building operations are active, rather than the whole area under the developer's control, and the Scottish Outdoor Access Code underlines that restrictions should be kept to the minimum area and the minimum duration that is reasonable and practicable.

Management arrangements should therefore be flexible enough to take reasonable account of public access requirements and to adapt as the site develops, so that access controls are focused on where the actual risks are present. This ensures that limitations on access are seen to be proportionate

and credible by recreational users. This approach is likely to encourage greater compliance by the public and will be more effective in meeting safety needs. Discussion with the Health & Safety Executive (HSE) has underlined both the importance of this approach and its consistency with the CDM Regulations.

A range of mechanisms can be used to manage access during construction, including informal, proportionate and short-term limitations on access (for the minimum necessary time and area), providing signposted alternative routes and active management of access where work is underway, for example using banksmen. Both the areas where construction work is taking place and routes which lead into and across the site from public roads should be considered.

Although access management must always be considered, the effort required will depend on the assessment of existing levels and patterns of access, and on the range of users involved (see 7.2). Particular time and attention will be needed when:

- There are significant levels of public use;
- The site is of particular importance for sport or recreation;
- The site is close to a community or populated area;
- There are paths present (such as core paths and rights of way) which play a key part in local access provision, with corresponding expectations within the local community;
- Nationally promoted routes (e.g. Scotland's Great Trails), or established rights of way cross the site; or
- The site extends over a particularly large area.

Access tracks that are used by construction traffic can be important for recreational users, particularly where these follow the lines of older tracks which have long been used for public access to the area. Construction traffic should normally expect access takers to be using these routes. Signs can remind the public to look-out for site traffic and to step aside to allow it to pass safely, and drivers should be trained accordingly. During periods of particularly heavy traffic, users can be asked to keep off the track and to use a reasonable alternative route (if there is one), in line with the usual principle of minimum time and minimum area. If this is not possible, mitigation measures should identify other ways to facilitate continued use of the route during these periods.

Maintaining access for a wide range of users will increase the benefits of the wind farm to the local community.

Effective communication with the public will be very important and can be achieved through on-site signs, information boards and way-marking, and other mechanisms such as leaflets, relevant websites, community newsletters and liaison with relevant representative groups. It may be helpful to identify and advertise a key point of contact for members of the public regarding access issues.

7.4 MANAGING ACCESS IN THE OPERATIONAL PHASE

Any new gates, paths, signs and other access infrastructure which have been installed on the site will require periodic maintenance, but an installed wind farm should not in itself raise other access management implications. Public access will often share vehicular tracks with maintenance traffic but this position is common to a wide range of tracks used for forestry and upland estate management and is unlikely to require any special provision.

Wind turbines have a risk of ice throw and warning signs at access points should highlight this issue. These should advise the public not to stand close below towers, and to take care when nearby and in-line with turbine blades, under icy conditions. Developers / operators should undertake an appropriate risk assessment, and implement suitable and appropriate measures to deal with risk.

7.5 LINKS/FURTHER INFORMATION/CONTACTS

Land Reform (Scotland) Act 2003

Scottish Outdoor Access Code

The Construction (Design and Management) Regulations 2015

Countryside Access Design Guide - SNH (2002 with updates)

Management for People – SNH (2004)

Public Access and Land Management - SNH (2007)

Signs Guidance for Farmers and other Land Managers – SNH (2006)

Outdoor Access Signage Guidance – Paths for All Partnership (2009)

A Brief Guide to Preparing an Outdoor Access Plan – SNH (2010)

Part 8

Woodland Management

8.1 INTRODUCTION

Scotland's woodlands and forests contribute significantly to Scotland's economy. They deliver multiple benefits for Scotland's society and play an important role in climate change mitigation by helping the government meet its ambitious greenhouse gas reduction targets. As they are valuable resources, it is important that they are managed in a sustainable manner. The renewable energy sector is a key stakeholder and can contribute greatly to this aim. The following guidance explains how the industry can adopt sustainable forest management standards in the design and construction of wind farms when planning their construction in forests.

Tree planting and sapling protection

This section provides details on:

- The requirement for tree removal
- Permission to fell trees
- Compliance with the UK Forestry Standards
- Tree removal
- The aims of habitat restoration

8.2 KEY CONSIDERATIONS

<u>The requirement for tree removal</u>

a. The UK Forestry Standard (UKFS) (2011) defines the approach of the governments in the UK to sustainable forest management. In Scotland the main body responsible for promoting and regulating the standard and associated guidelines is Forestry Commission Scotland (FCS). The UKFS and its guidelines are intended to be applied by all bodies with responsibilities for controlling the management of forests, including planning authorities when authorising tree planting, removal, or specifying future management standards as part of development consent. The Scottish Government expects all forestry plans and operations in Scotland to comply with the standards and it is therefore incumbent on all developments- when this does not lead to a change in land use- to demonstrate compliance with it.

b. Statutory guidance on woodland removal is included in Scottish Planning Policy (SPP) [para 218]. The Scottish Government's Policy on Control of Woodland Removal (referred to in this chapter as 'the Policy') provides policy direction for decisions on woodland removal in Scotland. It is relevant to all woodland removal for the purposes of conversion to another type of land use. One of the key guiding principles is that woodland removal should only be permitted where it would achieve significant and clearly defined additional public benefits. Where woodland is removed in association with development, SPP indicates that developers will generally be expected to provide compensatory planting. Whilst compensatory planting can potentially take place both off and on site, it will be preferable, where compliant with forestry best practice, for such planting to take place on site or in close proximity to the site. Careful consideration of future repowering options should take account of any compensatory requirements.

c. Where a developer intends to construct a wind farm within a forest, it is crucial that pre-application discussions are conducted as early in the process as possible.

Permission to fell trees

a. In relation to the forested site, planning authorities would expect discussions between the applicant and FCS to have taken place in advance of the scoping process. Applicants should contact the relevant regional Conservancy offices.

On site harvesting operations prior to wind farm construction.

b. Developers are advised to prepare a long term forest plan to provide a strategic vision to deliver environmental benefits through sustainable forest management, as well as describe the major forest operations over a 20 year period. Such a plan should be prepared alongside the ES and it should clearly indicate proposed forest areas for felling to accommodate new turbines, access roads and other infrastructure. The plan should describe the changes to the forest structure, the forest composition and describe the work programme. Operations need to comply with the UK Forestry Standards and associated environmental guidelines.

Compliance with the UKFS

Wind farm ESs should state that the project will be developed and implemented in accordance with the UKFS and associated guidelines. A key component of this is to ensure that even-age forests are progressively restructured in a sustainable manner. To achieve this, felling coupes should be of a scale which is in keeping with the context of the surrounding forest. Forests characterised by a lack of diversity, due to extensive areas of even-aged trees, should be progressively restructured to achieve a diverse structure of habitat- including an appropriate amount of open ground- and species and ages of trees, appropriate to the scale and context.

Tree removal

a. Methods for commercial removal of timber are well developed. Competent specialist advice should always be sought when arranging felling contracts so that safety, environmental and other requirements are fully addressed.

b. Any tree felling carried out without a felling licence or other valid permission is an offence unless it is covered by an exemption.

c. Developers are encouraged to seek competent advice on whether the timber felled will be eligible to be sold as 'Certified timber' under the forest certification schemes operating in the UK. Failure to secure certification can have a significant bearing on the value and saleability of timber, and may have implications for the final 'use' of the timber.

d. SEPA, SNH and FCS have produced and published guidance on use of trees cleared to facilitate development on afforested land (see box 4 below).

e. The harvesting of stumps and root plates can pose a significant risk to the soil and water environment. Accordingly, industry wide guidance on stump harvesting has been developed to encourage good practice and reduce risk. Removal of brash can have similar associated risks however this material can often be processed to fulfil other off- site of on-site uses. The role of brash within the development site needs to be clearly outlined and justified in the ES.

Harvesting adjacent to existing good habitat. Measures should be taken to protect areas of good habitat during felling/chipping.

f. In line with the Forests and Water Guidelines, streams and buffer areas should be kept clear of brash as far as practicable; avoid felling trees into watercourses and remove them or any other accidental blockages that may occur. Whenever chipping or mulching is proposed it should be discussed at an early stage of the planning process with SEPA and SNH.

g. On anything other than the steepest sites commercial harvesting is recommended using ground-based machines called 'harvesters' to fell and process the timber and forwarders to remove the logs from the site. Some brash material can be used to form brash mats for the machinery to move along safely and minimise soil damage and subsequent erosion and diffuse pollution. This method is usually used on mature commercially viable crops. Where the ground is too steep for the safe operation of ground-based machines, aerial extraction systems, known as cable-cranes, are used.

h. On immature crops that are not commercially viable as timber, other off-site uses should be considered and a number of techniques can be used on sites which chip the immature timber and branch wood. These approaches however can have unwanted environmental and regulatory (waste) consequences which require careful consideration.

Box 4. Use of trees cleared to facilitate development on afforested land
Some developers seek management approaches that allow felled trees to remain on site. Depending on their proposed use, materials produced as a result of development may be defined as waste and waste management licensing requirements may apply. In such situations SEPA's "Management of forestry waste" should be referred to.

The preference is for forest materials to be used for economic and environmental benefits and not to be disposed of as waste. We advise developers to:

- Seek professional forester input to quantify volumes, markets and economic uses of trees across the site
- quantify the likely volumes of material for which no economic off-site use can be found and identify valid uses on site for this material, using professional ecological /drainage consultant input where required.

As a general rule, any timber of diameter greater than 7 cm, bark included, should be considered as merchantable timber, and hence will be harvested and extracted from the site.

Where there are difficulties in transportation or concerns regarding market saturation, consideration should be given to phased felling, storage of felled trees on site or initial keyholing to facilitate. The impacts of options for timber extraction and reuse on other interests should also be considered to ensure that addressing one issue does not create another. Site conditions may make it less straightforward to remove trees without causing excessive damage to the soil and compromising the ability of the habitat to recover.

Some tree materials may also be used to support peatland habitat restoration, for example the inclusion of small amounts of brash in re-wetted ditches to provide a scaffold for *Sphagnum* growth. However, the amount of tree material that can be used in such a manner on a site must be fit for purpose and must not result in harm to the environment through, for example, nutrient enrichment.

For chipped material, as a rule of thumb, it is considered that:

- Where existing ground cover vegetation is present in the form of the target vegetation (i.e. the vegetation type that restoration is aiming to achieve), the spreading of chipped material is not acceptable.
- Where existing ground cover vegetation is in a form other than the target vegetation type, provide justification on how the application of forest material would facilitate or improve the restoration.
- Where there is no or sparse existing vegetation, it may be appropriate to apply mulch, along with other measures, to help create the physical requirements to encourage the regeneration of wetland habitats. Mulch should be:
  i) spread in a thin layer to allow the surface of the mulch layer to retain moisture in the surface of the soil where appropriate for the restoration being aimed for, but avoiding smothering of the *in situ* seed bank.
  ii) of random particle size between 5 and 30 cm length.
  iii) spread so as to allow a minimum of 25% light penetration to the ground surface

It is sometimes preferable for brash mats to be removed from the site as a brash layer could allow undesirable seedling regeneration. Where brash mats are to remain on site, the management plan will need to identify active management measures to remove seedlings and prevent the restored area from reverting to a non-target habitat. It is not expected that embedded material will be removed, as this would cause excessive ground disruption.

In general, it is recommended that trees are harvested as close to the ground as possible and that stumps are left in situ.

In some situations it may be appropriate to use forest material in addition to traditional drain blocking methods (such as peat dams or pile dams) to increase the speed with which active peat forming species are able to colonise these linear features. Where this use may be justified, the use of larger material (not brash or fine chipped material) to provide long term physical support to peat forming plants and to minimise the risk of nutrient leaching into the water environment may be appropriate.

i. Monitor tree felling before, during and after the operations to ensure the contractors' compliance with the safety and environmental specifications agreed within the contract.

<u>The aims of habitat restoration following tree removal</u>

Stored timber awaiting transport

a. The Policy describes situations where woodland removal is likely to be appropriate without the need for compensatory planting, for example where it would contribute significantly to enhancing priority habitats or their connectivity. Woodland removal for habitat restoration has to be carefully evaluated, planned and described.

b. Common issues that occur which can complicate the restoration of forested land to open ground habitats include: cultivated and severely disturbed land and hydrology as a result of forestry ploughing and drainage, slope gradient, harvesting residues, tree regeneration, lack of seed source for re-colonisation, colonisation by invasive species unintended pollution, siltation and run off via failed restoration attempts.

c. Long term monitoring is required to inform site management and aftercare. This should ideally be initiated pre-clearance to establish baseline conditions and then continued at an appropriate and pre-agreed frequency and duration post-clearance.

