Dornie Quarry Forestry Road

Environmental Statement
February 2017

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NON TECHNICAL SUMMARY

Introduction

The project relates to the construction of an 856m long forestry road around the perimeter of Dornie quarry in Leanachan Forest near Torlundy. This will replace the existing 405m long North – South road which runs through the centre of quarry, between the existing quarry and the extension area. This North – South road will be removed as part of the quarry development. The new road covers an area of 0.31hectares.

Leisure Road Use

The existing North – South road is used by both forestry related vehicles and leisure users with the `10 Under the Ben' mountain bike trail using the road. The mountain bike trail will be diverted along the new road when it is constructed and before the existing road is removed. The new road does not affect the core paths in the area.

Protected Species

An ecology survey confirmed there are no protected mammals in the area where the road is located.

Archaeological Features

Archaeological work undertaken for the quarry development confirms the road will have no impact on any known archaeological features.

Peat

The road has been designed to minimise impact on the areas of peat identified along the road by floating the road over the peat to minimise unnecessary excavation of peat during road construction.

Road Construction

The road had been designed to meet the Forestry Commission Standards and will be constructed using materials from the neighbouring Dornie quarry. No materials will be imported to site to construct the road.

Parallel Roads of Lochaber Site of Scientific Interest

Much of the road is located within the Parallel Roads of Lochaber Site of Scientific Interest which is a *'site of outstanding importance for geomorphology'*. Three shallow cuttings are required along the line of the road to meet the maximum gradient specified by the Forestry Commission. The three shallow cuttings will have a minor impact on the glacial features in this area.

Hydrology and Lon Leanachain Site of Scientific Interest

With the Lon Leanachain Site of Scientific Interest to the East of the road, shallow drainage swales (wide shallow ditches with gently sloping vegetated sides) will be located at either side of the road to ensure the risk of sediment laden run-off entering the SSSI from the road is minimised.

The existing watercourses will not be affected by the road and two culvert crossings will be installed as part of construction. The existing watercourses are sourced from land to the South and the volume of water entering the SSSI will not be reduced following construction of the new road.

Pollution Prevention and Mitigation

With the Lon Leanachain SSSI downstream of the road line and water crossings required as part of the road construction; detailed pollution control and mitigation measures are included in the design and construction method statement to ensure there is no risk of pollution from this development.

Construction of the road will adhere to the guidelines published by the Forestry Commission as Forests and Water, UK Forestry Standard Guidelines, 2011.

Conclusion and Consideration of Alternatives

If the existing road was retained and the new road was not constructed, leisure traffic and forestry vehicles would be routed through the centre of an active quarry.

Construction of the new road will divert all non-quarry related traffic around the perimeter of Dornie quarry which remove the risk of collision between quarry vehicles and non-quarry related traffic, if the existing road was retained. This new road also ensures that members of the public are kept away from the potential hazards present in the quarry site.

Non Technical Summary

1 INTRODUCTION

This Environmental Statement has been prepared in support of the planning application to form a new forestry road or private way around the perimeter of Dornie quarry at Torlundy.

Planning permission was granted for an Eastern extension to Leiths (Scotland) Limited's Dornie quarry at Torlundy (Application Ref: 09/00021/FULLO) in 2011. The two areas of the quarry are separated by an existing North – South running forestry road which is used by both forestry traffic and leisure users. The new forestry road will replace the existing North – South road which crosses Dornie quarry.

The new road will be used by both forestry related vehicles and leisure / recreational users of this area of Leanachan forest. The new road is 856m long and covers an area of 3103m^2 (0.310hectares). This will replace the 405m long North – South road (area 1270m^2 or 0.127hectares) which runs to the East of the existing area of Dornie quarry.

2 LEGISLATIVE BACKGROUND

The project is regulated by the Environmental Impact Assessment (Forestry) (Scotland) Regulations 1999.

Forest Road Works are listed as a relevant project in Regulation 3 of the 1999 regulations, if the area covered exceeds the threshold set out in Schedule 2.

In Schedule 2 (2) of the regulations all forestry road works in a sensitive area meet the threshold of a project which is likely to have significant effects on the environment where an Environmental Impact Assessment is required.

Sensitive areas are defined in Schedule 2 (1) of the regulations as:

'(a) land notified under subsection (1) of section 28 (areas of special scientific interest) of the Wildlife and Countryside Act 1981;

All forest roads in a sensitive area exceed the threshold where an Environmental Impact Assessment is Required.

Schedule 2 Paragraph 2 (1) states:

'For the purposes of regulation 3(3), the threshold for any project of a type specified in an entry in column 1 in the table below is the area (if any) specified in the corresponding entry in column 2 or 3 of the table, whichever is appropriate to the land covered, or proposed to be covered by that project.'

Column 1	*Column 2*	*Column 3*
Type of Project	*Threshold where any part of the land is in a sensitive area*	*Threshold where no part of the land is in a sensitive area*
Forest road works	*No threshold.*	*1 hectare*

The new forestry road is located within the Parallel Roads of Lochaber SSSI and crosses the head waters that feed the Lon Leanacain Raised Valley Bog SSSI. The new forestry road meets the threshold listed in Schedule 2 of the Regulations where an Environmental Impact Assessment is required to accompany the planning application.

3 OBJECTIVES OF THE EIA

The Environmental Impact Assessment process (EIA) aims to ensure that the likely significant effects of a new development on the environment are fully considered and used to inform the decision-making process. In this case the development relates to design and construction of a new forest road taking forestry traffic and leisure users around the perimeter of Dornie quarry.

Systematic analysis and clear presentation of information in a form which enables the importance of predicted effects, and the scope of mitigating them, to be properly evaluated is the key to the EIA process. Good practice suggests that the EIA process should be treated as an iterative process rather than a single post-design environmental appraisal. This ensures that the findings of the EIA can be used to achieve a "best fit" within the environment. This approach was used for the forestry road project. Where potentially significant effects have been identified, every effort has been made to incorporate appropriate mitigation measures within the design process.

An Environmental Impact Assessment was undertaken on the development of the extension to Dornie Quarry in 2009. This planning permission was granted in 2011 (Application Ref: 09/00021/FULLO). The EIA and the associated environmental studies undertaken for the quarry development are also applicable to the new forestry road. Where applicable reference to studies undertaken for the quarry development is made in the forestry road EIA.

The EIA for the forestry road concentrates on assessing the potential impacts and mitigation required for the aspects of the road construction highlighted during the scoping meeting.

The objectives of the Environmental Statement are summarised below:

- To present an impartial assessment of the environmental impacts and / or benefits of the development of the new forestry road.
- To highlight areas where mitigation measures are required to minimise potential environmental impacts identified.
- To enable the Forestry Commission, SNH, SEPA, the Local Authority and members of the public to take account of the environmental factors associated with the application by bringing the project to the attention of all interested parties for consultation and discussion.

3.1 Scope of the Environmental Impact Assessment

A scoping meeting and site visit was held with the Forestry Commission and Scottish Natural Heritage on the 12th of October 2016 to discuss the proposals and identify the main environmental aspects of the development which should be included in the Environmental Statement.

The scoping meeting identified

- A construction method statement will be required to be agreed with SNH and FCS. This will need to confirm the line, areas of cut and fill and detail of how this and the impact of constructing the road will be minimised. (In particular, the width and formation of the sides beyond the running surface.) The key areas being the kames that the proposed road-line crosses and where cut is required.
- A water management plan will be required to be agreed with SNH and FCS. This will show the current drainage and flow directions of water. It will also show how water will be managed both for the quarry extension and the new road to minimise any potential impact on water flow in terms of quantity and quality. The aim being to maintain the water flow to the bog but without any additional sediment load.
- To prepare a peat management plan to be agreed with SNH.
- To carry out protected species survey for, in particular, otters and badgers. Discuss and agree the results and any appropriate measures with SNH and FCS.

Following on from the Scoping Meeting SEPA responded requesting that the following information is included.

- Map showing assessment of all engineering works within and near the water environment including buffers.
- Peat depth survey map and table detailing re-use proposals.
- Schedule of mitigation including pollution prevention measures.

A copy of the scoping responses are included in **Appendix 1.**

3.2 Structure of the Environmental Statement

The Environmental Statement for the new forestry road at Dornie quarry has been prepared in accordance with Schedule 1 of the EIA (Forestry)(Scotland) Regulations 1999. This has been prepared to present information relating to the development in a straightforward, easily accessed format, which is indicated below:

Section 4
Background to the Development including Location, Sites of Special Scientific Interest, Land Use, Geology, Soils and Archaeology.

Section 5
Access. '10 Under the Ben' Mountain Bike Trail and Core Path Network

Section 6
Ecology and Protected Species

Section 7
Design and Construction Method Statement including:
Environmental Considerations, Route Constraints, Route Selection, Construction Standards, Road Materials, Design Criteria, Road Construction, Floating Road Construction, Roadside Drainage, Watercourse Crossings, Pollution Prevention and Mitigation

Section 8
Peat Survey

Section 9
Hydrology including:
Background Information, Watercourses, Existing Surface Water Drainage, Changes to Drainage, Assessment of Potential Impacts, Cumulative Impacts.

Appendix 1 Scoping Responses.
Appendix 2 Protected Mammal Species Survey (Highland Ecology).
Appendix 3 Forestry Commission Standard Road Specification
Appendix 4 Peat Survey Data

4 BACKGROUND TO DEVELOPMENT

4.1 Location

Dornie quarry is located within Leanachan Forest, the new forestry road is located around the Eastern boundary of Dornie quarry. The village of Torlundy is located approximately 4.2km to the West and Spean Bridge is approximately 5.1km to the North East of the development. The Nevis Range Ski Centre is approximately 1.3km to the West of the quarry boundary.

The Site Location is shown on **Plan DQR 01.**
The New Road Line is shown on **Plan DQR 02.**

4.11 Parallel Roads of Lochaber SSSI

Dornie Quarry and the new forestry road both lie partially within the SSSI. The Parallel Roads of Lochaber SSSI covers an area of 14,650hectares and is cited as a 'site of outstanding importance for geomorphology'. The Parallel Roads of Lochaber SSSI is unique in Britain. This is internationally recognised as a classic locality for Pleistocene ice-dammed lake shorelines, (which form the characteristic 'parallel roads') together with a wide assemblage of landforms and sediments recording geomorphological processes, both during and following successive episodes of catastrophic lake drainage. This assemblage includes glacier moraines, stagnant ice deposits, kame terraces, meltwater gorges, lake floor sediments, fans, deltas, river terraces and landslides.