<u>Biosecurity – tree pests and diseases</u>

a. Biosecurity measures are a series of precautionary steps designed to reduce the risk of transmission of harmful organisms and must address 'movement pathways' for such organisms. Good biosecurity practice refers to ways of working that minimise the risk of contamination and the spread of pests, diseases and invasive plants. This section addresses biosecurity issues which are specific to forestry and woodland management, including measures to control invertebrate pests (e.g. insects) that are harmful to trees, and diseases of trees caused by pathogens such as certain bacteria and fungi. Further information on biosecurity in general and to manage invasive non-native species can be found in Part 14.

b. Biosecurity is important when working in any forest or woodland, or when entering land or premises where there is a risk of spreading tree pests and diseases (e.g. where timber is stored).

c. Pests are most often transported in soil or organic material, such as plant debris, that can be carried on footwear or on wheels of vehicles and forest machinery. Diseases may also be spread via equipment used for tree work. Some pathogens are dispersed in water, in which case the risk of these being spread increases under wet conditions.

d. Assess the level of biosecurity needed at an early stage. If in doubt seek advice. Is there any evidence that leads you to suspect that a damaging tree pest or disease is present on site? If a damaging tree pest or disease is present

and there is a risk of further spreading then implement biosecurity measures for high risk sites, as detailed in the Forestry Commission guidance.

e. If you suspect a damaging pest or disease, previously unknown at a site, then inform Forestry Commission Plant Health team.

f. Assess the risk of activities to be carried out in relevant areas. Low risk activities include routine operations that are unlikely to involve contact with high risk pests and diseases. High risk activities include targeted operations that may involve contact with infested or infected trees, soil or other material. **If in any doubt, err on the side of caution and adopt high risk biosecurity control measures (see Section 14).**

g. **Low risk biosecurity control**:

- Ensure footwear is clean prior to going on site (visually free from loose soil and plant debris). If necessary brush or wash in soapy water. Make use of any facilities provided at the premises to clean footwear if required by the site manager;

- Ensure that vehicles are cleaned regularly to remove any accumulated mud, especially from wheels and wheel arches;

- Ensure all tools and equipment are clean, serviceable and free from organic debris;

- Keep vehicular access to a minimum: do not enter areas unnecessarily and, where practicable, keep to established hard tracks.

h. **High risk biosecurity control**:

- Clean and, where relevant, disinfect footwear;

- Clean and, where relevant, disinfect tools, particularly cutting equipment such as secateurs or knives after each time they are used and before moving on to the next plant or tree;

- If vehicles have entered an area where a damaging tree pest is known or suspected to be present, and have been taken off hard roads, ensure that the tyres and wheel arches are adequately cleaned and disinfected well away from drains and water courses and before leaving the site.

i. All staff visiting sites where there is a possibility of contamination should carry a basic disinfection kit (see Annex A of the Forestry Commission Biosecurity Guidance).

j. Details of biosecurity measures to take for low-risk and high-risk activities are provided in the Forestry Commission leaflet on Biosecurity. Information in section 14.4 of this guidance provides relevant guidance on vehicle and equipment biosecurity measures. Further detail can be found in the Forestry Commission Biosecurity Guidance.

8.3 LINKS/FURTHER INFORMATION/CONTACTS

Forestry Commission: UK Forestry Standards and associated guidelines (Fifth edition)

Scottish Government's Policy on Control of Woodland Removal

Guidance on Implementation of the Policy on Control of Woodland Removal

Forestry Commission technical note "Protecting the Environment during Mechanised Harvesting Operations."

Stump harvesting: Interim guidance on site selection and good practice

Guidance for site selection for brash removal

Use of trees on development sites

Restoring afforested peat bogs

SNH Wind farm proposals on afforested sites – advice on measures to minimise attractiveness to hen harrier, merlin and short-eared owl (2015).

Forestry Commission – Biosecurity Guidance

Forestry Commission leaflet – Biosecurity: good working practice for those involved in forestry leaflet

Forestry Commission – Tree pests and diseases

Forestry Commission – Biosecurity pages

Part 9
Drainage

9.1 INTRODUCTION

This section considers the need for a drainage strategy for the wind farm site. It provides detailed methods for the collection and treatment of all surface water runoff from hard standing areas and roads using sustainable drainage principles. Getting drainage right from the start of the construction process will significantly reduce environmental risks and delays.

The following recommendations and general principles should be adhered to on site, throughout all stages of construction from initial site investigation through to the operation stage:

- Engineering activities such as culverts, bridges, watercourse diversions, bank modifications and dams are avoided wherever possible in order to maintain the natural state of the water environment. Necessary watercourse crossings should use bridging solutions or bottomless arched culverts with abutments sufficiently set back so as not to affect the bed and banks, ecology, and water levels of the watercourse.

Sediment lagoons should always be situated away from watercourses, unless, as in this case, there are no alternatives. Better pre-construction planning should address this.

- Appropriate buffer zones between water bodies and construction areas are established.
- No large capacity build ups of surface water can occur that could lead to additional loadings being placed on the surrounding ground- that may lead to soil failure, especially in areas with peat stability concerns.
- Any effects on natural flora and fauna are minimised, and there are no indirect impacts on any surrounding designated sites.
- Impacts on sites of archaeological interest are avoided, including indirect impacts.
- Pollution Prevention and Environmental Protection Legislation are adhered to.
- Works are allowed to progress efficiently without flash wash-out events affecting partially completed sections.
- The completed wind farm can be suitably operated with the minimum maintenance to the installed drainage systems.

- Both temporary and long term foul drainage provisions and maintenance are considered and authorisation sought if applicable.

9.2 RELEVANT LEGISLATION

The Water Environment and Water Services (Scotland) Act 2003 (WEWS Act) gave Scottish Ministers powers to introduce regulatory controls over water activities, in order to protect, improve and promote sustainable use of Scotland's water environment. This includes wetlands, rivers, lochs, transitional waters (estuaries), coastal waters and groundwater.

The Water Environment (Controlled Activities) (Scotland) Regulations 2005 are more commonly known as the Controlled Activity Regulations (CAR). If you intend to carry out any activity which may affect Scotland's water environment, (this includes wetlands, rivers, lochs, transitional waters [estuaries], coastal waters and groundwater) you must be authorised to do so. Discharges, disposal to land, abstractions, impoundments and engineering works are all regulated by SEPA. Early engagement with SEPA is recommended.

9.3 KEY CONSIDERATIONS

- **Do** get to know your site, to understand drainage paths, downstream users, and areas where flows would normally collect and discharge.

- **Do** produce a water management plan

- **Do** identify potential "pinch points" which are likely to cause issues during construction such as long straight slopes or spots where the access track is particularly close to water courses or conduit.

- **Do** encourage diffuse movement of water across the site which preserves local hydrology and prevents issues with habitat mobilisation. Aim for water to be discharged in planar sheet flow way rather than as a single point discharge in order to slow and spread the flow and minimise potential scour.

- **Do** consider options for habitat enhancement or restoration through appropriate drain blocking and other measures.

- **Do** keep existing natural hydrology and hydrogeology in balance as far as reasonably practical. This includes preventing the under-draining of wetlands which are protected under WEWS 2003.

- **Do** keep clean water flows clean, by not allowing mixing with "construction" drainage. This means that there are less volumes of contaminated/ discoloured water to treat.

- **Do** include many small/mid diameter offlets, rather than collecting larger volumes of drainage flows to discharge to a smaller number of larger capacity outlet points.

- **Do not** allow direct, contaminated ditch discharge into watercourses, lochs and sensitive wetlands or grasslands.

- **Do not** divert natural flows, unless under prior agreement with SEPA.

SEPA's experience is that the discharging of surface water to vegetation is not an effective way of taking out fine material such as silt, particularly on upland sites where ground is often sloping, waterlogged or frozen. Whilst the discharging of surface water to vegetation is an acceptable method of disposing of excess clean water it should not be considered as a "treatment" stage in and of itself for silt laden run-off.

9.4 ACCESS TRACK DRAINAGE

Pre-earthworks drainage

This is the term generally given to cut-off/diversion ditches that are installed ahead of the main earthworks activities to minimise the effects of collected water on the stripped/exposed soils once earthworks commence.

These drainage ditches should be installed on the "high-side" boundary of the areas that will be affected by the access track earthworks operations, and should be installed immediately ahead of the main track construction operations commencing. They should generally follow the natural flow of the ground with a generally constant depth to ditch invert. They should have shallow longitudinal gradients. Their purpose is to intercept any storm water surface run-off, and collect it to the existing low points in the ground, allowing the clean water flows to be transferred independently through the works without mixing with the "construction" drainage.

This can be achieved through dedicated piped culverts and results in a significant reduction of the volumes of discoloured run-off that would require treatment prior to passing across the riparian zone, and ultimately filtering into the existing main watercourses.

In some locations substantial 'Step' designed settlement lagoons may be required to manage large volumes of contaminated run-off.

Depending on the types of soils that are local to the area the profile of the ditch can vary from a sharp 'V' to a flatter sided 'U' shape. "V" ditches tend to maintain more existing vegetation as their plan footprint is lesser than a flatter wider "U" ditch but are generally successful in harder ground conditions that would not be susceptible to erosion. A flatter "U" ditch has the benefit of allowing easier access, and egress to wildlife. Ideally, all ditches should be reinstated unless they are required for longer term drainage management of site infrastructure. If at all possible, any stripped turves should be placed back in the invert and sides of the ditches to assist regeneration, and to reduce potential erosion in softer soils.

Permanent track drainage

Track edge drainage is required to control run-off from the running surface to lower water levels in the subgrade, to control surface water and groundwater from adjacent higher ground, and to carry this flow to outlet points. They can also create habitats if designed sustainably. These ditches are nominally a uniform depth, and their invert gradient follows the track gradient. To reduce the potential for a larger volume flow collecting, it is important to install intermediate (closer-centred) offlet culverts under the built track with ditch blockers being installed immediately downstream of the culvert inlet. By introducing more offlets, this reduces the volumes of flows in the ditches and provides a more even redistribution onto the existing riparian zone. This flow reduction also lessens the potential for track edge erosion during periods of high rainfall. Where possible, consider sustainable drainage options, such as swales, to allow for sphagnum build up for habitat creation (in peatland locations), improved flow rates and attenuation, and natural sediment capture.

In sections of long cutting, a settlement lagoon may be required in a suitable location to deal with any flow in-rush capacity, and to allow settling out of the finer materials. It is important that the track surface remains free from standing water, and that any collected water is released through a settlement area, before reaching any watercourses, lochs, groundwater or sensitive wetlands.

Culvert under road – better attention to detail would 'hide' the exposed pipe.

CASE STUDY: HARESTANES WIND FARM

Harestanes Wind Farm is located within the Forest of Ae, a commercial forestry plantation in the South of Scotland. Construction works, over a 2 year period, involved the construction/upgrading of 60km of site access roads, 250km of underground cable, 600ha of tree clearance, 68 turbines, on-site concrete batching and the operation of 8 on-site borrow pits. The site lies within two river catchments, the Water of Ae and the Kinnel Water, both which are tributaries of the River Annan and are important for salmon and trout populations.

Prior to construction works commencing, a range of surface water management measures were planned, detailed and installed throughout the site. These measures were then reviewed, improved and maintained with support from the site team (developer, principal contractor, sub-contractors, dedicated contractors' Environmental Team, full-time independent Ecological Clerk of Works & other specialists) and further developed through stakeholder engagement.