4.12 Lon Leanachain SSSI

Lon Leanachain SSSI lies to the East of the new forestry road and the road crosses the main watercourse in the site which flows East and into the SSSI. Lon Leanachain SSSI covers an area of 126.4hectares within Leanachan Forest.
Lon Leanachain is described as *'the best inland example of a low altitude blanket bog in the north of Lochaber'*.
The blanket bog contains two distinct areas with patterned surfaces and vegetation which is more typical of western raised bogs; there being dry hummocks of reindeer moss and wet hollows containing bog mosses *Sphagnum spp.* Thirteen species of *Sphagnum* moss are known to occur on this site, several of which are rare or uncommon, and there are three species of insectivorous plant: two species of sundew *Drosera spp*. and common butterwort. In the mesotrophic conditions around lochans the swamp vegetation includes stands of common reed, bottle sedge *Carex rostrata* and white-beak sedge *Rhynchospora alba*. Towards the south and east of the bog there are transitions into birch scrub and marshy grassland with large tussocks of purple moor grass. Bog myrtle is locally abundant.

4.2 Land Use

The quarry extension area and the area where the forestry road is located have both been used for commercial forestry. All trees have previously been harvested over this area of the site as part of the normal woodland management cycle and to permit development to continue in the quarry extension, together with the associated new forestry road.

4.3 Geology

4.31 Bedrock

In Dornie quarry the solid geology comprises Dalradian Quartzite and Ballachulish Limestone. The beds are overturned with the older quartzite apparently stratigraphically overlying the limestone, the latter outcropping to the South of the River Lundy, the former to the North.

The limestone is largely restricted to the existing quarry area with the solid geology in the Eastern quarry extension and underlying the line of the new forestry road comprising Dalradian quartzite and quartzo- felspathic psammite.

4.32 Superficial Deposits and Soils

Quaternary fluvio-glacial sand and gravel deposits overlie the existing quarry and occur along the line of the new forestry road. These deposits are associated with ice damming to form the succession of impounded lakes in Glen Roy. Peat occurs on the valley floor with the peat probing survey showing depths ranging up to 2.22m. Over the section of the valley floor where the road is located the peat depth ranges from 0.6 – 2.22m. An area of blanket peat was also identified along the Northern side of the road line with depths from 1.2 – 2.5m recorded.

The peat survey is detailed in **Section 8**.

4.4 Archaeology

A desk top and walkover survey was undertaken as part of the EIA for Dornie quarry extension (Application Ref: 09/00021/FULLO). This identified one archaeological feature *'Tom na h-Iolaire'* a rectilinear enclosure which was shown on the 1st edition of the OS 6-inch map (Inverness-shire 1874, sheet cxl). This is at the South Eastern perimeter of the quarry extension area and mitigation measures including a targeted investigation of this site are included in the planning conditions for the quarry extension.

The *'Tom na h-Iolaire'* enclosure site is located on the elevated area of ground to the South and East of the line of the new forestry road. This enclosure site is located at a higher elevation than the new forestry road. The road follows an existing valley feature to the West of the raised area, then turns towards the East, running along the base of the 10 – 12m high steep slope at the North of the raised area.

The road will have no impact on archaeological features.

5 ACCESS

Leanachan Forest and the Nevis Range Complex are promoted as a recreational centre for cycling, walking and seasonal skiing. The impact of the new forest road has been assessed with respect to recreational access.

5.1 Mountain Biking - '10 Under the Ben'

A short section of the *`10 Under The Ben'* mountain bike track runs along the North – South forestry road, which is located at the Western end of the current extraction area of Dornie quarry. When the new forestry road is formed, the existing mountain bike track will be diverted along the new road. Leiths will ensure that suitable signs are erected to direct mountain bike riders along the amended track.

The diversion will not be put in place until the new forest road is completed. Only when the new forest road is in use will the existing road, which is currently used as part of the *'10 under the Ben'* track be removed.

This will increase the length of the mountain bike track by approximately 460m. The diversion of the mountain bike track will ensure mountain bikes are further away from the operational quarry area.

5.2 Core Paths

Core Path LO23.04 (Killiechonate to Leanachan to Nevis Range) follows the existing forestry road to the South and East of Dornie Quarry. In the area where the development is located the new forestry road will form a new 'T' junction off the existing forestry road, heading towards the North.

The existing road and Core path will not be affected.

Removal of the short section of existing forestry road which will take place following formation of the new private way will also have no impact on the core path, with the core path following the existing forestry road which will be unchanged

5.3 Consideration of Alternatives

The existing North – South forestry road is between 40 and 60m to the West of the existing quarry face. During the next phase of the quarry development quarry extraction takes place towards the East and into the quarry extension area covered by p/p 09/00021/FULLO.

If the new forestry road around the perimeter of Dornie quarry extension area was not constructed and the existing North – South forestry road was retained, this would result in both forestry and leisure road users travelling through the centre of an active quarry site.
This would have significant health and safety implications for quarry staff and customers along with the forestry and leisure road users.

Prior to submission of the planning application to extend Dornie quarry (Application Ref: 09/00021/FULLO in 2011 the forestry commission (FCS) concluded that it was beneficial from both an FCS and health and safety perspective that the new forest road was formed as part of the quarry development to divert both FCS and leisure users from potentially traversing through an active quarry site.

5.4 Land Reform (Scotland) Act 2003

The Land Reform (Scotland) Act 2003 theoretically gives access across any land, this does not relate to quarry operations since access is restricted on health and safety grounds.

6 ECOLOGY AND PROTECTED SPECIES

A detailed ecological survey of the area was undertaken as part of the EIA for the 2009 Dornie Quarry Application.

SNH requested that a protected species survey was undertaken along the road line and in the adjacent area of the site, for, in particular otters and badgers.

A protected species survey was undertaken by Highland Ecology on the 28th October 2016.

The survey concluded:

- No evidence of use by otters or badgers was found.
- No evidence of use by European Protected Species (EPS) found.
- Significance of development on all species surveyed was considered low.

The survey report also included recommended mitigation measures to follow during road construction. These mitigation measures have been included in the Design and Construction method statement in **Section 7.11.**

A copy of the Protected Mammal Survey Report is included as **Appendix 2**

7 DESIGN AND CONSTRUCTION METHOD STATEMENT

7.1 Introduction

Planning permission was granted for an Eastern extension to Leiths (Scotland) Limited's Dornie quarry at Torlundy (Application Ref: 09/00021/FULLO) in 2011. The existing quarry is separated from Eastern extension area by a North – South running forestry road.

The new forestry road is designed to replace the North – South road which crosses through the boundary of Dornie quarry. The new forestry road is required to divert all traffic around the perimeter of Dornie quarry extension area, providing a link between the existing forestry road to the South of the extension area and the existing forestry road to the North East of the quarry.

The new road is 856m in length and this will replace the 405m long North – South road which crosses Dornie quarry.

The existing road and line of the new road are shown on **Plan DQR 02.**

7.2 Environmental Considerations

Most of the route of the new forest road is located within the Parallel Roads of Lochaber SSSI which is a *'site of outstanding importance for geomorphology'*. To the East is the Lon Leanachain SSSI which is described as *'the best inland example of a low altitude blanket bog in the north of Lochaber'*.

With the location of the new forestry road it is a 'Relevant Project' under the Environmental Impact Assessment (Forestry) (Scotland) Regulations 1999.
The EIA scoping meeting on the 12th October 2016 was attended by the Forestry Commission (Richard Wallace and Chris Tracey) along with Corrina Mertens of Scottish Natural Heritage.
It was highlighted during the scoping meeting and emphasised on the associated site visit that:
'The formation of the replacement road has the potential to disturb and cover key features of the Parallel Roads SSSI and impact on drainage to the adjacent Lon Leanachain SSSI.'

SEPA stated in their Scoping response:
'as the site drains to Lon Leanachain SSSI, it is important that the road drainage is designed to ensure silty water and other pollution will be prevented from entering the watercourse.'

A Copy of the Scoping Responses are included in **Appendix 1**.

The road has been designed to reduce the potential impact on the geomorphological features identified within the Parallel Roads of Lochaber SSSI and ensure the impacts on the Lon Leanachain SSSI are minimised.

This Method Statement has been prepared to detail the road design and construction together with the pollution prevention and mitigation measures required during road construction.

7.3 Route Constraints

The new forestry road must meet the Forestry Commission Standard Road Specification for maximum gradient. This restricts the route options due to the undulating glacial topography at the Northern side of the quarry extension area together with the relatively steep slope between the extension area and the existing East – West forestry road.

A copy of the Forestry Commission Standard Road Specification is included as **Appendix 3.**

7.3.1 Route Selection

A detailed survey of the quarry extension area and its surroundings was undertaken to provide an accurate 3d model of the area.
A provisional route for the road was identified on plan, based on a route which, in principle, would avoid steep or difficult terrain, use existing harvester tracks where possible, minimise the length of cuttings and allow suitable watercourse crossings to be constructed. This was followed up by a site walkover where the route was refined and set out, based upon observations of localised ground conditions and small scale topography changes.
The road has been designed as a floating road across areas of peat to minimise the environmental impact.

Plans and gradient calculations for the refined route were supplied to the Forestry Commission for approval.

The road route was discussed at the 12th October 2016 EIA Scoping Meeting site visit. The scoping response stated: *'It was agreed that the revised line as presented and looked at on site is the best available subject to requirements as noted below.'*

7.4 Construction Standards

The road will be constructed in accordance with the Forestry Commission Standard Road Specification as detailed in **Appendix 3**.

Where the road is to be a floating road in the peat areas, construction will follow the methodology detailed in the Forestry Commission Scotland / Scottish Natural Heritage publication Floating Roads on Peat, August 2010.

Construction of the road will adhere to the guidelines published by the Forestry Commission as Forests and Water, UK Forestry Standard Guidelines, 2011.

7.4.1 Sequential Construction

With the environmental sensitivity of the site, particularly in the low-lying fen / mire area the road construction will take place in a sequential manner, including installation of the drainage swales in parallel with constructing the road. This will minimise the time that areas are exposed and will minimise unnecessary plant traffic over the fen / mire area during construction.

7.4.2 Tree Felling

The area where the new road is to be constructed has previously been clear-felled, consequently there are no trees along the route of the road or in any adjacent areas which require felling. At the Northern side of the site the route of the new road is close to the tree line but no tree felling is required in this area.

7.4.3 Road Materials

All rock or aggregate to be used in the road construction will be sourced from Leiths Dornie quarry which is adjacent to the site. The only exception to this is where the material excavated from the three cuttings along the road line is suitable for use in the road construction.

No rock or aggregate will be imported from elsewhere.