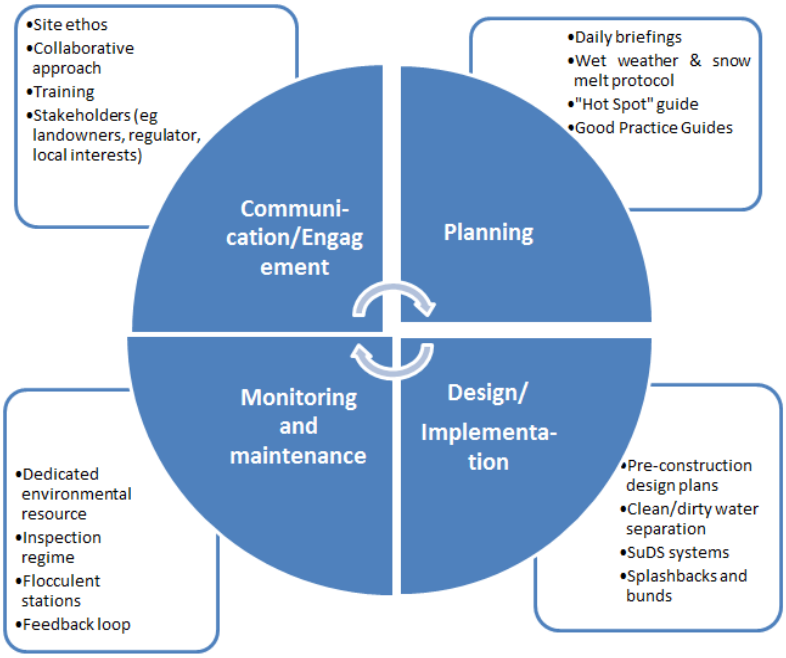


Figure 1 – Surface Water Management measures and controls

Despite these measures, and due to various site complexities (such as poor stone quality, large-scale earth works over winter period, complex existing forest drainage network, site topography, intense periods of wet weather including snow melt), silty water run-off issues were experienced on the site in early 2013. Additional solutions to manage and mitigate surface water run off throughout the site were required, in order to protect the surrounding environment.

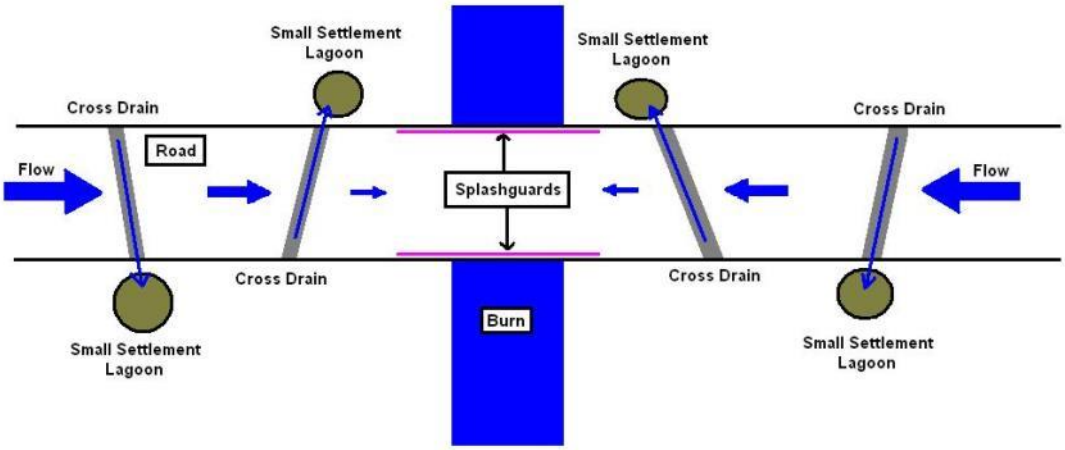
A collaborative approach was adopted by the site team in the development and implementation of further solutions to surface water management on the site (as shown in the diagram), and included the involvement of key stakeholders and regulators. Approximately **120 surface water management systems** were installed throughout the site, with more than **500 settlement pond**s being constructed.

These systems were further supplemented by "Good Practice Guides" prepared by the contractor, which detailed solutions to issues arising on the site. These solutions included the innovative clean water separation systems using flexible pipes, temporary bridge deck drainage methods, installation of flocculent dosing stations, splash-backs and bunds at road crossings and extensive series of settlement ponds. ***The approach adopted on the project managed to successfully overcome the complex site characteristics and challenges.***

Culverts/Headwalls/Outlets

The main method of transferring the collected surface waters 'through' the track, allowing water flow balance to be maintained, is through the use of culverts, or piped crossings. These culverts transfer flows from track side ditches, or are installed to ensure that existing paths in periods of high rainfall are maintained.

The culverts should be of suitable diameter to allow sufficient surface water transfer in periods of excessive rainfall, and should have further capacity allowed as a factor of safety assuming that in some cases a build-up of deposits in the invert level could reduce overall capacity.



The culverts should be installed in such a way that the invert levels are slightly lower than the corresponding levels on the inlet and outlet sides, to allow a natural bed to form.

Culverts should not be installed with a "hanging" outlet (i.e. significantly higher than the corresponding ground level), as this will cause erosion of the ground through the forced action of the water flows, and would not provide a suitable path for small mammals to use in periods of drier conditions. Headwalls should be provided around the inlet and outlet ends of the culverts to retain the track building materials, as well as to minimise any subsequent wash-in of finer materials from the track causing potential blockage to the culvert ends.

Culverts should be designed to allow for easy escape for species i.e. otter, water vole, and reptiles.

Where drainage ditches have been installed in materials that may give rise to erosion, silt traps should be installed which take the form of a formed pit, which could either be situated at the inlet, or outlet ends or both. It may be necessary to construct a retaining structure (e.g. pre-cast manhole ring units) to ensure that a robust structure is in place to allow future maintenance to take place without damage or erosion to the substrate material. A route should be provided out of these ditches for small mammals that may become trapped.

Cross-drain on access track

Track Running Surface Cross-drains

On sections of tracks that have particularly long gradients, surface erosion can occur following periods of persistent rainfall. Due to the design (normal WTG component delivery vehicle) specifications that usually limit the amount of track camber or crossfall, the surface water tends to run down the roadline, accumulating as it nears the lower sections. This can lead to significant volumes of flow on the access track that scour out the running surface, causing runnels to form that accentuate the problem.

To alleviate this issue, it is recommended to install a series of surface cross-drains to intercept these flows, and divert then into the side ditches, preventing the build-up of flow. These cross-drains can be constructed with channels of various materials but should be strong enough to withstand the expected traffic loadings.

9.5 ADDITIONAL PROTECTION MEASURES

During the construction process provision should be made for a combination of some or all of the techniques listed below:

Silt Traps

Silt traps can be a simple and effective method of controlling sediment laden run-off, but are limited by capacity of what the expected flows are likely to be. These can be installed either on the inlet (sump) or outlet side of culverts but must be robust enough to allow for frequent clearing out of collected sediments.

Any installed silt traps should be regularly inspected and procedures should be put in place to have them cleared out regularly. It is recommended that this be done in a period of dry weather, when flows would not affect the disturbed silt materials.

Silt Fencing

This system involves the installation of some semi-permeable geotextile fabric, vertically held on simple timber posts, and is used primarily as an additional means of filtering out sediments from run-off water. The fences can be installed (to manufacturers' recommendations) alongside any sensitive areas, e.g. watercourses, large areas of stripped materials, or downstream from outlet ends of culverts, and can usually be arranged in a horse-shoe style configuration to contain, and allow settlement of suspended sediments. Bales can also be installed in multiple layers to great effect; however their effectiveness is reliant on proper installation and ongoing maintenance.

Straw Bales

Straw bales can be used to filter out sediments from normal flows in drainage ditches, but their installation positions should be carefully considered, and should allow for potential overtopping in periods of high flow.

Straw bale 'pinned' in place

They should be pinned securely in position to avoid being washed down into larger watercourses. Bales can become saturated and can become very heavy to manually move, so a means of mechanical recovery and replacement also needs to be considered. These require to be replaced periodically, once they become silt-laden. Bales that become silt-laden, and cease to be effective require to be discarded in an appropriate manner subject to relevant waste legislation.

Check Dams

Used in a similar way to hay bales, these consist of clean gravel used to create a filtration device. They need to be solid enough to not be washed away and to slow movement of water through the drainage system and increase the retention time for silty water in the system.

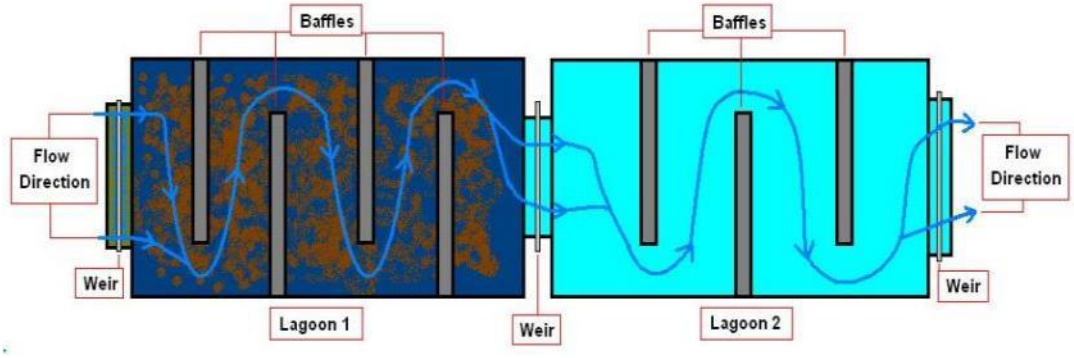
Regular, robust check dams on road sloping ditches

Settlement lagoons

Large capacity settlement lagoons require careful planning and location. Calculate and forecast the expected volumes of flows that they will be required to cope with is necessary. Lagoons are particularly effective where a large run-off volume is expected and suitable small scale dispersal to suitable vegetation would not be successful.

Settlement lagoons normally take the form of a large contained pool area, either partially dug in to the ground or bunded to act as a barrier to stop the surface run-off escaping. This pool should be further compartmentalised to allow different levels of filtration and settlement to occur, progressively, from the inlet end through to the eventual discharge end. Care is required to ensure that the sidewalls are strong enough to withstand any potential loadings as an uncontrolled discharge (burst) could have serious environmental consequences.

For further information, refer to the CIRIA C648 guidance on Control of Water Pollution from Linear Construction Projects.



Settlement lagoon good practice

Flocculent dosing

Where all other possibilities of sediment control have been considered, tried, or discounted, another method to increase the rate of settlement would be by the introduction of liquid, or solid dosed flocculants. These work by pulling together finer suspended solids, into larger and therefore heavier particles that settle out quicker. The use of flocculant agents should be considered where there are limits on available space. Liquid flocculants can be dosed into settlement lagoons, and solid flocculant blocks can be set in flowing water to slowly dissolve, thereby giving a 'dose' to the suspended sediments in the run-off. Specialist assistance should be sought if this option is being considered, and approvals from the statutory agencies sought, prior to use.

Pumping

Where there is a significant build-up of water it may be necessary to pump this to avoid further build up, or to allow works to progress in that area. Any discharge from pumping should enter a settlement lagoon, an appropriate distance away from watercourses, lochs, sensitive wetlands and groundwater in order to filter out any suspended sediments. Proprietary equipment such as "Siltbuster" type tanks can also be used to assist with the reduction of suspended solids.

Watercourse Crossings

The location of watercourses should be given careful consideration in determining the routing of roads and pipelines and the location of temporary and permanent infrastructure. The crossing of watercourses is to be avoided where possible. Where these are necessary developers should use bridging structures or bottomless/arched culverts which will not impact on the bottom, banks and ecology of the watercourse.

Bridge and bank habitat. Steep sides of loose material could be washed off in a storm event. Use of splash boards on bridges can prevent contamination of watercourses.

All watercourse crossings must be carried out in accordance with the Controlled Activity Regulations. Controls range from

General Binding Rules, through to complex licences. Further information should be sought from SEPA. For each level of authorisation, different timescales apply, and these timescales should be allowed for in the overall Construction Planning.

Maintenance

- Any protection measures should be regularly inspected, and procedures should be put in place to have any collected sediment cleared out to ensure maximum capacity can be maintained. Clearing out should done in a period of dry weather, when flows would not affect the disturbed sediment materials. Headwall conditions should be checked as well as the inlet, and outlet ends of culverts to ensure no blockages are evident.

- If there are any permanent settlement lagoons these should be checked for leakage. Following periods of heavy rainfall, if there has been sufficient settling of sediments, water levels should be lowered to allow increased containment capacity to be available within the lagoon for the next rainfall period.

- Ditches should be checked for blockages, and kept clear and in good order. Any growing vegetation in ditches should be left as this will aid in the filtering of some of the sediments.

- Surface water quality (including turbidity/suspended solids) should be monitored before, during and after construction, in addition to regular visual inspections (as noted above). This is to ensure the effectiveness of the mitigation measures and a minimal effect on aquatic flora and fauna.

- Draw up a Surface Water Action Plan outlining trigger points at which action will be taken should a problem occur, e.g. pollution event, release of sediment etc. Trigger points should be related to monitoring activities informed by baseline data.

A well designed and located cement wash out bay can prevent bad practice elsewhere on site. A ticketing system to ensure it is used by all drivers has been shown to be useful.

9.7 LINKS/FURTHER INFORMATION/CONTACTS

Forestry Commission: Forests and Water Guidelines (Fifth edition)

CIRIA Publications: Control of Water Pollution from Linear Construction Projects. Site Guide

SEPA Pollution Prevention Guidelines

HSE: 'Avoiding Dangers to Underground Services'

Scottish Government: 'River Crossings and Migratory Fish' (2000)

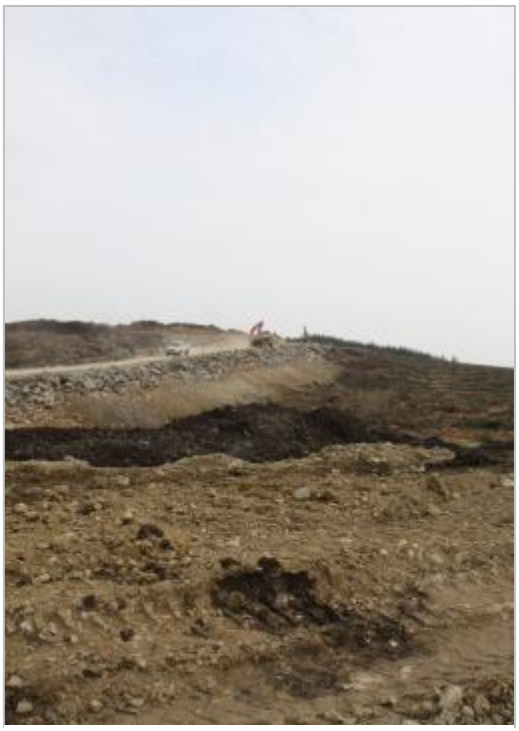
Part 10

Construction of Access Tracks

10.1 INTRODUCTION

The Access Tracks constructed on a wind farm are required for four main phases of the works:

1. Initial installation to allow the main construction plant, personnel, and materials to gain access to the remaining areas of the site to allow the construction of the civil and electrical infrastructure.
2. Safe haulage of the main Wind Turbine Generator component parts and access for cranes.
3. Long term access for the Operational & Maintenance needs of the wind farm, as well as providing amenity access for landowners and the public.
4. Access for the eventual decommissioning of the wind farm.



A very steep track edge which should be properly restored post construction.

Getting the track construction correct means that, with properly considered design and construction methods, you can expect to:

- Avoid track failure
- Reduce volumes of sediment laden run-off during, and post-construction
- Reduce quantities of road stone used
- Minimise waste production
- Avoid delays in allowing access for wind turbine component deliveries
- Reduce timescales for the re-generation of reinstated verges
- Limit the long-term requirement for maintenance
- Minimise the impact on the existing landscape and habitat by careful micrositing, construction and restoration of tracks.
- Avoid impacts on sites of archaeological interest
- Improve success of decommissioning activities on site

10.2 KEY CONSIDERATIONS

- Where a wind farm is proposed in an upland area then this section should be read in conjunction with the SNH publications 'Constructed tracks in the Scottish Uplands' and 'Floating Roads on Peat' (2010).

- Drainage (please refer to Drainage section 9)

- Pre-Construction tasks:
  - Existing ground conditions analysis
  - Existing ground surveys/Topography
  - Catchment/Run-off studies
  - Construction Planning (including waste management)
  - Limits of Construction
  - Existing services and other constraints

- Track Design:
  - Alignment Horizontal & Vertical, and consideration of upgrading existing tracks
  - Peat Stability issues
  - Specification requirements

- Track Construction:
  - Floating Construction (geogrid types, structural stability, hydrology, inclusion of existing roots and vegetation)
  - Traditional 'Cut & Fill' Construction (consider an estimate of the excavated material that this technique will generate)
  - Rock Source; Quantity & Quality
  - Ditches/Culverts/Catchpits (Temporary and Permanent)

- Verge Reprofiling/reinstatement (please refer to chapter 14)

- Operational Maintenance

10.3 PRE-CONSTRUCTION TASKS

It is essential that there is a full understanding of the area where the tracks are proposed. This should cover the following points:

Topography of the ground ought to be considered ranging from detailed reviews of current mapping, right through to detailed ground surveys. This information is also important to assess the potential catchment area for expected ground water and surface water run-off, as this will be required when sizing culverts, spacing off-lets, settlement lagoons etc. Access tracks should avoid water bodies wherever possible. It is also important that tracks and access to and from borrow pits are considered.

The Ecological Clerk of Works (ECoW) should be on site to advise on the final track route to minimise habitat impact. The ECoW will also advise on the placement of mitigation in the track structure to maintain natural groundwater or surface water flows – this may be a requirement to meet planning conditions.

Results from a comprehensive **ground investigation** should also be reviewed to understand what the expected ground conditions will be. Important information from the ground investigations for tracks includes **peat/topsoil probing**, and **trial pitting,** in-situ shear vane tests, particle size distributions**.** This information allows a full understanding of the ground make-up.

Initially, peat probing should be carried out over a wide corridor, within the **limits of construction** (set through the Planning Permission) and roughly following the intended track line. The results of detailed probing of sufficient intensity (including characterisation of peat and habitats present) could then allow a more detailed fix of the tracks' intended centre-line, avoiding areas of deeper peat, or sloping

ground.

A series of “on-line” trial pits should be commissioned to allow physical cross-checks to correlate the probing of the softer materials, and to provide an inspection of the underlying soil types. Good ground investigation is extremely important when considering the types of track construction to be employed, when assessing the need for additional reinforcement materials and when considering any potential slope stability issues, borrow pits and waste management.

Construction of a cut road

10.4 TRACK DESIGN

During the more detailed **track design** stages, the specification limits for the intended track construction must be fully considered. Usually there are limits set by either the turbine supplier, or delivery contractor, for horizontal, and vertical alignment gradients, as well as minimum track widths, and load bearing capacities. At this stage, a Geotechnical Engineer may need to be consulted to ascertain any potential issues with regard to the intended track construction style, track gradients, temporary construction stages and how this may affect the stability of the existing ground form, and in particular any potential **peat stability** issues. Throughout the construction phase it is also recommended that regular Geotechnical inspections are made to promote good practice, and that forums are created to review and discuss any potential concerns.

Prior to the **commencement of construction**, it is advised that the centre-line of the track is “set-out”, and a walk over is performed by the site manager or general foreman, along with the Geotechnical Engineer, and appropriate Clerk of Works (please refer to Section 5). This should be carried out to check that the ground conditions/drainage paths are as expected, sites of archaeological interest are adequately fenced off, and if “fine-tuning” of the alignment is required. This can usually be accommodated without too great an effect on construction progress.

Any requirement to install pre-earthworks drainage can also be carried out at this stage, once the final line has been agreed. In sensitive sites, the installation of drains and settlement lagoons in advance of the track construction is considered good practice.

10.5 TRACK CONSTRUCTION

The track construction method generally follows one of two options:

- A **"Floating track"** where the vegetation and supporting subsoils remain intact, with a track built off the existing ground surface supported with the introduction of geotextiles and geo-grids to reinforce the track building roadstone. This technique may produce less waste due to a reduction in the amount of excavation required.

Poor floating road construction, e.g. attention to detail is required at track edges to prevent construction material spilling onto surrounding vegetation. Tipping large aggregate onto the geogrid, as shown, is unlikely to create the necessary interlock with the geogrid. Please refer to 'Floating road on Peat' guidance.

- A more traditional **"Cut & Fill track"**, is generally constructed where there is a relatively thin layer of vegetation, and soft (soils/subsoils) materials that can be easily removed to provide a suitable bearing layer, or if the topography is steeper, and floating construction is not considered acceptable. Note that this technique may generate more excavated material.

<u>Floating tracks</u>

These tracks are commonly constructed across areas of deep soft materials usually gently rolling peat, or occasionally soft poor-strength clays. It is important that the topography of the surrounding area is fully understood and that a suitable peat probe survey has been carried out to inform the type of construction. Floating tracks are not recommended on areas where the "crossfall", or slope of the virgin ground is of a magnitude that could lead to a slip or a circular failure. Where the strength of the virgin materials could not support the loadings of the track construction plant and materials, and more significantly the weight of the WTG components & vehicles during the delivery stages, cut and fill might be more appropriate. Some crane types may have to be de-rigged to travel on floating roads due to the loading.

For best results the vegetation layer should be left in place, and in the case of clear-felled forested areas, the tree roots systems should not be grubbed up, but the stump remains should be cut/ground to the vegetation level. Where feasible and appropriate, brash from woodland removal can be re-used to add support to a floating road.

A full installation procedure is given in the SNH/FCE publication 'Floating Roads on Peat' (2010).

Cable trenching remaining "open", and drainage ditches in close proximity to floating track areas, can offer void space for underlying soft materials to migrate into from track edges. This can cause weak points in the track. Any gathered surface water should be allowed to run off the track edges, at very close intervals across the verges, and onto the neighbouring vegetation, to avoid any surface ponding.

Surveying floating road structural integrity. Note that excessive material should not be placed on the side of tracks as shown on the left of this image.

Cut & Fill tracks

These tracks are constructed in a more traditional form, where the vegetation layer (nominally the top 300mm) and remaining underlying "soft" materials are removed, allowing access to construct off the sub-soil or bed-rock, which would usually consist of better bearing capacity material.

After the centre-line of the track has been set-out, and any required pre-earthworks drainage provisions have been made, the corridor of the intended track is marked out to allow the excavators to commence. The vegetation and materials holding the seedbank, (300mm of the top of the softer materials) should be stripped, and carefully set aside for re-use in the reprofiling and reinstatement works.

Where practical, whole turves should be set aside, watered (if required) and stored vegetation side up, for use in restoration. The sub-soil materials can then be assessed, and in some cases some localised soft-spots may require to be excavated and replaced with better quality, imported materials. If the bearing materials are assessed as being "marginal", it may also be necessary to install some geotextile reinforcement to spread the track load over the bearing surface.

Care is required to ensure that the surface of the tracks do not hold standing water, as this can lead to more extensive maintenance being required to fill potholes and can lead to premature track failures.

For best results when constructing the final running surfaces of the tracks it is important that a **good quality stone which is suitable for the specific task** is utilised. "Making do" with a substandard material, that will break down more readily, will lead to more silt-laden run-off, more maintenance and earlier track deterioration. Expert geotechnical advice should be sought where the suitability of a given material is uncertain. The source rock should be of good quality either from an external quarry, or from an on-site "Borrow-Pit". As a guide, rock that can be easily extracted from the borrow-pit is generally rock that is quicker, or more prone, to deteriorate as a running surface (has a higher levels of fines), and become a source of pollution. If the quality of rock is poor then an alternative source should be considered, or suitable mitigation implemented.

When sourcing rock, sands or gravels, it should be borne in mind that these are non-renewable resources and their extraction may have a permanent impact on the earth science interests of the area. Further guidance is available in SNH's 'Constructed tracks in the Scottish Uplands' (2015).

Verge Reinstatements

Once the track running surface has been installed, the verges can be reinstated. The main objective is to create a good landscape tie-in with the original ground form and habitat. To secure the best results, the previously stripped soils should be brought back over the verges as quickly as possible, as this gives the seedbank and vegetation the best chance of an early regeneration. Replacing whole turves is the ideal method of restoration.

An example of bad practice. Excavated peat placed 4m from edge of access track. Note that no peat turves have been re-used. This peat is likely to dry out and provides no ecological benefit.

The soils should not be spread back on the verges too thinly as the material may then have a tendency to dry out and crack (particularly during the summer months) before the root system has had a chance to form, stabilising the surrounding soils. There will be differences in the growing performance depending on season, and altitude, but an early reinstatement generally provides for the most beneficial results.

An example of good practice. Track edges have been reinstated with whole turves.

There is no ecological benefit from using excess and unsuitable material to create shoulders on floating roads or cut tracks. The soil smothers the existing vegetation, preventing natural re-growth of bog vegetation adjacent to tracks. Also, the material will likely be unstable and at increased risk of drying out, which may lead to carbon loss or runoff problems. Guidance on the appropriate use of peat for floating road edges is provided in 'Floating Roads on Peat'(2010).