7.4.4 Design Criteria

The road will be constructed to meet the following criteria

Design Speed	25 km/h
Design Loading	44 tonnes (Construction and Use Regulations 1986)
Road Width	3.4m Running Width (+/-200mm) The road will be widened on the inside of bends to suit the radius. *(As detailed in the Horizontal Bend Widths and Gradients Table in the Forestry Commission Standard Road Specification)*
Maximum Gradient	The road has been designed with a maximum gradient of <8%. The Standard Road Specification states: *'<8% in general to be preferred, but gradients up to 10% acceptable. Small lengths (<200m) up to 12.5% may be permitted provided that they are contained within an overall gradient of 10%. For restrictions on gradient on bends, see table.'*
Minimum Gradient	2% except over short sections on crests and sags.
Passing Places	Specified passing places need to be 20m long and at least 3m wide with 10m splays. Spaced to be inter-visible with a maximum spacing to be agreed. One passing place is required as shown on the prepared plans. This area has been chosen where there are shallow peat depths and gentle ground slopes. *With the environmental sensitivity of the low-lying area where the watercourses are located this area is unsuitable for passing places.*
Bridge Approaches	The road is designed to allow both watercourse crossings to meet the Standard Road Specification. *'Minimum approach straight is 20m.'*
Turning Places	Turning "T's" to be 26m in overall length (i.e. from far edge of road to end of 'T'), 4m wide with 11m radii. *There will be no turning places within the route since this can be achieved where the road joins on to the existing forestry road at the Southern and North Western end respectively.*
Harvesting Facilities	Not Applicable *The new forestry road has been deigned to provide a route for forestry related traffic around Dornie Quarry extension through an area which has been clear-felled.*

7.5 Earthworks

Earthworks will be undertaken in accordance with Clauses 601 and 602 of MCHW(1).

While unsuitable materials will be stripped and removed in accordance with the Forestry Commission Standard Specification, the exception to this is in the areas where peat has been identified where a floating road construction will be used.

The road has been designed to minimise the requirement for excavation and removal of materials from the low-lying fen / mire area at the Eastern end of the site which has been identified as environmentally sensitive. Any soil excavated from the remainder of the road will be utilised in the landscaping of the area immediately adjacent to the road. No soil or peat will be removed off site.

The foundation layer will be shaped to keep it clear of standing water.

There is a negligible risk of contaminated materials or controlled wastes being encountered along the route of the road which is within an area that is largely undisturbed. In the unlikely event that potentially contaminated materials are identified these will be assessed, sampled and tested as deemed appropriate by member of Leiths Technical Services Department.

7.5.1 Timber and Timber Brash

Outside the floated road areas all residual timber, tree stumps or timber brash along with any rocks or boulders will be cleared from the road line and associated drainage corridors at either side of the road.
Where possible tree stumps can be upturned, and compacted down within the road corridor.

No rocks or boulders have been identified during previous site inspections.

(1) Manual of Contract Documents for Highway Works Volume 1 Specification for Highway Works

7.5.2 Turf and Soil

Where a peat depth in excess of 0.6m has been identified, a floating road construction will be adopted. The Forestry Commission / Scottish Natural Heritage publication Floating Roads on Peat suggests depths of 0.6m to 1.5m and above when to *'float'* a road, highlighting that the decision whether to excavate or float a road would be dependent on the specific circumstances at a location.

The peat depth survey **(Section 8)** identifies two areas where a floating road is required. In these locations, the vegetation surface should be left intact.

In the areas where a floating road construction is not being used, turf and soil will be stripped from along the road and temporarily stored for re-use adjacent to the road corridor.
Care should be taken to ensure turves are retained to minimise damage to vegetation and allow the vegetation to become re-established when turves are re-used.
Turves should be stored 'turf side up' wherever possible. If required, the turves should be stacked up to a maximum of thickness of two turves high.

At the Southern side of the site where the road runs adjacent to the low-lying mire/fen area, no turves or soil should be stored at the North side of the road within the fen / mire.

7.5.3 Formation Width

The Formation Width is affected by the sub-grade strength, the variation in moisture content along with the capping layer and the running surface material quality. The pavement width must be structurally sound over the total running width.

The Minimum Formation Width is calculated based on a Running Width of 3.4m (+/- 0.2m), plus 1.5 times the Pavement Thickness on each side.

The Formation Width will be increased in the areas where the road is constructed as a floating road.

On sloping ground the Minimum Formation Width should be increased to allow for drainage features on sloping ground, an embankment, or for safety reasons e.g. to keep the traffic away from a drop down an embankment.

7.5.5 Passing Place

One Passing Place is required in the Northern Section of the road. This should be 20m long and at least 3m wide with 10m splays.
The Passing Place location is shown on **Plan DQR 03.**

7.5.5 Pavement Thickness

In practice the pavement thickness can only be assessed on site by an experienced, competent contractor with the pavement thickness varying along the length of the road depending on underlying formation conditions.

7.6 Cuttings and Embankments

With the undulating glacial topography in the Northern and Southern sections of the site, three cuttings are required to ensure the road meets the maximum gradient detailed in the Forestry Commission Standard Road Specification

The Standard Road Specification states:
'Cutting slopes must be stable and free of overhangs and loose rock. The maximum slope to be 30% for slopes up to 2m high. For slopes more than 2 m high, the maximum slope to be 1 in 2 (50%) for fine grained soils, 1 in 1½ (67%) for other soils, and 1 in 1 for rock slopes.'

Cuttings are shown on **Plan DQR 03.**
Section Locations are shown on **Plan DQR 04.**
Cutting Long Sections are shown on **Plan DQR 05.**

All cuttings are within sand and gravel. A maximum slope of 50% as listed in the Forestry Commission Standard is suitable for natural sand and gravel slopes.

When the formation cut has been made a 2m wide bucket should be used on the tracked excavator to finish off the batters to leave a smooth slope. A smooth slope will consolidate more quickly than a rough face.

A gentle slope as designed will vegetate more easily and in a shorter time than a steep slope, reducing the visual impact of a cutting. Leaving narrow ledges on the cutting slope will also promote vegetation growth.

7.6.1 Cutting A

The road lies within a shallow cutting which follows a natural valley feature in the existing terrain. The line of the new road also ensures a level area is maintained at the junction with the existing East – West forestry road.
This cutting results in a maximum road gradient of 7.4% in a cutting length of 86m. Most the cutting is less than 2m deep with a maximum depth of 3.4m. Using the existing terrain in this area the side slopes or batter in the cutting have a slope less than 40%.
The maximum slope permitted in the Forestry Commission Road Specification for slopes in excess of 2m high is 50%.

Cutting A Cross Sections are shown on **Plan DQR 06**

7.6.2 Cutting B

The second cutting allows a road line with a gradient of 7.7% in a 136m long cutting. The maximum cutting depth is approximately 3m. The side slopes or batter in this cutting are again less than 50% which is the maximum permitted in the Forestry Commission Road Specification for slopes in excess of 2m high.

Cutting B Cross Sections are shown on **Plan DQR 07**

7.6.3 Cutting C

This is a short 55m long cutting which provides a road line with a gradient of 7.5%. The maximum cutting depth is approximately 3m. The maximum side slopes or batter in this cutting are again less than 50% which is the maximum permitted in the Forestry Commission Road Specification for slopes in excess of 2m high.

Cutting C Cross Sections are shown on **Plan DQR 08**

7.6.4 Embankments

Apart from the 3 cuttings discussed above the road is designed to closely follow the natural topography and substantial embankments are not required.

Any small 'localised' embankments required will meet the standard Forestry Commission Specification.

'Unless agreed beforehand, the fill material to be free draining and non-cohesive, placed in layers and effectively compacted in accordance with Clause 612 of the MCHW. Slopes as for cuttings.'

Any spill slopes associated with embankments will be formed at a gentle angle. A gentle slope will be more stable than a steep slope and encourage re-growth of vegetation.

7.7 Road Construction

7.7.1 Capping Layer / Road Base Construction

The purpose of the capping layer is to form a solid base for the road. The capping layer should be spread on top of the formation for the full width of the running surface of the road to protect the formation from wear and to improve the CBR of the subgrade / formation to a minimum of 5%.

The CBR (California Bearing Ratio) is a penetration test for evaluation of the mechanical strength of road subgrades and base courses. The test is described in BS EN 1377: Soils for civil engineering properties: Part 4, Compaction related tests.

The CBR rating was developed for measuring the load bearing capacity of soils used for building roads. The harder the material, the higher the CBR rating. The moisture content also has an effect on the CBR rating.

Capping Layer Depth and Camber

The depth of the Capping layer should be regulated to meet the needs of the underlying formation and to ensure that the road camber meets the appropriate gradient (alternatively the road should incorporate a crossfall). The road should have a minimum camber of 5% (alternatively a crossfall of 5%) in accordance with the Forestry Commission Standard Specification. This gradient will ensure the risk of ponding on the road surface is kept to a minimum and surface water will run off the road into the drainage swales at either side of the road.

The capping layer should also be laid so that the longitudinal gradient can be kept even.

Rock Type / Specification

The capping layer should utilise a suitable durable rock or road base to Clause 613 of MCHW(1).

The ideal material in the capping layer is a 75 - 100 mm well-graded granular material. Sharp, angular material or crushed rock compacts well and is better than rounded gravel.

The angular quartzite aggregate from Dornie quarry is ideally suited for use in the capping layer.

The capping layer is impossible to compact properly when saturated. The capping layer should be laid in suitable weather and ground conditions, although the strength will increase as the material drains and consolidates.

(1) Manual of Contract Documents for Highway Works Volume 1 Specification for Highway Works

CBR Values

Typical CBR values for the types of formation which will be encountered in this location are

Typical Material	CBR (%)
Peat	<2
Silt	<2
Saturated Sand	7
Fine Sand	10
Graded Sandy Gravel	20
Rock	>250

7.7.2 Running Surface

The final layer of aggregate placed on the capping layer seals off the road and acts as a wearing course. The running surface of the road will be formed using Granular Type 1 Sub-base to Clause 803 of MCHW(1).

The aggregate for the running surface will be sourced from Dornie quarry, this meets the Magnesium Sulphate Soundness requirements detailed in the Forestry Commission Standard Road Specification.
The wearing course / running surface will be laid in accordance with Clause 801 of MCHW.

The overall road metal thickness will comply with the table in the Forestry Commission Standard Road Specification (see **Appendix 3**).

7.7.3 Road Verges

The restoration of verges and cuttings will be undertaken alongside the initial road formation to avoid prolonged storage of stripped materials and allow early assimilation of the verges.

With the varied vegetation along the route of the roadway, re-using the turves stripped from the line of the roadway and temporarily stored alongside the road will ensure the vegetation becomes re-established as soon as possible.

No planting is required alongside this road.

(1) Manual of Contract Documents for Highway Works Volume 1 Specification for Highway Works

7.8 Floating Road Construction

Within the low-lying area at the Eastern end of the site the road has been designed as a floating road to minimise excavation and disturbance of peat. The road will also be a floating road in the short section of blanket bog at the Northern side of the site.

This will provide a reduced environmental impact by comparison to excavation of peat along the road line and replacing the peat with a suitable fill material.

The Forestry Commission and Scottish Natural Heritage published guidance on good practice in the wind farm industry as 'Floating Roads on Peat' in 2010. While this report has been primarily prepared to discuss how floating roads can be used in constructing the internal road network of wind farm developments, the good practice is applicable to the road design around the perimeter of Dornie quarry.