Operational Maintenance

Wind farm tracks require careful monitoring to ensure that there is no significant standing water forming, which would lead to potholes in the running surface. If there are areas of track identified that are causing concern, repairs should be carried out in favourable, preferably dry, conditions, to ensure that there is no saturation of the surface of the track. It is also important to check that it is always possible for the surface run-off to clear the road edges. It will be necessary to clear channels to allow the run-off to exit clearly. Transverse camber or cross fall surface profile should be maintained.

Because of the unbound nature of the access tracks they will be susceptible to the freeze/thaw effects of frost (frost heave). Saturated water within the track matrix can freeze and expand. Subsequent thawing will leave the track surface soft, due to the previously expanded frozen material now appearing more ”open” than before.

It is not recommended that commercial road salts be used, as although they will locally thaw the build-up of ice, they can also have a damaging effect on the track surface, the verge vegetation, and a negative effect on the water environment.

10.6 KEY ITEMS TO ADDRESS IN CONSTRUCTION METHOD STATEMENT

- Prevent uncontrolled surface run-off by including pre-earthworks drainage, silt traps, settlement lagoons, silt fencing, etc.

- Consider details in a CEMP and look at the pre-construction, construction, and post construction phase performance of the track build.

Reinstated turves at road verge provide optimal restoration. Careful supervision of works may be required to achieve this.

- Plan for suitable areas for the storage and maintenance of “soft” materials that are to be temporarily stored, effectively managed and suitably utilised in a later construction phase, e.g. peat turves.

- Has the need for snow poles, and the frequency of passing places along the route been properly considered?

- Gather all available information to gain a full understanding of the terrain, and soil types, in the area you are to work on, with particular respect to potential peat stability issues and surface / ground water movements.

- Understand the likely source, and quality of the roadstone that will be available to construct the tracks.

10.7 LINKS/FURTHER INFORMATION/CONTACTS

Forestry Commission: Forests and Water Guidelines (Fifth edition)

CIRIA Publications: Control of Water Pollution from Linear Construction Projects. Site Guide

The Water Environment (Controlled Activities)(Scotland) Regulations 2005

Constructed Tracks in the Scottish Uplands (2015)

Floating Roads on Peat (2010)

Part 11
Site Compound

11.1 INTRODUCTION

All wind farms require a site compound during the construction stage of the project. Typically the compound would include office and welfare facilities, parking, laydown and storage areas.

Under the Construction (Design and Management) Regulations 2015 (CDM) it is the Client's responsibility to ensure suitable welfare facilities are provided from the start for workers under their control, and maintain them throughout the work.

This section provides details on best practice for design considerations and construction methods, including possible environmental mitigation methods. Specifically this includes:

i. Location of the site compound.
ii. Design of the site compound and construction methods.
iii. Environmental mitigation methods.
iv. Reinstatement of site compound.

Considerable lay-down areas are required on site and should be planned for early in the process.

11.2 KEY CONSIDERATIONS

a) <u>Location of the site compound</u>

The location of the compound is normally part of the planning consent and any impacts, including visual intrusion and ground conditions, should have been considered as part of the Environmental Impact Assessment.

The site compound is normally situated towards the entrance of the site to enable control of material onto the site, ease of access for workers and visitors, and ease of construction at the beginning of the works.

When considering the location of the compound at the construction phase the following should be reviewed from earlier planning stages:

i. Distance from watercourses, lochs and wetlands
ii. Topography of the area
iii. Ground conditions
iv. Hydrology
v. Designated Sites and protected species
vi. Visual impact
vii. Sites of archaeological interest

The results of baseline surveys (and any subsequent survey work) should provide much of the information required.

b) Design of the compound and construction methods

During the design phase it is desirable to minimise the overall footprint of the site compound. Where the compound has been proposed on an inclined area, the use of split level areas should be considered to reduce the excavation into the slope and balance the cut and fill required on the area thus minimising haulage of excavated material.

When designing the compound the use of a perimeter drain should be assessed. Where the surface drainage across the compound could affect its integrity a perimeter drain should be designed taking into account mitigation for sediment transport. Where surface drainage is unlikely to affect the compound, perimeter drains should be avoided thus preventing impact on the hydrology of the area and potential of sediment transport.

When constructing the site compound the peat/topsoil should be stripped and stored in a suitable location even when using geotextile material. Suitable stone should be placed and compacted to create the compound. It is important that the stone does not include a high percentage of fines which could increase the risk of sediment contamination of the adjacent area and watercourses.

The site facilities will include mess and toilet facilities for the site workers. The design of the effluent system, either septic tank and soakaway or contained tank, will depend on the sensitivity of the adjacent area. Where soakaways are proposed they should be kept as far away from watercourses as feasibly possible. SEPA licences may be required.

If compound lighting is required it should be designed to minimise light pollution to the surrounding area. All lights should face inwards to reduce overall environmental impact.

Normally bulk fuel and oil storage will be within the site compound area. Suitable bunded areas should be designed and constructed to meet the requirements of SEPA's pollution prevention guidelines and oil storage regulations (PPG 6 and 8). Additional facilities should be provided for other hazardous materials e.g. non-bulk fuel and waste oils.

c) Environmental Mitigation Methods

The highest risk of pollution is sediment transport from runoff across the compound area. The use of silt/sediment traps, settlement ponds and hay/straw bale barriers should be considered to prevent sediment entering watercourses. Where high percentages of clays and silts occur, the use of flocculants should be considered to reduce settlement time (which may take weeks). Flocculants should only be used following consultation with SEPA and relevant fisheries groups.

Oil pollution, from high levels of traffic in this area may make its way into groundwater if spilled on hard standing (un-made ground). Oil / water interceptors can also be installed in the vehicle bays.

The contractors on-site should have an emergency procedure for dealing with oil and fuel spills. Emergency spill kits should be available within the compound and a contract with a 24 hour response environmental clean-up company should be in place for the construction period.

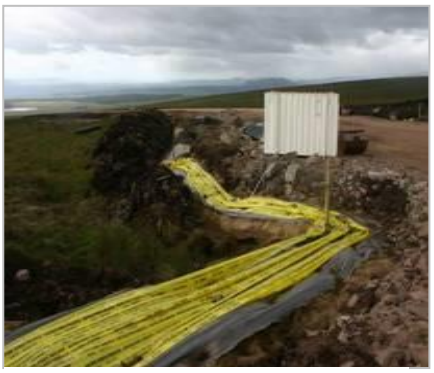
d) Compound Reinstatement

The compound is required during the whole of the construction period, and without appropriate management it is likely that any turves which were stripped would have decomposed depending on the length of time for which these are stored. The reinstatement of the compound area would normally include a degree of landscaping followed by replacement of the peat/topsoil over the area. The compound area will take a number of years to fully reinstate, dependant on the type of adjacent vegetation. The use of reseeding or temporary fencing of the area to protect against grazing animals should be considered to help accelerate vegetation.

If the compound is not required during the operational phase of the wind farm the area should be re-graded to match in with the surrounding levels. Suitable material for reinstatement should be appropriately stored and managed, near to the site compound but away from/with suitable buffers from watercourses and other sensitive receptors.

Part 12
Cable Installation

12.1 INTRODUCTION



Cable trench adjacent to constructed road

Most wind farms in the UK install the power and communication cables in trenches that are excavated and then backfilled. On some sites they are ploughed in using machines that are capable of dealing with different ground conditions. The main difference between these two methods is the ability to inspect the cables following them being laid.

It is important to balance land, ecology, archaeological, economic, drainage requirements and safety factors when designing the wind farm electrical collection system. This section provides advice on good practice construction methods to minimise the impact during construction.

This includes:

a) Designing the location of cable trenches.
b) Design of the cable trenches and construction methods.
c) Timing of construction and reinstatement works.

12.2 KEY CONSIDERATIONS

Designing the location of cable trenches:

a) <u>Cable route design</u>

When designing the cable route for the wind farm it is important to take the following into consideration:

i. The design of the consented turbine and site track layout.
ii. The environmental/ecological sensitivity of the area.
iii. Existing land use.
iv. Archaeological sites.
v. The hydrology of the area.
vi. Ground conditions.
vii. Topography of the area.
viii. Economics of the cable route.
ix. Ability and speed to repair the cables during the operational phase.

When designing the cable routes it is important to take into account the physical layout of the turbines and site tracks. Generally it is more convenient to install the cables adjacent to the site tracks to allow easy access for the cable laying and trenching plant.

It is preferable from a pollution control perspective to install cable trenches on the down slope side of the site tracks, as this prevents the cable trench acting as a clean water diversion ditch and conduit for ground water flows. If they are on the upslope side there should be a clean water diversion ditch upslope of the cable trench.

Ground conditions and topography need to be considered for various practical reasons. Separate cable routes on steep gradients, especially with soft ground, have high risks of causing machines to topple. It may also be more difficult to reinstate and subject to erosion by surface water flow. Cables should not be installed in deep soft peat as they will slowly sink adding tension into the cable, which may require premature replacement.

Cable routes should avoid areas of potential archaeological interest. Where this is not possible mitigation should be proposed, including a written scheme of investigation. Consultation with Historic Environment Scotland or the Local Planning Authority may be required.

b) <u>Cable trench design, installation and reinstatement</u>

Cable trenching is likely to involve:

i. Stripping and storing separately the topsoil/peat layer.
ii. Excavating the trench through the subsoil.
iii. Laying earth tape/cable in contact with the base of the trench.
iv. Placing sand bedding.
v. Laying power and communication cables and sand surround.
vi. Cable markers must be clearly visible.
vii. Installing marker tapes/tiles and back filling the trench.
viii. Reinstating the topsoil/peat layer.

Where cables are installed adjacent to floating track sections, trenching in the reinstated track edges should be considered as part of the track design. This can minimise any additional land take area for cable trenching as well as giving support to the cables preventing them sinking through the peat or soft sub-soils. This has the additional benefit of not requiring separate cable trenches in virgin ground thus minimising hydrological and ecological impacts.

Installing cables in areas which require specialist installation equipment or through designated/protected areas (which require notification procedures) will cause delays to repairs.

Wind farms have recently been targeted, due to high metal prices, by thieves wanting to steal cables and earth tapes/cables. As well as cost of the theft this activity can destroy the reinstated area and reduce the quality of any further reinstatement attempts.

The quality of reinstatement of cable installation areas is generally dependent on the following:

i. The amount of time between the excavation of the trench and the reinstatement of the topsoil/peat. Trenches left open for long periods of time tend to act as conduits for water causing erosion and potential sediment pollution of adjacent watercourses and land.

ii. Poor separation of excavated material will lead to mixed soils. Consideration should be given to over stripping for the cable trench areas to prevent mineral soil/sediment contamination of the adjacent vegetated areas. The over stripping method will be dependent on the materials excavated from the trench. Where cable trench arisings are mineral soil or weathered bedrock over stripping should be considered.

iii. Consider the hydrology at the design stage to ensure the type of vegetation on the reinstated area does not differ from the adjacent area.

iv. Where these pass through areas of wetland, include mitigation in the trench such as clay plugs to prevent trenches from becoming a preferential flow path and to maintain local hydrological conditions within the wetland. It is strongly recommended that the ECoW oversees the placement of this mitigation.

The number of cut-offs or bunds to be installed should be proportionate to the gradient of the trench section and take into account the elevation differential to avoid excessive head on the clay plugs.

Where wetlands with more discrete groundwater flows are intercepted (e.g. spring and flush habitats) we suggest that a clay plug is placed immediately either side of the spring or flush feature to maintain the original hydrological conditions/flows within the wetland on either side of the cable trench.

Part 13

Turbine Foundation and Crane Pad Construction

13.1 INTRODUCTION

Before detailed foundation and crane pad design can be carried out, adequate ground investigations are required. Typically this involves: trial pits, boreholes, in-situ testing and laboratory testing of samples to inform the design of the foundation.

Turbine foundation under construction with adjoining crane pad.

Some turbine manufacturers insist on using their standard foundation design, which are normally designed for a large range of ground conditions. A key consideration should be waste minimisation and the reduction of carbon emissions. In areas of poor ground conditions it may be more appropriate to consider alternative methods such as piling.

The most appropriate type of the foundation (gravity, piled or rock anchored), can only be determined following ground investigation works. The use of piled foundations should be considered in future, particularly for planning any repowering and decommissioning activity. The results of a peat survey completed during the EIA stage should inform whether piling is a feasible option. Design piled foundations where ground conditions allow and peat conditions are such that removing the peat would cause more disturbance. This practice would be dependent on safety, cost and construction logistics and consideration of other potential environmental impacts such as noise, vibration and disturbance of wildlife.

The construction of foundations and crane pads involve heavy civil and earthworks, which have a high risk of sediment pollution and chemical contamination of the water environment. When considering the foundation and crane pad design it is important to consider the following ecological, hydrological, archaeological and operational factors:

- Minimising excavation of material.
- The possible effect on the water table.
- The possible effect of drainage on the type of vegetation.
- How to deal with silty water within the excavated areas.
- How the topsoil/peat stripping should be carried out.
- How excavated material should be stored temporarily or re-used.

13.2 KEY CONSIDERATIONS

a) Turbine and crane pad location

The location of the turbine and crane pad will determine how much earthworks will be required to enable the civil works. A turbine located on a steep gradient will require extensive earthworks to level a large enough area to accommodate both the foundation and crane pad area. Areas of deep peat should be avoided to minimise the volume of peat excavated.

Preparation of turbine foundations

b) Soil and overburden stripping

When designing the turbine foundation it is essential to understand the existing ground conditions.

Where stripped/excavated peat is not suitable for reinstatement it is likely to be considered to be a waste material and the relevant waste management legislation will apply (this should be discussed with SEPA). In light of these discussions the CEMP should identify appropriate handling and storage methodologies.

Subject to any waste management control a plan showing areas which are safe for stockpiling should be created prior to works beginning. Where excavated material is not suitable for back filling over the foundation or for reinstatement purposes it should be transported to its final agreed location. Double handling of silty material increases the risk of pollution and contamination of the adjacent land.

If designed properly the use of a temporary low bund of sub-soil around the perimeter of the excavated area can be a useful mitigation method, to prevent silt from stockpiles being washed into the adjacent area or watercourses. Deep excavations should be fenced with appropriate warning signs until suitably restored.

c) Drainage

Cut off drains are commonly used on the top side of excavations to prevent surface water runoff entering the excavation. If possible the excavation should be designed to allow drainage out through a limited number of controlled outlets, where sediment can be controlled through a series of settlement ponds or filtering systems. Flocculants should be considered to assist sediment precipitation. A flocculent specialist as well as SEPA should be consulted prior to use.

Where water collects in the bottom of an excavation it will be necessary to pump the water out to allow continued works. If pumping is required it is important to agree locations away from water courses where further treatment can occur. Have you considered permit-to-pump procedures?

d) Crane pad (hardstanding) size and layout

Careful micro-siting of crane pads will be required to minimise longer term impacts.

The size of the crane pad is normally directly related to the size of the cranes required for installation. The turbine manufacturers may also require the crane pads for temporary storage of turbine components; e.g. blades and nacelles.

It is possible to reduce the size of the crane hardstanding area by designing separate pads for the crane outriggers, but only if the precise installation crane is known. Specifically designed crane pads also limit the type of crane that can be used for maintenance during the operational phase. A storage area for turbine components would also be required either on-site or near to site.

e) During construction

It is good practice to utilise proprietary shuttering for the foundation pours which incorporate built-in ladders/steps and access platforms with handrails. Also, backfilling after the first pour improves access/egress for the second pour and minimises H&S issues.

Turbine foundations and crane hard standings involve heavy earthworks and civil works. It is important that any mitigation measures designed are monitored (by the contractor and the appropriate Clerk of Works) and maintenance carried out.

f) Reinstatement

The use and frequency of use of crane pads during the operational period should be considered prior to reinstatement. From experience the use of crane pads during the operational period can be an ongoing requirement. Where crane pads have been reinstated with a layer of peat following construction, the peat is often stripped off within the first 2 to 3 years of operation to allow maintenance.

When the layer of peat is stripped off using an excavator the peat becomes mixed with the stone from the hardstanding and is usually not suitable for reuse. Typically reinstatement over crane pad areas take 2 to 3 years to establish but due to the reuse of the hardstanding the reinstatement of these areas rarely reaches a high percentage of vegetation cover unless reseeding is used.

In the light of operational experience it is recommended that crane pads are not covered with peat, in particular catotelmic peat, or topsoil for the operational period of the wind farm. It is critical that the area around the crane pads and any exposed batters are reinstated to reduce visual impact. Long-term storage of peat material is not a recommended option due to weathering, drying, erosion

and run-off. If possible micro-siting of the crane pad should be considered at the design stage to reduce excessive excavation and visual impact. It is also desirable to remove any temporary raised hardstandings used for storing turbine components on site.

Part 14

Biosecurity and the management of invasive non-native species

14.1 INTRODUCTION

Non-Native Species (NNS) are any animal or plant introduced (deliberately or accidently) by human activity to an area in which they do not naturally occur. Some animals and plants may have been transported here a long time ago and be considered "naturalised", but these are still considered non-native species. Others are native to some parts of the UK but not to other parts (for example native to the mainland but not all islands).

Invasive Non-Native Species (INNS), sometimes referred to as 'invasive alien species', are those non-native species that have the ability to spread rapidly and become dominant in an area or ecosystem, causing adverse ecological, environmental and economic impacts. INNS can also affect our health.

Examples of the negative effects caused by invasive non-native species include; economic cost, structural damage, environmental degradation, aesthetic degradation, biodiversity loss, loss of land function, access restrictions and increased risk to human and animal health and safety. Costs incurred because of invasive non-native species can include repairs to damaged structures and environment, delays to works, loss in value of a landholding or other asset, potential for prosecution because of damage caused by invasive species or infringement of legislation. There is also a risk of loss of reputation through mismanagement of invasive species, especially where the interest of sensitive local groups (such as a fisheries trust) could be affected.

14.2 KEY CONSIDERATIONS

Managing land inhabited by a non-native species, in a timely and appropriate way, **can help avoid**:

- Excessive development costs
- Physical damage to buildings and hard surface
- Harm to the environment.
- Reputational damage
- Compensation claims
- Prosecution

Identifying a non-native species on a site early lets developers assess and cost options for managing, disposal, or destruction.

Making sure staff can identify non-native species which are present on site can reduce waste costs and improve how you manage the site. A clerk of works can oversee the management of non-native species and is a good way of ensuring that contractors treat them in an appropriate manner.

14.3 YOUR LEGAL RESPONSIBILITIES WHEN DEALING WITH NON NATIVE SPECIES

Under the Wildlife and Countryside Act 1981 it is an offence to plant or otherwise cause to grow in the wild any non-native plant, or release any non-native animal.

If you have invasive non-native species on your premises you have a responsibility to prevent them from spreading into the wild.

If you are undertaking control of any non-native plants on land that you own or occupy, you must comply with specific legal responsibilities relating to:

- Spraying herbicides
- Burning invasive plants
- Burial of soil containing invasive plant material
- Disposing of invasive plants and contaminated soil off site.

Full details are available via Netregs.

When dealing with any non-native species, demonstrating that you have exercised due diligence, adopting best practice and taking reasonable steps to comply with the legislation is prudent. This involves:

- **Adopting a precautionary approach**. Don't release or plant until you have a clear understanding of the situation.

- **Carrying out risk assessments**. Due diligence is likely to include assessing the risk of an offence happening, establishing what to do to avoid it happening and acting according to best practice to prevent it happening. Further advice and information, including identification guides, can be found at the GB Non-Native Species Secretariat website: www.nonnativespecies.org.

- **Seeking advice and following good practice**. You should seek advice from an expert if you are unsure about any issues relating to the release, or planting of non-native plants and animals.

- **Reporting the presence of non-native species**. The cost of removing or controlling a well-established invasive non-native plant or animal can be very high. You can report your finding to iRecord [http://www.brc.ac.uk/irecord] or SEARS (Scottish Environment and Rural Services) 24/7 customer service number 08452 30 20 50 or email info@sears.scotland.gsi.uk

14.4 AVOIDING THE INTRODUCTION, MOVEMENT AND SPREAD OF NON-NATIVE SPECIES ON AND OFF YOUR CONSTRUCTION SITE

a) Pre-construction considerations:

- Ensure detailed checks and risk assessments are carried out for non-native species within initial site feasibility assessments and surveys.
- Where any non-native species is present, ensure you understand the risks and implications of managing it, as well as your legal requirements. Seek advice early.

- Where a non-native species is identified as a risk of being introduced, spread within, or moved off site, ensure mitigation measures are considered at the early planning stage, and ensure enough time is given to implement them.
- Consider phasing the development to allow time to deal with the presence and/or risk of spread of non-native species.
- Ensure non-native species and locations (mapped) are incorporated within all relevant site method statements, including the site Ecological Protection Plan and Species Protection Plans, where appropriate.
- Where a species requires long-term management (e.g. Japanese knotweed), ensure a site management plan is put together that addresses all issues associated with it
- Nominate a designated Clerk of Works to manage the issue of non-native species on your site from an early stage.

b) Biosecurity considerations on-site:

If your site does not currently have any non-native species, it is also important to consider potential pathways of introductions onto your site from elsewhere and for mitigation procedures to be put in place to prevent this.

An example of a foot bath & biosecurity station (Copyright Galloway Fisheries Trust)

You should brief all contractors fully, and ensure all staff are aware of what the species looks like and the issues associated with it. This could be done through 'tool-box' talks or within site introductions. Everybody working on site must understand the role and authority of the Clerk of works managing the issue of the non-native species.

You should record any areas that are contaminated/infested with non-native species within your management plan, isolate them with fencing and put up restricted access signs.

c) Equipment / machinery

To maintain good site hygiene when dealing with any non-native species:

- A fence that can be clearly seen should mark out the area of issue. Signs should be erected to warn people working there that the area is infested / contaminated.
- Where contaminated soil, materials or water are located, signage should be erected to indicate them.

- Personnel working on or between sites should ensure their clothing and footwear are cleaned where appropriate to prevent spread
- Tracked vehicles should not be used within the area of infestation.
- All vehicles leaving the infested area and / or transporting infested soil/materials must be thoroughly pressure-washed in a designated wash-down area before being used for other work.
- Where cross-contamination is possible (i.e. from one site to another), consider designating vehicles or machinery to specific sites where possible to prevent spread.
- Material / water left after vehicles have been pressure-washed must be contained, collected and disposed of appropriately.
- All chemicals used for the control of non-native species should be stored and used in a responsible manner.
- All wash facilities including waste water from washing vehicles, equipment or personnel should be managed in a responsible way so as not to not cause harm to the environment.

See www.netregs.org.uk

d) Use and movement of soil and water

The introduction of a non-native species both onto and off a site is most likely to happen in the following ways:

Contaminated topsoil
If soil has been treated for and is free from Japanese knotweed it can be re-used on site without the need for a waste management license or an exemption. If taken off site, this material must be disposed of in a licensed landfill. Developers reuse treated soils at their own risk and they should be re-used in a restricted area, rather than spread across the site, but this should be recorded in an ongoing management plan and inspected/treated accordingly.

You should always consider the source of topsoil brought onto any site, which can easily introduce a non-native species along with it, particularly Japanese knotweed.

Section N.6.4.5 of BS 3882:1994, the British Standard for topsoil clearly states that it is critical that material should be free from Japanese knotweed propagules, rhizome and vegetative fragments.

CASE-STUDY: CLYDE WINDFARM, EAST AYRSHIRE

Introduction
The Clyde Windfarm was constructed spanning two river catchments; the River Clyde in South Lanarkshire and the River Annan whose headwaters are in Dumfriesshire.

As part of early investigative work it was noted that the Clyde river catchment was inhabited by a very invasive non-native species; the North American signal crayfish, which can cause significant adverse impacts within our freshwaters, and can spread between waters either by the movement of individual animals and/or the movement of their eggs.

The status of signal crayfish within the river Annan catchment, however, was unknown, but it was flagged early on that the construction of the wind farm must not inadvertently spread them from the River Clyde to the River Annan, if they were not already present. The two river catchments were, however, hydraulically linked which could offer easy access for crayfish.

Pre-site surveys
The windfarm construction company commissioned the Annan District Salmon Fishery Board (ADSFB) to undertake a report to confirm/establish the status of signal crayfish on the Annan headwaters which were closest to the Clyde and close to the construction site (i.e. if present or not), and electrofishing, kick-sampling and trapping were carried out on four of the most vulnerable burns most likely to see accessed by signal crayfish. Results showed that although difficult to confirm with 100% certainty, it was highly unlikely that there were any crayfish in this part of the Annan.

Recommendations were made by ADSFB to undertake further surveys to prevent natural spread of signal crayfish, but also to prevent cross-contamination by civil engineering work for the windfarm (by people and machinery) across the river catchments.