The FCS / SNH report highlights both the engineering and environmental benefits of using geogrids in floating road construction including:

- *Road construction thickness can be reduced by more than 50% compared with a road on peat without geogrids. This can result in a reduction in the amount of fill that needs to be won and transported. This reduces fuel use, noise, dust and other pollutants associated with heavy plant operations;*
- *Although the use of geogrids will not eliminate settlement, the fact that the road is thinner will mean that the road is lighter and that settlement will be less than an equivalent road without geogrids;*
- *The installation of a geogrid can reduce differential settlement through spreading loads and creating a more even distribution of pressures across the peat surface. This can result in an improved performance of the finished road.*
- *Floating roads can usually be expected to cause less compression of the underlying peat and thus have a lesser effect on the hydrology of the site. This is not always the case however and can depend on the thickness of peat being floated over. Thin peat deposits (< 1m) can compress significantly, particularly as much of this form of peat can be acrotelmic and highly compressible, which can have a significant adverse impact on hydrology;*
- *By maintaining the surface layer of vegetation, it is arguable that the basic ecology of the site will not be affected to the same degree as would occur if traditional construction methods were adopted;*
- *The environmental impact of construction activities and traffic can be reduced due to the quantities of aggregate required;*
- *Lower carbon footprint than that of an equivalent excavated road, and less carbon released through excavation of the existing peatland.*

7.8.1 Forestry Commission Engineering Timber Raft Construction

In the floating road areas, the road construction will utilise the Forestry Commission Engineering (FCE) Timber Raft Construction Method as detailed in the FCS / SNH published guidance.

This method involves laying a platform of local forest materials or brash on the peat surface to support and distribute the loads of the new road until the underlying peat can gain sufficient strength to support the floating road on its own.
The brash platform is a 150mm - 250mm thick matt of brushwood laid directly on to the peat. This comprises a mat of branches spread to build up a carpet of vegetation capable of supporting the road.

The Forestry Civil Engineering method detailed in the FCS / SNH report is:

- Undertake a peat probing survey at a minimum 50m interval along the road line to provide peat depths. Each probe location is recorded by GPS.

The results of the peat probing survey are detailed in ***Section 8****.*

- Prepare a formation 7-8m wide.
- Lift tree stumps outwith 5 metres of the centreline of the formation and place these inverted between any undisturbed roots within the area of the formation.
- Cover with all available brash to form an even mat.
- The depth of the timber mat will vary depending on the quantity of timber and brash available from the road line with all available brash normally placed on the road. Additional timber should be brought in to those sections where it is felt that the mat is not providing suitable structural integrity.

A large volume of suitable brash is available adjacent to the line of the new forestry road.

- Seal with a minimum of 300mm of suitable material as a regulating layer for the geogrid.
- Place a 40N geogrid on the regulating layer.
- The FCS / SNH guidance states the optimal depth of rock is between 600mm and 1000mm but highlights that settlement on areas of poor quality peat will require additional thickness of rock and geogrids.

7.8.2 Settlement and Peat Loading

The following procedures should also be followed to minimise settlement while adhering to the recognised Forestry Civil Engineering method.

The FCS / SNH report highlights the importance of controlled peat loading related to the rate of construction and laying of the foundation layer or aggregate.

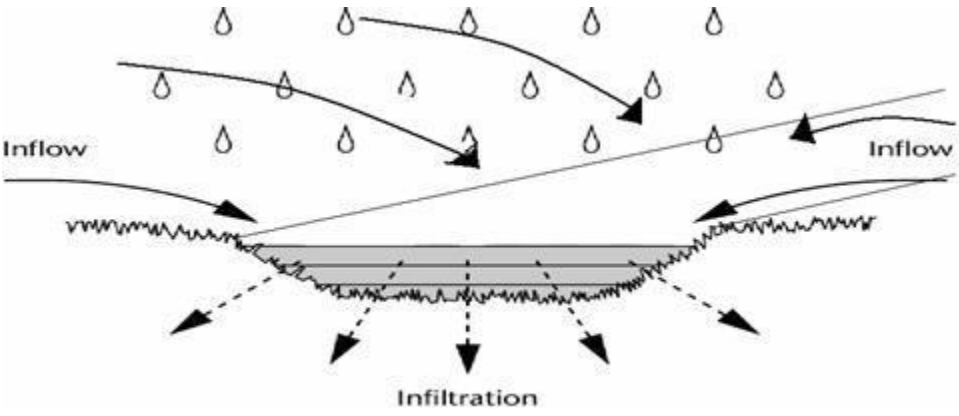
'Peat should be loaded slowly to allow the underlying peat to respond to the increasing load and be given sufficient time to consolidate and gain strength rather than shear. If a floated road is placed too quickly so as to approach, or exceed, the in-situ strength of the underlying peat then failure can follow. If peat is loaded too quickly, without allowing time for water pressures to be released, the in-situ peat will effectively have the shear strength of its water, i.e. zero. This has to be avoided at all costs. Modern design methodologies and risk management strategies can help prevent this but designers should be aware that serious shear stresses can be induced in peat, even by moderate fills, if loadings are not sufficiently controlled.'

The construction of the road will be undertaken by a contractor who is experienced in construction of floating roads over peat. This will ensure that the peat loading is undertaken using best practice to minimise the risk of overloading the peat substrate.

7.9 Roadside Drainage

With the sensitivity of the Lon Leanachain SSSI and the nearby low-lying fen / mire area through which the new forest road passes, the road has been designed using shallow drainage swales in preference to drainage ditches.

Drainage swales are broad shallow vegetated open channels, designed to convey runoff, reducing its volume and velocity and removing suspended sediment. The swales treat run-off through filtering by vegetation, through the subsoil and/or infiltration into the underlying soil structure.



Typical Swale Profile (not to scale)

The road design has shallow drainage swales located at either side of the roadway.

The drainage swales are shown on **Plan DQR 03.**

The swales will ensure that surface water run-off from the adjacent ground is captured within the swale and does not flow across the road surface, reducing the potential of erosion of the road surface during periods of heavy rainfall.

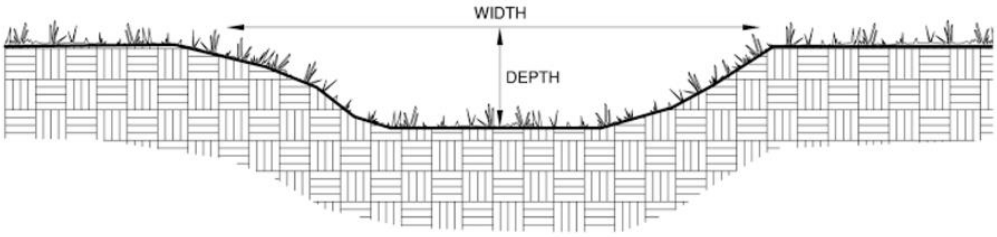
Locating swales at either side of the road will also capture any sediment from the road surface carried up by vehicle (truck) wheel spray in periods of heavy rainfall.

The use of shallow drainage swales will ensure that the risk of sediment reaching the watercourses in the low-lying fen or mire area and subsequently the Lon Leanachain SSSI is minimised.

The swales are designed NOT to feed directly in to the existing watercourses in the low-lying area.

7.9.1 Drainage Swale Design

The swales are designed with a width of approximately 2m and a maximum depth of between 0.3m and 0.5m. The swale profile will be created with gentle sloping side slopes with a maximum side slope of 3:1.



The Standard Road Specification states:

'A roadside ditch shall be provided on the uphill side of a road and on both sides where the road formation is at or below the adjacent ground. Drains shall have a depth of not less than 150 mm below the formation edge and a longitudinal gradient of not less than 2%. Ditches and drains shall not lead directly into watercourses. Filters will be provided in and adjacent to the drains and culverts to avoid pollution and sedimentation of watercourses. Drains can help in temporary storage of flood water.'

Silt traps should be installed every 25 – 50m where required, apart from in the low-lying area. These silt traps can be removed when road is fully established and risk of sedimentation / siltation removed.

7.9.2 Roadside Drainage in Floated Road Section

The FCS /SNH publication 'Floating Roads on Peat' 2010 states:

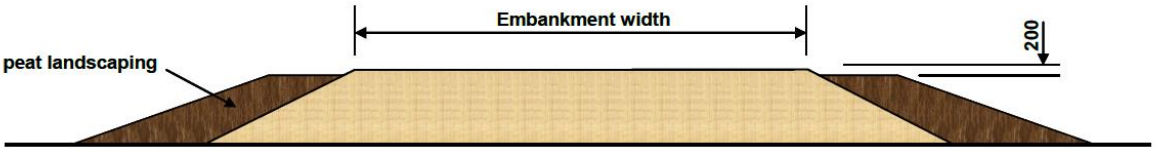
'Unlike standard road construction on firm ground, it will not always be necessary to provide intercepting ditches for floating roads. The first decision to be made when considering drainage associated with floating roads over peat is whether or not intercepting ditches are really needed.'

In this location drainage swales are required at either side of the road in the 'floating road' areas to capture any sediment carried from the road during wet weather and minimise the risk of sediment from spray associated with vehicle wheels entering the sensitive environment of the Lon Leanachain SSSI.

Any rainfall in the fen / mire will continue to be retained within the fen / mire area. The floating road areas are on level ground and the design of the drainage swales ensure they will have a minimal impact on the hydrology of the upper layer of the peat.

The FCS / SNH publication states:
'A well designed floating road should be able to be constructed to stand above the bog and as a result any rain falling on the bog and road should be contained within the bog as previously'

Where the floating road construction technique is required in the low-lying fen / mire area the swale will also be in the landscaped section within the low verge at the side of the road 'embankment' to minimise disturbance of the adjacent land.



7.9.3 Timing of Drainage Swale Construction

The FCS / SNH publication highlights the potential problem of settlement of a floating road section when excavating new ditches, or deepening existing ditches, after construction of a floating road invariably triggering settlement problems.

'Ditches excavated into the Catotelmic layer of the peat will lower the groundwater table and the resulting hydrostatic uplift on the road will reduce its "buoyancy", effectively making the road heavier, causing further compression and settlement in the underlying peat.'

The drainage swales designed are shallow and will not enter the Catotelmic peat layer.

The FCS / SNH publication also highlights the environmental considerations related to drainage works prior to commencing the main road construction.

'Advance drainage works, particularly intercepting ditches established ahead of the floating road construction, can sometimes be a good idea but are not always environmentally acceptable. Where they can be provided, the new drains make it possible to stabilise the local hydrology and allow floating construction to proceed with greater confidence of a successful outcome.'

The swales will be formed while the floating road is constructed rather than post construction to minimise the risk of hydrostatic uplift and to minimise the environmental impact in the low-lying area.

In both areas where the floating road will be located the ground is relatively level and consequently there is no requirement for additional culverts underlying the floating road.

7.9.4 Ditch Relief Culverts

Apart from the three cuttings detailed in Section 7.6 above, the road is on level or near level ground. With drainage swales at either side of the road, ditch relief culverts as described in the Forestry Commission Standard Specification are not required in this location. If during construction ditch relief culverts prove necessary, these should be restricted to the section of the road outside the low-lying fen / mire area.

Depending on ground conditions it can be normal practice to install cut off culverts close to stream or watercourse crossings. With the nature of the ground in this area and the environmental sensitivity of the Lon Leanachain SSSI there is no requirement for additional cut-off culverts.

7.10 Watercourse Crossings

Two watercourse crossings are required as part of the road construction. Both crossings are at the Eastern end of the road.

The location of both culverts is shown on **Plan DQR 03**.

With the environmental sensitivity of the low-lying area and the adjacent Lon Leanachain SSSI through which the watercourses flow, the formation or installation of the watercourse crossings is identified as an aspect of the road development where the pollution prevention and mitigation measures included in the method statement will reduce the risk of an environmental incident to a minimum.

The scoping response from SEPA states:
'Given the important of this watercourse for Lon Leanachain SSSI, then we would expect a bridge crossing to be used for the watercourse crossing. Provided the watercourse crossing is designed to accommodate the 0.5% annual exceedance probability event and any other infrastructure is located well away from watercourses we do not foresee from current information a need for detailed information on flood risk.'

The new watercourse crossings are in the fen / mire area which has peat depths ranging from 0.6m – 2.2m. In this area the road will be constructed as a floating road. By comparison to a traditionally excavated road this will have a reduced effect on the hydrology of the site. The land upstream and downstream of the floating section of the road is semi-waterlogged and the installation of the road will not have a significant effect on this hydrological system.

Installing a bridge or bottomless culvert type crossing would require excavation of the peat substrate to ensure a stable foundation can be achieved. Excavating peat over an area surrounding the watercourse to install a crossing will both reduce the effectiveness of the floating road construction and adversely affect the hydrological balance in this area.

Floating road construction relies on slow gradual settlement and consolidation of peat over the area of the road until stability is achieved. Installing a bridge or bottomless culvert, which in effect is a solid or rigid structure, with a section of floating road at either end will cause settlement problems in the road.

Excavating an area to provide a stable foundation for a bridge or bottomless culvert crossing will, overtime, locally lower the groundwater table. This may reduce the 'buoyancy' of the adjacent areas of the floating road, effectively making these areas of road 'heavier' than the remainder of the floating road causing further compression and settlement in the underlying peat.

With the road in this area designed as a floating road over a peat substrate, pipe culverts will provide suitable watercourse crossings without the requirement to excavate the peat substrate.

Using culvert crossings in association with the floating road construction will ensure the existing drainage is retained and will minimise any additional impact on hydrology over and above formation of the floating road.

The road has been designed to utilise two pipe culverts to meet the requirements of the Forestry Commission Standard Specification.

The Standard Road Specification states:
'All pipes shall be to Clause 501 of the MCHW - excavated in accordance with Clause 502; bedded, laid and surrounded in accordance with Clause 503; and backfilled in accordance with Clause 505. Laid in natural ground or in bed of original watercourse where applicable. Aim for bed continuum, for flora and fauna. Minimum size 300 mm although 450 mm preferred. Inlets to be provided with erosion protection. Outfalls should be so constructed as to eliminate possible erosion.
Ditch relief culverts should be spaced as required with a maximum spacing of 200m. Where appropriate, culverts to be designed for 1 in 50 year storm. Where the diameter is greater than 1.2 m, the culvert to be designed for 1 in 100 year storm. Bridges are preferred, including for flora and fauna riparian zones.'

There are no requirements for ditch relief culverts associated with either crossing.

7.10.1 CAR Registration

The watercourse crossing on the main watercourse, watercourse 1 will require a registration under The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended). CAR registration is required for *'Closed culverts used for footpaths, cycle route, single track roads or railways in rivers ≤2m wide'*
In this location the watercourse is shown on the 1:50,000 OS map.
Watercourse 3 is not shown on the 1:50,000 OS map and as a drainage ditch no registration is required for the culvert installation under CAR.

7.10.2 Culvert Installation Timing

The FCS / SNH publication 'Floating Roads on Peat' states:

'Cross – carriageway culverts can be installed ahead of floating road construction, during the work, or after the road has been constructed by excavation through the finished road. The latter case will however disturb any equilibrium that has been built up between the road and underlying peat, and should be considered to be the least preferred option.'

With the recognised sensitivity of the low-lying area where the crossings are located, both crossings must be installed during the construction of the floated road section.

Installing the culvert before installation of the remainder of the floating road section would require plant to traffic over the peat area with the resultant damage / disturbance to the upper vegetation layer which is the strongest layer in the peat profile. This would result in additional work being required to form a stable floating road structure and would result in additional settlement and compression of the underlying peat.

7.10.3 Water Discharge Volumes

Two existing watercourses flow into and through the area where the new road is located. Both watercourses have their source further to the South and enter the area where the new road is located through two culverts below the existing East – West forestry road. The two existing culverts restrict the volume of water which can flow into this area.

Watercourse 1 flows through a 0.43m ID concrete pipe (Culvert 1).
Watercourse 2 flows through a smaller 0.3m diameter pipe (Culvert 2).

Watercourse 2 joins Watercourse 1 upstream of the new crossing. The new road crossing over Watercourse 1 has to accommodate the maximum volume of water which can enter the site through the two upstream culverts.

The Watercourses and Culverts are shown on **Plan DQR 09**.

Manning Equation

The Manning Equation has been used to calculate the maximum discharge volume through the two existing culverts.

The Manning Equation is the most commonly used equation to analyse open channel flows. It is a semi-empirical equation for simulating water flows in channels and culverts where the water is open to the atmosphere, i.e. not flowing under pressure, and was first presented in 1889 by Robert Manning.
The Manning Equation was developed for uniform steady state flow, for uniform steady flows, the slope of the water surface is equivalent to the slope of the bottom of the channel.

$$Q = VA \qquad V = \frac{k}{n}\left(\frac{A}{P}\right)^{2/3} S^{1/2}$$

k	Unit conversion factor: (k=1.0 for SI units)
A	Flow area of the pipe, culvert, or channel.
P	Wetted perimeter (the portion of the circumference in contact with water).
Q	Discharge (flow rate).
S	Downward (longitudinal) slope of the culvert.
V	Average velocity in the pipe, culvert, or channel.
n	Roughness Factor

Using the Manning Equation allows a calculation to be made for the maximum flow capacity for each of the two existing culverts. The Maximum Discharge and Velocity occurs when the culverts are approximately 94% full and this maximum figure is used to calculate the volume required for the new watercourse crossing on the main watercourse (Watercourse 1).

Culvert 1 (concrete pipe)

Fill Depth	100%	94%
Wetted Perimeter (P)	1.351m	1.138m
Diameter	0.43m	0.43m
Length	9.34m	9.34m
Level Difference (Inlet to Outlet)	0.36m	0.36m
Downward Slope	0.03854	0.03854
Roughness Factor (n)	0.012	0.012
Discharge (Q)	0.537m^3/s	0.602m^3/s
Average Velocity	3.699 m/s	4.146m/s

Culvert 2

Fill Depth	100%	94%
Wetted Perimeter (P)	0.943m	0.794m
Diameter	0.30m	0.30m
Length	6.63m	6.63m
Level Difference (Inlet to Outlet)	0.23m	0.23m
Downward Slope	0.03469	0.03469
Roughness Factor (n)	0.009	0.009
Discharge (Q)	0.262m^3/s	0.294m^3/s
Average Velocity	3.691m/s	4.138m/s

The material used in the pipe in Culvert 2 was not identified. The calculation above has used a roughness value (n) of 0.009 which is appropriate for a smooth plastic pipe culvert. If the pipe is a steel or concrete culvert an increased roughness value of 0.012 would apply resulting in lower velocity and discharge.

Fill Depth	100%	94%
Wetted Perimeter (P)	0.943m	0.794m
Roughness Factor (n)	0.012	0.012
Discharge (Q)	0.197m^3/s	0.220m^3/s
Average Velocity	2.769m/s	3.104m/s

With the restriction on flow due to the two existing culverts the maximum volume of water which can enter Watercourse 1 from upstream is 0.896m^3/s.

7.10.4 New Watercourse Crossing – Installation and Design

The minimum volume of the new road watercourse crossing on Watercourse 1 is calculated to accommodate the maximum volume of water which can enter the watercourse from upstream. (0.896m^3/s)

The FCS / SNH publication 'Floating Roads on Peat' provides details on installation of culverts or pipes which minimises the requirement for excavation.

The pipe or culvert should be hung in a supporting or hanging geogrid, surrounded by lightweight forest brash or peat. The pipe or culvert is then 'covered' by the normal floating road construction.

'Where drainage paths or peat pipes are detected they should be taken through the floating road in a permanent conduit such as shown in Figure 8.6. The conduit should be of a sufficient "pipe equivalent" size to accommodate the expected flow through the drain and, as with cross-carriageway culverts above, hung in a geogrid below the floating road.'

Figure 8.6 below from the FCS / SNH publication illustrates a hanging geogrid and pipe culvert in a floating road.

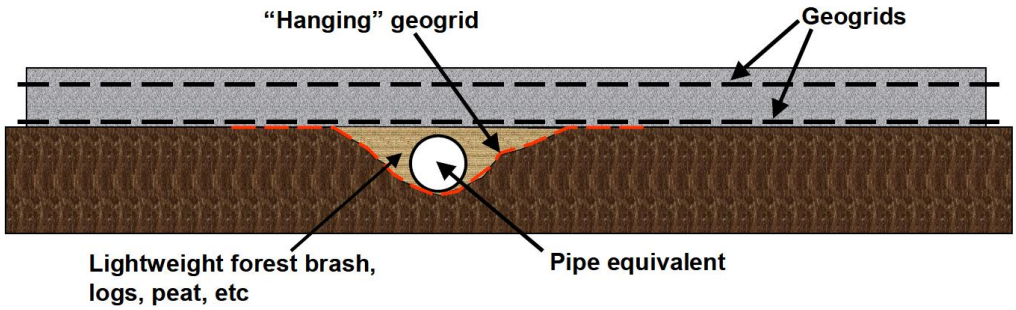


Fig 8.6 Dealing with ditches and natural peat pipes below a floating road

The water crossing for Watercourse 1 utilises a minimum of a 0.8m diameter pipe culvert. This will accommodate more than the calculated maximum flow rate able to enter Watercourse 1 via the upstream culverts.

Fill Depth	75%(1)
Wetted Perimeter (P)	1.676m
Diameter	0.80m
Length	8m
Level Difference (Inlet to Outlet)	0.04m
Downward Slope	0.005
Roughness Factor (n)	0.009
Discharge (Q)	1.232m^3/s
Average Velocity	3.046m/s

(1)A fill depth of 75% has been used in the calculation to account for the culvert invert being buried a quarter of the rise below the existing level.