Mitigation policies and procedures
The windfarm company adopted the following policies and procedures in order to mitigate risk of the spread of signal crayfish:

- Catchment boundaries were clearly marked.
- Separate plant was used for forestry felling operations in one catchment or another, or plant washed down if moved between catchments;
- A drive through wheel wash was set up at key sites to prevent potential spread between sites.

Use of water and/or crossing of water
If using water on your site for construction purposes or to wash vehicles or equipment, you should ensure that the source of that water will not inadvertently act as a vector for the transportation of non-native species to/from your site or elsewhere.

If you abstract or store any surface or ground water on your site for any reason you must gain appropriate authorisation from SEPA. Disposal of contaminated wash water must also be dealt with in a responsible manner to avoid pollution and to prevent the spread of any non-native species that may be present. For further information see www.netregs.org.uk (Pollution Prevention Guidance 5 - Works and maintenance in or near water).

Contamination of vehicles or machinery
Where non-native species are known to be within or close to your site, you should take care not to facilitate the transportation of plant seeds or fragments, animals or eggs on machinery, vehicles or by foot, from one site/river catchment to another. This may require the need for an exclusion zone and/or the use of designated machinery/ equipment on key sites to prevent movement from one site or river catchment to another.

An example of a drive-through bath

You should inspect vehicles before moving them from site to site or off site, and provide wash facilities suitable for the machinery you have, if needed, e.g. a drive through bath or footbaths. You should pay particular attention to caterpillar tracks and where trucks and dumpers are stowed.

14.5 FURTHER CONTACT INFORMATION & GUIDANCE IN SCOTLAND

Relevant bodies in Scotland under the Framework of Responsibilities for non-native species:-

Relevant Body	Habitat
Scottish Natural Heritage	dry land, river banks and wetlands
Forestry Commission Scotland	woodland, trees & woody shrubs
Scottish Environment Protection Agency	standing and running freshwater environments
Marine Scotland	marine environments

All non-native species enquires and reports should be directed to:

SEARS (Scottish Environment and Rural Services) 24/7 customer service: 08452 30 20 50 or
info@sears.scotland.gov.uk

Contacting the Habitat Lead directly:

- SNH: non_native_species@snh.gov.uk
- FCS: fcsscotland@forestry.gsi.gov.uk
- Marine Scotland: marinescotland@scotland.gsi.gov.uk
- SEPA: www.sepa.org.uk/about_us/contacting_sepa/by_email.aspx

The Non-native Species Secretariat (NNSS)

Wildlife and Countryside Act 1981 & Code of Practice on Non-Native Species, Wildlife and Natural Environment (Scotland) Act 2011

Net Regs (Construction and Building Industries INNS guidance in Northern Ireland and Scotland)

OTHER SOURCES OF INFORMATION

CIRIA Manual C679 'Invasive species management for infrastructure managers and the construction industry' (Available for purchase).

The Knotweed Code of Practice – managing Japanese Knotweed on development sites (EA) (Environment Agency document - England & Wales only)

The Economic Cost of Invasive Non-Native Species on Great Britain 2010

FCS – Tree pests and diseases

Part 15
Habitat Restoration

15.1 INTRODUCTION

This section provides an overview of habitat restoration, habitat creation and land-management measures that may be required for wind farm developments.
The successful delivery of habitat restoration and management requires co-ordination by all parties involved in the construction and operational phases of the wind farm. The onsite Ecological Clerk of Works (see section 5) is of particular importance, facilitating habitat restoration during the construction stage. Compliance will be monitored by the ECoW, in addition to providing expert advice on restoration options.

15.2 SITE PROPOSALS AND WRITTEN STATEMENTS

Management, reinstatement and restoration of habitats that may be impacted by a wind farm development is often a requirement of planning permission. It may be covered by site-specific conditions relating to Habitat Management Plans (HMPs), Peat Management Plans (PMPs) and Construction and Environmental Management Plans (CEMPs). Where restoration or compensatory habitat creation is required, the plans may cover delivery methods of habitat improvements and their long-term management.
Works on site can fall into two broad categories, each capable of being undertaken individually, but are best considered together to give a clear picture of site works, impacts and improvements in their entirety:

- Construction reinstatement
  - Guided by Construction Method Statements (CMSs) / Construction and Environmental Management Plans (CEMPs) (see chapter 4)
- Post-construction restoration and on-going site management
  - Guided by a Habitat Management Plan and associated plans.
  - Any formal planning agreements?

15.2.1 Habitat management plans

Habitat Management Plans (HMPs) will outline:

- Mitigation (e.g. for maintenance of hydrology supporting wetland habitats);
- Compensation (e.g. work that occurs in other areas within the site to compensate for losses to habitats impacted by the development);
- Enhancement (i.e. delivering an overall improvement in the environmental quality of the site).

The HMP may include areas outwith the red-line planning boundary on land within the developers control to offset the impact of the development (e.g. the improvement or creation of raptor foraging habitats away from the development to reduce the risk of collision mortality in protected species).
Monitoring will form a key part of all HMPs. It is important to quantify the successes, or failures, of the measures employed on a site to allow for adaptive management and contingency works, as well as to better understand the effectiveness of current best practice and trial innovative methods.

Always consider the long-term vision for all restoration work, extending beyond the end of the initial operational phase. How will the site be managed during repowering or decommissioning of the proposed wind farm, and beyond? Further information on HMPs can be found on SNH's website

15.3 REINSTATEMENT OF CONSTRUCTION IMPACTS

The impact of infrastructure can be reduced through micrositing and environmentally responsible construction. However, it is inevitable that a certain amount of environmental damage will occur through construction although these impacts can be further reduced through sensitive reinstatement. Reinstatement aims to reverse disturbance and, as far as possible, recover the original condition and functioning of the displaced habitat.

Different types of reinstatement that may be relevant to wind farm construction are outlined below and external links to relevant guidance are provided where possible.

General principles for reinstatement of soils

Maintain the original soil layering and do not mix topsoil and subsoil layers. For peat soils, the acrotelm and catotelm should be handled and stored separately and reinstated with the acrotelmic layer on top. For peat and mineral soils, it is especially important to keep the layer of surface soil and stripped turves of vegetation on the top of the reinstatement, the right way up.

Turves should not be stacked but placed beside each other. Turves must be cut to an appropriate depth to maintain plant root systems and provisions for keeping soil moist must be considered in the event of dry spells of weather where vegetation may succumb to drought or the soil may be susceptible to wind erosion. Maintaining the seed bank and existing vegetation on the surface provides the best possible start for effective restoration.

The creation of bare ground through inappropriate construction activities may lead to soil erosion that demands costly mitigation measures including soil stabilisation, re-seeding and pollution-control measures. Options include:

- The easiest method and most cost effective way to quickly stabilise bare soils is to **reuse the turves already cut from the site**. Alternatively turves from adjacent ground can be used in consultation with the ECoW.

- Encourage rapid re-vegetation through re-seeding. This option is not suitable all year round and so the timing of works and exposure of soil needs to be considered. Some hydro seeding mixes contain chemicals that can be harmful to aquatic environments. SNH or SEPA will be able to provide advice on suitable seed-sources and mixes. Some useful advice notes are available online;

    - Re-establishment of heather

    - Some advice covering general restoration principles in relation to decommissioning, but also relevant to the construction phase restoration, can be found in pages 32- 37 SNH's Commissioned Report No. 591

- Protect the bare soil surface with a physical barrier. This could be a thin layer of mulch (e.g. heather mulch/brash protects the soil surface and provides a suitable

seed source for the restoration of heath communities) (SNH or SEPA will be able to provide advice on suitable use) or geotextile/erosion control matting such as coir or GeoJute.

- Downstream drainage systems receiving sediment from bare soil areas (silt mitigation) need to be carefully constructed, monitored and maintained to ensure that they are capable of capturing and controlling sediment pollution.

Do not mix soils with other material. Mixing of soils alters the hydrological and chemical properties, reducing its suitability for re-use in ecologically beneficial restoration.

Avoid over compaction of soils, for example though excessive vehicle tracking. Where vehicle tracking over vegetation is unavoidable, minimise the number of trips and for softer ground such as peat, consider the use of low ground pressure or tracked vehicles.

Peat soils

Acceptable uses for excavated peat on a wind farm site are limited. Peat depths on site, potential excavation and re-use volumes are all serious considerations at the scoping stage. Detailed guidance on the use of excavated peat can be found in 'Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and the Minimisation of Waste' and some key principles regarding excavated peat are outlined below:

- Key to effective reuse of peat within a site is good planning and minimal transportation.

- The carbon content of carbon-rich soils (peat and peaty soils) should be protected throughout reinstatement. Peat soils should only be placed where supporting hydrological conditions exist, or can be created; this may involve measures to restore the water table and micro-topography in reinstated areas.

- Fibrous acrotelmic peat, particularly vegetated peat turves, may be used for reinstating vegetation around the edges of infrastructure such as tracks and crane pads.

- Mixing of carbon-rich soils with other materials will also likely result in oxidation and release of carbon stored within the peat.

- Excess peat should not be used to create bunds around infrastructure. Even where landscaping and screening is a specific requirement of planning permission, it is unlikely that peat soils will be suitable to meet this requirement and other options should be discussed at the planning stage.

- Excess peat should not be used to create shoulders on floating roads or for cut tracks, or spread on land adjacent to tracks because this will smother existing vegetation (see Verge Reinstatement section in section 10, Construction of Access Tracks).

- Excavation of deep peat (>0.5m) should be avoided through layout design at the planning stages. Excavation of deep peat areas will likely result in the excavation of amorphous peat which is difficult to handle and store safely. Amorphous peat

is unsuitable for use in reinstatement and restoration works on site and cannot be accepted in off-site waste-management facilities.

Borrow pits

Firstly, identify whether there is a requirement to reinstate or restore the borrow pits on site (it may be that the borrow pit is to be kept open). Once the construction phase is complete, there is often a desire to reinstate the soils excavated from the borrow pit or restore the area using other methods such as re-profiling. Consider the potential for delivering environmental benefits/enhancement in the design and proposed methods for restoration.

For borrow pits located out with peatland habitats, restoration techniques using material other than peat may require careful consideration in order to meet overall habitat, landscape and environmental reinstatement objectives. The reinstatement considerations outlined below apply equally to mineral soil use.

Provided the overall habitat and environmental reinstatement objectives (including landscape) and requirements at the site are maintained, and no residual risks from pollution of the environment or harm to human health exist, peat may be reused within borrow pits for the purpose of their restoration. Although waste legislation constraints may apply, peat used in this manner should not require any pre-treatment, with minimum quantities utilised to meet objectives. One of the criteria for the re-use of peat is a waste exemption on the grounds of ecological benefit. To satisfy this requirement, details should be provided to fully justify the use of peat material. These include:

- The depth and profile of peat proposed. What depths of catotelmic and acrotelmic peat are being used?

- How the hydrology of the borrow pit will support the placement of soils and protect the carbon stored within that soil?

- Demonstrate that the profile of peat reinstatement within the borrow pit is safe and does not pose a risk to surrounding areas e.g. from surface runoff or peat slide.

- Define the target habitat restored on-top of the re-used peat. Different vegetation types are typically supported on different depths of peat soil and the profile of the peat should be matched to the desired vegetation community. The target vegetation within the reinstated borrow pit should tie in with the surrounding habitats and landscapes.

Treatment of borrow pits is covered in detail in 'Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and the Minimisation of Waste':

Fencing or other appropriate barriers to prevent entry to the area may be justified in the short to medium term, to prevent grazing or allow vegetation re-growth in order to stabilise the surface. It is likely that there may be some medium-long term management of the area such as control of undesirable vegetation (e.g. non-native species or regeneration from forestry).

15.4 KEY RESTORATION PRINCIPLES PER HABITAT TYPE

15.4.1 Peatlands, bog and wet heath habitats

For links to guidance on practical peatland restoration see the SNH Peatland Action website.

The aim of peatland restoration should be to restore the original function of the peatland. This involves ensuring that the hydrological conditions are suitable for establishing or maintaining bog vegetation. 'Good quality' bog vegetation communities combined with the right water table regime will lead to creation of an active bog - a bog which actively stores carbon by forming peat soil.

Every peatland is slightly different and is a product of the range of pressures on the peatland habitat and the magnitude of damage from construction activities, or other land use practices. For further information on restoring peatland under felled forestry, please refer to Restoring afforested peat bogs (FCS, 2010). In order to establish the most appropriate restoration techniques, detailed survey information of variables such as peat depth, vegetation type and coverage are often required. Mapping visible features of damage such as drainage and erosion features helps to target the appropriate measures to the right location. There are well-established methods for restoration and some of these, along with relevant sources of guidance, are outlined below.