The culvert invert will be buried at least one quarter of the rise below the existing level. Culverts installed within a stream or burn are recognised as increasing the flow velocity and consequently can lead to development of scour holes at the culvert exit. The area around the culvert outfall will be reinforced with suitable site sourced boulders to restrict / reduce the risk of erosion.

The culvert must be installed during the sequential formation of the floated road section, this will minimise the requirement for additional plant movements over the fen / mire area.

7.10.5 Watercourse 3 Crossing

Watercourse 3 which is effectively a narrow, shallow slow running ditch starts within the low-lying fen / mire area. The ditch runs near to the base of the slope at the Northern side of the road area. Any surface water run-off from this slope will be captured in the ditch and flow towards the East.

The new road also needs to cross Watercourse 3 which is also in the floating road section. The water depth in this ditch in the location the crossing is required was measured at 0.25 – 0.3m on the 18th November 2016. The Ditch had a maximum width of 0.3m.

With the installation of the new road the drainage swales will capture surface water run-off from the North of the road, reducing the volume of water which enters Watercourse 3.

A 0.45m diameter pipe culvert is required for the watercourse crossing for Watercourse 3.

The culvert will be installed using the same techniques detailed for Watercourse 1 crossing in Section **7.10.4** above.

The culvert invert will be buried at least one quarter of the rise below the existing level. The area around the culvert outfall will be reinforced with suitable site sourced boulders to restrict / reduce the risk of erosion.

The culvert must also be installed during the sequential formation of the floated road section and as part of the floated road structure to minimise the requirement for additional plant movements over the fen / mire area.

7.11 Pollution Prevention and Mitigation

The new forestry road is to be constructed by a suitably qualified and experienced sub-contractor. While a sub-contractor is undertaking the work on a Leiths operated site, the equipment, plant and pollution prevention procedures will comply with the same standards as if Leiths employees were undertaking the work using the company's equipment.

Best practice for earthworks taking account to localised proximity to watercourses and the environmenatlly sensitive Lon Leanachain SSSI will be followed. Works will be undertaken in compliance with SEPA Engineering in the Water Environment Good Practice Guide Temporary Construction Methods.(WAT-SG-29). All works will be undertaken in accordance with the best practice published in Pollution Prevention Guidance (PPG 5) : Works and Maintenance in or Near Water.
Construction of the road will adhere to the guidelines published by the Forestry Commission as Forests and Water, UK Forestry Standard Guidelines, 2011.

Site Specific Procedures

- No plant should drive through the watercourses on site.
- Plant should only be trafficked along the route of the road and not in adjacent areas, this is particularly appropriate in the low-lying area.
- Straw bales should be used downstream of the watercourse crossings to trap any sediment created during construction. These bales should be replaced as required and straw bales retained in place until the running surface of the road is completed.
- The road should be constructed in a sequential manner to avoid unnecessary traffic on the low-lying area where the fen / mire is identified as a sensitive habitat.

Pollution Prevention Measures

- All plant used in the construction of the forestry road will carry oil spill kits.
- All plant operators will be conversant with the use of oil spill materials and will receive on-site instruction on the environmental sensitivities at this site.
- Additional oil spill materials should be available at all times to replenish any materials used on site.
- Any fuel or oil spills will be recorded in the site diary and an appropriate investigation undertaken.
- All refuelling will take place in a suitable area of hard standing to minimise the risk of fuel spills or oil spills entering the low-lying area, watercourses and the Lon Leanachain SSSI.
- All refuelling should be manually controlled with the operator observing the fuelling operation to ensure that overfilling cannot take place.
- Oil spill materials will be available at the refuelling station.
- Fuel Oil (diesel) will be stored in a bunded secure storage tank; all plant fuel systems will be secured and checked daily.

- The bulk fuel tank used by the contractor will meet the requirements of Statutory Instrument 2006 No. 133, The Water Environment (Oil Storage) (Scotland) Regulations 2006.
- All plant used on site will be inspected daily, the inspection includes assessing for oil, coolant or fuel leaks. Where appropriate the plant will be taken out of service until leaks are repaired.
- Daily oil level checks and replenishment should be undertaken away from the working area.
- No plant maintenance will take place close to the watercourses or in the low-lying area.
- Where a fuel, oil or coolant leak occurs when plant is in operation.
  If the plant can be moved without making the leak worse or spreading the leaking fluid it should be moved to an area of hard standing where the leak can be fully contained and repaired.
  If the plant cannot be moved oil spill materials, sand /soil bunds should be used to contain the leak until the plant can be repaired. All potentially contaminated absorbents, soil, sand etc. should be transported to Dornie Quarry for disposal in accordance with the duty of care.
- Any hazardous materials must be stored in a secure area.
- All refuse or debris generated will be disposed of in accordance with duty of care. 'Domestic' waste including food scraps or packaging will be disposed of in the appropriate bin within Dornie quarry.
- No fires, or burning of rubbish will be permitted.

Ecological Mitigation Measures

Taken from recommendations included in Proposed Forestry Road Protected Mammal Species Survey, Highland Ecology (see **Appendix 2**).

Otters

Although no signs of otter were found during survey the following mitigation should be adopted as a precautionary measure:

- All staff directly involved in track construction should be made aware of otter legal status and potential risks to otter associated with construction.
- Ensure that no organic rubbish/waste food is left lying around the site that may attract otter or other wildlife into the construction area.
- If any new signs of otter (e.g. holts, lie-ups or animals) are encountered, work within 30m must cease, and advice sought from an Ecologist or SNH. A site inspection and further mitigation may be required.
- During construction, it should be ensured that best practice is employed at all times, with specific regards to those on-site hazards which could affect otter. This includes covering all deep pits/trenches whilst not in use, or providing exit ramps, to prevent otter from being trapped/injuring themselves.
- Any harmful substance or materials should be secured whilst unattended.

Badgers

Although no signs of badger were found during survey the following mitigation should be adopted as a precautionary measure:

- All staff directly involved in track construction should be made aware of the legal status of badgers and potential risks to badger associated with construction.
- Ensure that no organic rubbish/waste food is left lying around the site that may attract badger or other wildlife into the construction area.
- If any new signs of badger (e.g. setts or animals) are encountered, work within 30m must cease, and advice sought from an Ecologist or SNH. A site inspection and further mitigation may be required.
- During construction, it should be ensured that best practice is employed at all times, with specific regards to those on-site hazards which could affect badger. This includes covering all deep pits/trenches whilst not in use, or providing exit ramps, to prevent badger from being trapped/injuring themselves.
- Any harmful substance or materials should be secured whilst unattended.

8 PEAT SURVEY

8.1 Introduction

Peat can cover a wide range of organic soil types with a wide range of properties. The Soil Survey of Scotland defines peat as having a surface horizon greater than 50cm thick with an organic matter content of more than 60 percent.

For this development, the road design aims to minimise excavation of peat on the site by utilising the recognised technique of constructing the road as a floating road where peat depths are in excess of 0.6m(1). This will minimise disturbance to peat on the site, reducing the impact on hydrology and ensuring there is no release of CO^2 from within the peat structure.

The topography of the site restricts the location of the route along with the vertical and horizontal alignment of the road. Crossing two areas of peat cannot be avoided. In both peat areas, the road will be constructed as a floating road.

8.2.1 Initial Site Investigation

The initial site investigation comprised a desk study and a site walkover / ground verification to verify the proposed road route. The two areas where peat was likely to occur were identified during the site walkover.

(1) The Forestry Commission / Scottish Natural Heritage publication Floating Roads on Peat suggests depths of 0.6m to 1.5m and above when to *'float'* a road, highlighting that the decision whether to excavate or float a road would be dependent on the specific circumstances at a location.

8.2.2 Peat Probing

With the road design not involving peat excavation through the use of floating road construction, a peat probing study was undertaken to survey the peat depths along the road route and in neighbouring areas.

Manual peat probing involves pushing an extendable metal pole into the ground until the point of resistance is met. The point of resistance is the base of the peat deposit. Depth to the base of peat is measured and the position of each survey point is recorded using a hand-held GPS system.

The FCS / SNH Report 'Floating Roads on Peat' states:
'The extent and frequency of any ground investigation works will by necessity be dependent on the particular circumstances at each site but, as an example, Forestry Civil Engineering recommend that probing is carried out at 50m centres along the planned road alignment unless local conditions warrant closer intervals.'

Scottish Government Guidance 'Developments on Peatland' states:
'Experience from wind farm developments indicate that peat surveys should comprise:
• A detailed survey on a 10m² grid around the centre of each proposed turbine base or other infrastructure base.
• A detailed survey at 50m intervals along proposed track/road locations using 10m right angled offsets
This assumes a low resolution survey on a 100m² grid has already been undertaken and that extensive areas of deep peatland are noted and avoided and steep slopes are avoided reducing the risk of landslide.'

Scottish Natural Heritage at Torlundy loaned Leiths a purpose designed peat probe to undertake this survey.

The peat probing survey was undertaken on the 18th November 2016 along the road route at a minimum 50m spacing to meet both Forestry Civil Engineering and the Scottish Government guidance. Additional survey points were recorded over the general area at a wider spacing.

The survey point were located where the geo-referenced road marker posts were installed and additional survey points were positioned using a hand-held GPS.

8.2.3 Peat Sampling and Testing

No peat sampling was undertaken for this development with no excavation of peat required as part of the road construction plan.

8.3 Survey Results

The peat probing results were used in conjunction with the site survey data to produce plans showing peat depths over the site area. The plans show that the maximum peat depth that will be encountered along the road route is 2.22m

A table of the peat probe data is included in **Appendix 4.**
The peat probe data is plotted on **Plan DQR 10** and **Plan DQR 11**.

9 HYDROLOGY

9.1 Introduction

This section of the Environmental Statement details the existing hydrological and hydrogeological conditions along the route of the new forestry road. The potential impacts on the hydrological and hydrogeological conditions from both construction and use of the forestry road are assessed. The mitigation measures which will be employed to ameliorate any adverse impacts identified are also detailed.

With the proximity of the extension of Dornie quarry to the road, the hydrological and hydrogeological conditions in the quarry extension area also need to be considered when assessing the effect of the new forestry road on the area.

The background hydrology and hydrogeology together with the effect of the quarry extension was initially assessed as part of the Environmental Impact Assessment undertaken for the Eastern extension to Dornie quarry, (Application Ref: 09/00021/FULLO), in 2011.

9.2 Background Information

The Planning and Environmental Statement prepared for the Eastern extension to Dornie quarry contains background information on:

- Climate / Meteorology
- Soils
- Flooding and Floodplain Issues
- Geology
- Groundwater
- Assessment of Surface Water Flows (primarily within quarry extension)

9.3 The Allt Coire Eoin (River Cour) Catchment

The new forestry road is located within an area where much of the surface water drainage flows towards the East and is contained within the catchment of the Allt Coire Eoin or River Cour.

To the West, the existing quarry lies within the catchment of the River Lundy. Surface water flow in the North Western 'corner' of the area where the new forestry road is located drains towards the existing quarry. This small area is contained within the catchment of the River Lundy. This area is shown as Catchment A and B on **Plan DQR 12**.

Further to the South and East all surface water drainage is towards the East and is within the Allt Coire Eoin or River Cour catchment.

9.4 Watercourses

The three watercourses in the area where the new forestry road is located are shown on **Plan DQR 12**.
The three watercourses have been identified as 1 – 3 in the report and on the accompanying plans.

A minor surface watercourse flows through the quarry extension area towards the East. This 'main' watercourse (Watercourse 1) is sourced from land to the South and crosses below the existing East - West forestry road through a concrete pipe culvert with an inside diameter of 0.43m.

Watercourse 1 is fed by a second smaller watercourse (Watercourse 2), further West, closer to the existing quarry. Watercourse 2 is again sourced from land to the South and crosses the forestry road through a culvert of 0.3m diameter. Watercourse 2 is in turn fed by shallow roadside swales or ditches at either side of the East – West forestry road.

To the East of the watershed between the Cour and Lundy catchments, all overland flow from the South of the existing forestry road enters either Watercourse 1 or Watercourse 2.

The 'main' watercourse, Watercourse 1 flows through the low-lying land in the centre of the quarry extension area and flows towards the blanket bog in the Lon Leanachain SSSI to the East of the new forestry road.

Watercourse 1 is a minor tributary of the Allt Coire Eoin or River Cour.

A third smaller watercourse (Watercourse 3) was identified during the site survey at the North side of the low-lying fen / mire area. This ditch also flows towards the East and eventually joins Watercourse 1 to the East of the line of the new forestry road.

No other watercourses have been identified at the North side of the low-lying land. With the nature of the sandy ground and the steep slope North of Watercourse 3; drainage in this part of the site will largely be due to infiltration into the substrate, entering the ditch at the base of the slope when a less permeable layer is encountered.

9.5 Existing Surface Water Drainage

Five catchments have been identified in the area as shown on **Plan DQR 12**.

The new forestry road runs through all 5 catchments identified.

Catchment 'A'

The first catchment 'A' sheds water via overland flow towards the existing quarry. This catchment includes a steeply sloping area of undeveloped land to the North of the quarry extension boundary and a section of the existing North – South forestry road and cycle track.

With the undulating nature of the topography there is a small area to the North of the line of the new forestry road where overland flow may initially be towards the North, this area has been included in Catchment 'A' for the purpose of the assessment.

To the West some surface water will be intersected by the perimeter bund at the North of the existing quarry, overland flow is then towards the West where it enters an area of marshy land to the North West of the existing quarry boundary.

There are no natural drainage features in Catchment 'A'.

Catchment 'B'

To the East of Catchment 'A' the undulating nature of the topography results in an isolated area where overland water flow is directed towards a valley feature and then towards the South West.

Towards the base of the slope, close to the old Forestry Commission sand and gravel quarry, local small scale topographic changes indicate that a share of overland water flow is linked both to the existing quarry (continues in Catchment 'B') towards the South West and to Catchment 'C' in the South East. The permeable nature of the ground in this area, (free draining sand and gravel as seen in the existing quarry), has a strong bearing on overland water flow.

There are no natural drainage features in Catchment 'B'.

Catchment 'C'
Catchment 'C' includes a section of the glacial terrace to the North of the quarry extension area, the low-lying land in the centre of the extension area and the small disused Forestry Commission quarry.

The existing North - South forestry road lies at or close to the Western limit of Catchment 'C'.

The boundary between Catchment 'C' and Catchment 'D' is defined by Watercourse 1 and Watercourse 2.
Watercourse 3 lies wholly within Catchment 'C'

Overland water flow from Catchment 'C' enters either Watercourse 1, 2 or 3.

Catchment 'D'
This Catchment lies to the South of Watercourse 1 and Watercourse 2.

The area this catchment covers includes the glacial terrace to the South of the site, together with the low-lying area to the South of Watercourse 1 and Watercourse 2. The existing East – West running forestry road is also included in this catchment area, as is the elevated ground to the South of the existing forestry road which drains into Watercourse 1 or Watercourse 2.

Overland flow from Catchment 'C' enters Watercourse 1 or 2.

Catchment 'E'
By comparison to the other four catchments identified this catchment covers a small area and relates to an elevated area of the glacial terrace where locally the overland flow is directed towards the North, away from the existing quarry and the low-lying area.

9.6 Surface Water Drainage - Formation of New Road

The new forestry road is designed with a shallow drainage swale at either side of the road. These drainage swales fulfil two purposes:

a. Minimising the risk of sediment carried by run-off from the forestry road entering the existing watercourses and subsequently entering the Lon Leanachain blanket bog.
b. Maintaining surface water drainage towards the low-lying area at the East end of the site and towards the Lon Leanachain blanket bog.

Most the water flow within the 'main' watercourse, Watercourse 1 and Watercourse 2 is sourced from outside the site area; from higher land to the South of the existing East – West forestry road and will not be affected by the new forestry road.

The drainage swales either side of the forestry road have been designed to allow any run-off from the roadway and any associated sediment to be captured within the swales. The swales are designed to slow the water flow and allow any sediment sourced from the road surface to settle before the remaining water enters the low-lying area. The sandy nature of the substrate, particularly at the Northern half of this site will also influence water flow, with a percentage of the water in the swales attenuated directly into the ground.

At the Northern side of the site the 'outside' swale has been positioned to capture the existing overland water flow from the North and direct this towards the East of the site, maintaining the water flow towards the Lon Leanachain blanket bog. This swale will intercept any surface water which currently flows across the area where the road is to be located. Following installation of the new forestry road and the associated swales the volume of water entering the Watercourse 3 ditch will be reduced. The drainage swale at the opposite or inside of the road in this area has the primary function of ensuring no sediment due to run-off from the road surface reaches the low-lying area and Lon Leanachain blanket bog.

At the Southern side of the site the swale to the South of the new forestry road has been positioned to capture surface water flowing towards the North from the steep slope between the low-lying fen / mire area and the existing East – West forestry road. This swale will divert this water towards the Lon Leanachain blanket bog in the East. The drainage swale at the opposite (North) side of the road in this area has the primary function of ensuring no sediment due to run-off from the road reaches the low-lying area and Lon Leanachain blanket bog.

The drainage Swales are discussed in the Design and Construction Method Statement in **Section 7.9**.

9.61 Changes in Catchments A – E

Water flow following formation of the new road is shown on **Plan DQR 13**.

Catchment 'A'

Approximately 138m of the new forestry road is within Catchment 'A'
The drainage swales at either side of the new forestry road will influence drainage in Catchment 'A', diverting surface water captured in the swales away from the new forestry road and towards the North West. This will result in a reduction in overland flow from Catchment 'A' travelling towards the existing quarry. The reduction in Catchment area is approximately 3000m^2 or 16.6%.

Catchment 'B'

Approximately 58m of the new forestry road is located within Catchment 'B'
The new forestry road has only a small direct effect on drainage in Catchment 'B'. The drainage swales at either side of the new forestry road will divert surface water away from the new forestry road and towards the East. This will result in a reduction in overland flow from Catchment 'B' travelling South West towards the existing quarry. Catchment 'B' reduces in area by approximately 800m^2 or 3% when the new forestry road is formed.
The new drainage swales will increase the volume of water flowing towards the East and consequently indirectly increase the volume of water travelling towards the low-lying fen / mire area and the Lon Leanachain blanket bog.

Catchment 'C'

Approximately 320m of the new forestry road is included in Catchment 'C'. The design and location of the drainage swales at either side of the new forestry road will change the drainage characteristics in Catchment 'C'. Currently overland flow travels downslope into the low-lying fen / mire area and Watercourse 3. When the new forestry road and associate swales are formed much of this water will be diverted, towards the East, the low-lying area and Lon Leanachain blanket bog, away from the new forestry road and the area where the quarry extension is located.
The downstream end of both drainage swales remains within Catchment 'C'.

The new forestry road and associated drainage swales will result in a reduction in water flow in Watercourse 3 at the Northern side of the low-lying area. The drainage swales are designed so that all water captured by the drainage swales is directed towards the East. There will be no reduction in surface water volume from Catchment 'C' travelling towards the low-lying land to the East of the quarry extension area and the Lon Leanachain blanket bog.

Much of water within the 'main' watercourse, Watercourse 1 and Watercourse 2 is sourced from land to the South of the East – West forestry road, out-with the area where the new road is located. The volume of water in these watercourses will not be affected by the new forestry road.
The water captured by the drainage swales alongside the new forestry road would originally have entered the low-lying area and the associated watercourses. With

the formation of the drainage swales the captured water is directed to the East by the orientation and vertical alignment of the swales.

Catchment 'C' reduces in area by approximately 4500m^2 or 7.4% when the new forestry road is formed.

Catchment 'D'

Approximately 248m of the new forestry road is included in Catchment 'D'.
Catchment 'D' lies to the South of the 'main' watercourse, Watercourse 1. The new forestry road and associated swales will result in a reduction in water flow directly in to the low-lying area from the South. Both drainage swales are designed to divert any surface water from the road towards the East, maintaining the water flow towards the low-lying area at the East of the site and maintaining water flow towards the Lon Leanachain blanket bog.

Catchment 'D' reduces in area by approximately 2600m^2 or 11.5% when the new forestry road is formed. This reduction in area is attributed to the drainage swale at the South side of the new forestry road trapping any overland flow from the South and diverting this flow towards the East. In practice the overland flow remains within the low-lying area where the new forestry road is located and does not reduce the water flow into this area.

Much of water within the 'main' watercourse, Watercourse 1 and Watercourse 2 is sourced from the South of the East – West forestry road and will not be affected by the new forestry road. Both watercourses continue to flow through Catchment 'D' and the reduction in overland flow due to the new drainage swales will not have a significant effect on the overall hydrology of the low-lying fen / mire area in Catchment 'D'.

Catchment 'E'

Approximately 92m of the new forestry road is included in Catchment 'E'.
The orientation and vertical alignment of the drainage swales alongside the road in Catchment 'E' results in all surface water captured in this area being diverted to the East and eventually to the Low-Lying area and the Lon Leanachain blanket bog.
Prior to installation of the new forestry road the overland flow is directed towards the North, away from the existing quarry and the low-lying area.

Catchment 'E' reduces in area by approximately 1300m^2 or 29% when the new forestry road is formed. The reduction in area relates to formation of the new forestry road and associated drainage swales. The swales divert all overland flow in this area towards the East and towards the low-lying area.
Prior to construction of the new forestry road all overland flow was towards the North, away from the low-lying area.

9.7 Surface Water Drainage - Development of Quarry

While the new forestry road is designed and located to re-route leisure users and forestry related traffic around the extension to Dornie quarry, the development of the quarry in an adjacent area of land will have a local effect on hydrology.