Drainage

Existing guidance on drain blocking is available on the SNH Peatland Action project website

The principle behind restoring drainage within peatlands is to recover a water table and hydrological regime which supports the target vegetation community. For example for bog species, this typically involves restoring the average annual water table to within 15cm of the surface.

Peat dams

- Peat dams should be considered the default technique to block ditches or moor grips. They are much cheaper to install than dams made of other materials, especially where a large number of dams are required.
- Peat dams can be used on deep peat or shallow peat, where plastic dams cannot form a watertight seal.
- The results blend in with the

Peat dam construction

landscape and the excavator can be used to profile dams and ditches to prevent deep, steep-sided pools being left behind after ditch blocking that might be a hazard to stock.

- Fibrous, acrotelmic excavated peat *may* be used as blocks for drainage ditches as part of restoration proposals for blanket or raised bog.
- Generally, humified peat that is saturated (and impermeable) is most suitable for ditch blocking. Dry, unconsolidated peat and surface peat should not be used to block ditches. The suitability of the peat for the intended use should be carefully considered and its suitability tends to be restricted to ditches which are on a slope of <3° and with a cross-sectional area of <0.7m^2 (Armstrong, 2009). This is because the peat dam does not have a spillway and if the gradient is too steep the water flows cause erosion over the top of the dam resulting in failure.
- In some cases, particularly on intermediate raised bog, the peat thickness reduces to between 50 and 75 cm, often with a rock substrate below. Plastic piling will not provide a watertight seal in the rock substrate, so peat is often a more suitable alternative.

Blocked drainage ditch using plastic sheet dam

- Some sites have a high density of ditches (every 10 metres) often over large areas. Installation of plastic piling becomes logistically difficult. Peat dams are the preferred option here.
- The difficulties of transporting material and access to ditches are also important considerations.
- The use of peat in drainage ditches must be demonstrated as *required* by delivering ecological benefit under a waste exemption.

Engineered dams

For larger drainage, engineered methods such as plastic piling or wooden frame dams may be required.

Techniques for bare peat

The general principle for restoration of eroded areas is to slow the flow of water and reduce the erosive forces on the peat surface and then to encourage vegetation re-establishment on the area once erosion has been minimised. The Yorkshire Peat Partnership have some useful advice on treating and restoring areas of bare peat.

15.4.2 Restoration principles for dry heathland

Dry heathland restoration should be targeted to areas with freely draining, nutrient-poor, acidic soils. Restoration typically involves the development of ericoid dwarf shrub dominance (such as ling heather) to create the micro-climate suitable for establishing or maintaining heathland vegetation. Seeds and vegetation should be sourced locally; using commercially available seeds may introduce plants that are not genetically suited to local conditions.

There are well-established methods for restoration and some of these are outlined below. For guidance on practical heathland creation see the Natural England website.

Natural regeneration

Where undisturbed heathland habitats are within close proximity, bare areas may naturally regenerate via windblown seeds. However this process is likely to be slow, taking up to 50 years before the heath has reached the target condition.

Translocation of turves and top soil

Turves of heathland vegetation and associated topsoil from construction activity represent a valuable resource that can be used in the restoration of bare areas. Turves must be cut so that they capture the root systems of mineral soil as this will ensure any viable seeds are present. Turves can be laid in blocks or in a patchwork over bare areas; over time heathland will develop within gaps and will provide a mosaic of structure. Alternatively, heath vegetation can be cut and collected as brash and used for spreading (see below) and the top soil spread on to bare ground. In some situations spreading top soil may require the use of a nurse grass crop to stabilise the soil and create the microclimate for seed germination. However, grasses should be of low viability and must not compete with pioneer heathland vegetation.

Mulch/brash spreading

Cutting and collecting ericoid shrubs and spreading on to bare areas will provide seeds and the conditions for heath vegetation to develop. Cutting and bailing from a donor site is best done mechanically during late September to late November in areas of mature ling heather with a large volume of seeds. The material should be used immediately to prevent it overheating thorough decomposition which can render seeds non-viable. The brash/mulch is then spread mechanically to 1cm deep or less. Heather seeds should germinate within two years. Subsequent monitoring must be considered.

Management

Heathlands vary in their condition and are subject to a variety of management regimes from extensive grazing to burning and cutting. Threats to heathland maintenance include under-management that leads to bracken and scrub encroachment or over-management that may lead to habitat change (e.g. to grassland).

Heathland condition can be improved by the removal of invading scrub. This may be native species such as birch, Scots pine and common gorse or non-native invasive species such as rhododendron. Removal by mechanical and/or chemical means can be used, however SEPA should be consulted in regard to waste from brash and the use of herbicides.

Habitat restoration success may depend on subsequent management. Light spring and summer grazing may be required to control competitive species such as palatable grasses. Mowing may be considered or, in areas of high grazing pressures (e.g. from sheep or deer), appropriate fencing should be considered.

15.4.3 Restoration principles for grassland

Grassland type

Pre-development survey work should always establish the variety, location and extent of grassland types to NVC (National Vegetation Classification) community level before any work commences. The NVC survey can then inform any grassland restoration and/or creation projects post development. Restoration and creation should be faithful to existing grassland types.

A clear vision of the type of grassland desired post construction is essential. This will be determined primarily by the grassland type that is being damaged and/or destroyed, by soil type and the management practices available on the site to maintain the grassland post construction.

Soil type

The type of grassland to be restored will depend on the substrate: whether acid, neutral or calcareous soil, whether nutrient-rich ex-arable topsoil or nutrient poor, unfertilised topsoil or subsoil. Survey to ascertain soil type is essential. Grassland on nutrient-rich soils is species-poor because a few competitive grasses grow rapidly and exclude the great variety of smaller, slower growing herbs. Conversely, a greater variety of grassland plants will thrive on nutrient-poor soils. So, where species-rich grassland is to be restored, nutrient poor sub-soils make the best substrate.

Management

Grasslands can only be maintained in the long term if sympathetically managed either by grazing or mowing. Without annual management grasslands will soon become dominated by strong, coarse grass species at the expense of finer grasses and wildflower species.

Key points to consider with grazing are timing, and availability and type of livestock. Mowing must be timed carefully and most importantly, the cut material must be removed to prevent the build-up of dead plant material which will suffocate the desirable species. Removal can either be by aftermath grazing or mechanically.

Soil reinstatement

Soil should be carefully stored maintaining the original soil layers. Turves should be stored separately, placed side by side, never stacked on top of each other – see previous section on reinstatement of soils.

Natural regeneration

Areas left bare after construction activities will eventually re-vegetate naturally. Annual species typical of disturbed soils will invade to start with and, in time, these will be followed by perennials. The species invading will depend on the species growing nearby and on the soil. If nutrient-rich ex-agricultural topsoil is used for restoration purposes, species-poor grassland will develop. On the other hand, if nutrient-poor subsoil is used, there is potential for species-rich vegetation to develop, particularly if there is species rich grassland close by to act as a seed source.

Natural regeneration will require management to establish a good grassland sward in the long term. Initially invasive weed species may require control either by hand pulling or cutting, or by herbicide treatment if across a large area. Grazing or mowing will be required annually to encourage the development of a species rich sward.

Seeding

Commercially obtained seeds can be used to seed bare areas. The choice of seed mix will depend on the community type, ideally identified to NVC community in the pre-development survey. When seeding, the soil surface must be carefully prepared to create a suitable seedbed and subsequently managed to ensure the sown grassland mixture has the opportunity to develop in to grassland. Sowing in early autumn usually gives the best results, however spring sowing can also be considered. Grazing or mowing will be required annually to encourage the development of a species rich sward.

Hay spreading

Hay cut from a suitable local donor site between July and August (preferably two cuts to capture late seeding species) can be spread on bare ground so that the seed will drop and establish new grasslands. The hay must be transported and spread within a few hours so that seeds remain viable, and must be removed after a day or so or it will smother the new growth. The soil will need to be carefully prepared to ensure good germination rates. Careful management in subsequent years will be essential to encourage the development of species rich grassland.

Useful links

There are well-established methods for restoration and some of these, along with relevant sources of guidance, are outlined below. There is information on grasslands and grassland management on the SNH website. For guidance on the management of species-rich grasslands, see The Lowland Grassland Management Handbook.

15.4.4 Restoration principles for woodland

Woodland restoration should aim to improve the structure of an existing woodland or aim to create woodland in appropriate locations. Consider planting if natural regeneration is not likely or colonisation is anticipated to be slow. Carefully consider the suitability of tree species for the region. Only choose sites for woodland creation or restoration that are not already habitats of conservation importance (e.g. species-rich grassland). Woodland creation and restoration is a long-term investment and future management should be secured. Aim to create woodlands that are inter-connected with good-quality woodlands or large enough to remain viable (>5 hectares).

There is a suite of woodland guidance relating to planting and restoring woodlands of different types. Contact Forestry Commission Scotland for the guidance most appropriate to the landscape setting and site requirements.

Natural regeneration

Woodland creation is best achieved through natural succession, where possible. Areas within proximity of woodlands (particularly ancient or well-established stands) will have a greater chance of natural regeneration than those that are not. Natural regeneration is low cost and allows the colonisation of local species, however without intervention it can be a long-process and may not achieve the desired woodland if slower growing species are scarce.

Planting

Trees and shrubs should be planted that are suitable to the local conditions. Trees should be planted irregularly with open areas to provide habitat heterogeneity (around 20% to remain unplanted). Planting should be reasonably spaced to allow for the development of ground flora. Where ground flora is sparse seeding can be considered. Competitive ground flora should be supressed for the first 4 to 5 years. Fencing may be required to reduce grazing/browsing pressures. The creation of a woodland community should be guided by NVC surveys of the immediate area.

Management

Scrub and pioneer species (e.g. native scrub such as birch or non-native invasives such as rhododendron) may require thinning to improve conditions for more slow tree growing species. Excessively large gaps in the woodland canopy may require planting. Deadwood should be maintained where possible.

15.5 FURTHER CONSIDERATIONS OF GOOD RESTORATION

- Can the environmental and social benefits of the reinstatement / restoration work be shared and promoted as good practice? Are there opportunities to link with wider Local Biodiversity Action Plan aims, for instance?
- What are the wider public perceptions, reputational and legacy aspects of effective restoration of landscapes and habitats for the sector and developments of this nature? These are important considerations.
- What are the implications of repowering or decommissioning on habitat restoration. Will progress be undermined by a new construction phase and disturbance?

15.6 REFERENCES AND LINKS TO GUIDANCE

Anderson, R. (2001). Deforesting and Restoring Peat Bogs – A Review. Forestry Commission Technical Paper 32.

Armstrong et al., (2009) Drain-blocking techniques on blanket peat: A framework for best practice. Journal of Environmental Management. Vol 90 (11) p3512-3519

SNH (2006). South of Scotland Bog Scheme Guidance for Land Managers – Installing Plastic Piling Dams. (available at Installation of Plastic Piling Dams)

SNH Floating Roads on Peat (2010)

Wilkie, N.M. & Thompson, P.S. “Identification and Restoration of Damaged Blanket Bog – A Guide to Restoring Drained and Afforested Peatland.” LIFE Peatlands Project, SNH.

GLOSSARY

Acrotelm
The upper layer of peat in which the water table fluctuates and upon which the surface layer of vegetation grows. The acrotelm is typically fibrous in nature and can vary in its thickness across site depending upon hydrological regime (i.e. typical depth of 0-30cm)

Catotelm
The layer of peat below the acrotelm (see above). It is permanently below the water table and is therefore saturated. The catotelmic layer of peat is typically more decomposed than the acrotelm and can be up to several metres in depth. The structure of the catotelmic layer degrades with depth and deep layers of catotelmic peat can be amorphous.

Amorphous
Lacking form or having no specific shape. This term is typically used to describe highly decomposed peat that is liquid in nature.

Sphagnum
A group of moss species. Also known as 'bog mosses'. Sphagnum species are often responsible for the main accumulation of peat soils in waterlogged habitats such as peat bogs. There are a number of different species in the Scotland which favour different conditions.

Brash
Material resulting from the removal of branches and tops of trees after felling and removal of timber products.

Seed bank
Term typically used to refer to the plant propagules (seeds, rhizomes etc.) which remain viable and able to grow from the surface layers of the soil. Some plant species can survive for long periods of time as dormant seeds in the soil and this seed-bank can be an important resource to support restoration of suitable vegetation.

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