Two phases of the quarry design (planning application Ref: 09/00021/FULLO from 2011) include extraction within the Eastern extension to the quarry.
The hydrological changes due to mineral extraction are detailed separately for Phase 4 and Phase 5 of the quarry development.
The new forestry road will be installed during Phase 3 of the quarry development with extraction in the Eastern extension area commencing during Phase 4. There are no additional changes to the new forestry road.

9.71 Changes in Catchments A – E, Quarry Development Phase 4

Water flow following Phase 4 of quarry extraction plan is shown on **Plan DQR 14**.

Catchment 'A'
With the extraction of the sand and gravel underlying the existing North – South running forestry road at the Eastern perimeter of the existing quarry the differentiation between Catchment 'A' and Catchment 'B' is less distinct. With the new perimeter bund at the North of the quarry extension area, potentially a larger volume of water will be diverted towards the existing marsh / bog area at the North of the quarry boundary.

Over the area where a detailed survey has been undertaken Catchment 'A' will be reduced in area by approximately 4300m^2.

Catchment 'B'
The area in Catchment 'B' is increased in size due to mineral extraction taking place. This Catchment can also be split into two sub-Catchments; Catchment 'Bb' and Catchment 'B'.

All surface water within the quarry extension area is included in Catchment 'B'. Surface water will be captured in shallow catch ditches excavated at the Southern and Northern side of the quarry extraction area. The catch ditches are designed so water will flow towards the West through a series of new settlement ponds from where the outflow will be channelled to the existing quarry drainage system via further settlement ponds.
All water in Catchment 'B' is directed towards the existing quarry in the West.

The increase in area of Catchment 'B' is approximately 19000m^2 *(an overall increase of approximately 22900m^2 including Catchment 'Bb')*.

Sub-Catchment 'Bb'
This is restricted to the small area between the new forestry road and the new perimeter bund of the quarry.

The majority of surface water will continue to be captured by the drainage swales at either side of the new forestry road; any remaining overland flow will be trapped against the quarry perimeter bund and will disperse by infiltration through the permeable substrate and enter the quarry area and Catchment 'B'.
There are no changes to the drainage swales associated with the new quarry road at the Northern perimeter of Catchment 'Bb'.
Catchment Bb has an area of approximately 3900m^2.

Catchment 'C'
The overall area of Catchment 'C' will reduce by the end of Phase 4 of the quarry development due to mineral extraction. The reduction in area of Catchment 'C' due to mineral extraction is calculated at approximately 17800m^2.

The effect of the roadside drainage swales on the volume of water entering Catchment 'C' is discussed in **Section 9.6**.

There will be no changes to the volume of water channelled to the Lon Leanachain blanket bog via Watercourses 1, 2 and 3 as previously discussed in **Section 9.6**. The area where the watercourses are located is initially unaffected by quarry extraction during this phase of the quarry development.

While the overall area of Catchment 'C' reduces by the end of Phase 4 the effect on water flow to the Lon Leanachain SSSI will be minimised by the drainage swales channelling water towards the East alongside the new forestry road and the existing watercourses being unaffected.

Catchment 'D'
There are no changes to area or water flow in Catchment 'D'. Catchment 'D' lies to the South of Watercourse 1 and Watercourse 2.

Catchment 'E'
There is a minor reduction of approximately 450m^2 in area due formation of the new quarry perimeter bund. There are no other changes to the area of Catchment 'E' related to extraction of Phase 4 of the quarry.

It is inevitable that some water seepage will take place into the quarry void, reducing the volume of water flowing towards the roadside swale at the perimeter of Catchment 'E'. The new quarry perimeter bund and limit of extraction is located close to the highest level in this area, the perimeter bund will help minimise the reduction in water entering the roadside drainage swale.

9.72 Changes to Catchments A – E, Quarry Development Phase 5.

Water flow following Phase 5 of quarry extraction plan is shown on **Plan DQR 15**.

Catchment 'A'
There are no additional changes to Catchment 'A' following Phase 4 of the quarry development.

Catchment 'B'
The overall area in Catchment 'B' is increased by approximately 23500m^2 due to additional mineral extraction taking place following the end of Phase 4 of the quarry development. Catchment 'B' is the area of quarry void within the quarry extension area and at the Eastern end of the existing quarry. With further extraction following Phase 4 the area of Catchment 'B' will increase. All surface water within the quarry extension area is included in Catchment 'B'.
All water will be channelled towards the West where the outflow will enter the existing quarry drainage system. Where required additional shallow catch ditches and settlement ponds will be excavated in the floor of the quarry during Phase 5.

Sub-Catchment 'Bb'
There are no additional changes to this Sub-Catchment related to further extraction in the quarry. The majority of surface water will continue to be captured by the drainage swales at either side of the new forestry road and any remaining surface water will be trapped against the perimeter bund and will disperse by infiltration through the permeable substrate and enter the quarry area and into Catchment 'B'.

Catchment 'C'
The overall area of Catchment 'C' will reduce by approximately 23000m^2 by the end of Phase 5 of the quarry development due to additional mineral extraction taking place.
The effect of the roadside drainage swales on the volume of water entering Catchment 'C' is discussed in **Section 9.6** above.

There will be no changes to the volume of water channelled to the Lon Leanachain blanket bog via the watercourses previously discussed (**Section 9.6**) with the area where the watercourses are located unaffected by quarry extraction.

While the overall area of Catchment 'C' further reduces by the end of Phase 5 the effect on water flow to the Lon Leanachain SSSI will be minimised by the drainage swales alongside the 'new' Forestry Road and the existing watercourses being unaffected.

Catchment 'D'
There are no additional changes to water-flow in Catchment 'D' during Phase 5 of the quarry development.

Catchment 'E'
There are no additional changes to the area of Catchment 'E' related to extraction of Phase 5 of the quarry.

9.8 Assessment of Potential Impacts

9.81 Watercourses and Watercourse Crossings

The project has been designed to ensure there are no direct impacts on the water flow of the main watercourse (Watercourse 1) or the secondary watercourse (Watercourse 2) which flows through the site area. The majority of water in these watercourses is sourced from higher land to the South, outside the area affected by either the new forestry road or by the associated quarry development.

The volume of water in the small watercourse at the Northern side of the low-lying area, Watercourse 3 is predicted to be reduced following the formation of the new forestry road, with the drainage swales adjacent to the road capturing water which would previously have entered the watercourse. The drainage swales are designed to transport water towards the East to mitigate the impact of reducing the water flow in Watercourse 3.

The detailed road design in the area where both watercourse crossings are located will minimise the risk of sediment laden run-off from the roadway entering the watercourse at either crossing.

The Design and Construction Method Statement is included as **Section7**.

9.82 Particulates and Run-Off

With the sensitive habitat to the East of the site, the forestry road has been designed to utilise vegetation lined shallow drainage swales. These swales will slow the flow of surface water and ensure any suspended solids settle within the drainage swale to minimise the risk of sediment being transported into the sensitive habitat. At the Northern side of the site the sandy substrate will also aid surface water attenuation and further reduce the risk of particulate laden run-off.

The drainage swales will capture any surface water run-off from adjacent land and stop run-off from reaching the new forestry road. These swales will also capture any direct run-off from the new forestry road, this will minimise the risk of sediment laden spray from forestry trucks in wet weather entering the sensitive habitat to the East of the site.

Within the extraction area of the quarry all surface water flow is towards the West. The bunds at the perimeter of the quarry will divert all surface water into the quarry void, removing the risk of sediment / particulate pollution from quarry operations entering the sensitive habitat at the East. The surface drainage system within the quarry extension will include a sequence of settlement ponds which will be linked to the existing settlement pond system to reduce the risk of particulates entering the River Lundy.

9.83 Impact on Groundwater and Ground Water Sources

The groundwater in this location generally mirrors the topography and is coincident with the interface between the bedrock and superficial deposits (sand and gravel).
The shallow cuttings along the route of the new forestry road are within the sand and gravel superficial deposits.
No vulnerable aquifers, have been identified in the area.
The new forestry road will not encounter groundwater and there will be no impacts on groundwater or aquifers.

9.84 Contamination from Fuels / Oils

Pollution Prevention and the associated Mitigation Measures included in the road design and road construction plan are detailed in **Section 7.11**.

9.85 Lon Leanachain SSSI

Lon Leanachain SSSI is located to the East of the development site and covers an area of 126.4hectares. The SSSI is described as *'the best inland example of a low altitude blanket bog in the north of Lochaber'*.

The Objectives for Management in the Site Management Statement are:
'1) To maintain the condition and extent of the blanket bog
a) Maintain the area and hydrology of the bog by controlling tree colonisation.
b) Maintain grazing at light levels.
c) Safeguard against fire '

The main watercourse in the area, Watercourse 1, a tributary of the Allt Coire Eoin or River Cour, flows into and through the Lon Leanachain SSSI. With the majority of water in this watercourse sourced from outside the forestry road / quarry extension area the reduction in water flow to the SSSI is assessed as minimal.

The drainage swales alongside the new road are designed to 'flow' towards the low-lying area to the East of the site which is connected to the SSSI and this will ensure that the impact on the hydrology of the low-lying area is reduced when the road is installed.

The road is designed as a floating road in the low-lying area of the site which is recognised to have a reduced impact by comparison to a road constructed by the normal technique.
This is detailed in the Design and Construction Method Statement in **Section 7**.

9.86 Parallel Roads of Lochaber SSSI

Prior to 3rd September 1986 the Lon Leanachain SSSI was included as part of the Parallel Roads of Lochaber SSSI.
The new forestry road lies partially within the Parallel Roads of Lochaber SSSI. The SSSI covers an area of 14,650hectares and is cited as a 'site of outstanding importance for geomorphology'.

The Objectives for Management in the Site Management Statement are:

1. ***To maintain the physical integrity of the landform assemblages within the site*** *by ensuring developments involving earth movements (such as housing developments, construction of tracks, infilling of quarries, or large-scale sand and gravel quarrying) are assessed carefully for their likely impacts and carried out sensitively.*
2. ***To maintain or enhance the visibility and accessibility of the landforms and sediments*** *by continuing positive grazing management of the site and by ensuring that developments such as afforestation, felling and restructuring of forestry plantations, or woodland regeneration, are assessed carefully for their likely impacts and carried out sensitively.*

The line of the new forestry road has been designed to minimise the impact on geomorphology while ensuring the road retains a gradient which is suitable for forestry related haulage as detailed in the Forestry Commission Standard Road Specification as included in **Appendix 3**.

To achieve the gradient permitted by the Forestry Commission Standard Road Specification three shallow cuttings are required along the road route, these are detailed in **Section 7.6**.

The changes to the hydrology due to construction of the new forestry road within the SSSI relate to the formation of the two new water crossings and the excavation of shallow drainage swales at either side of the road.

These minor changes will not significantly affect the geomorphological features within the SSSI.

9.87 Cumulative Impacts

The new forestry road is located adjacent to the consented extension to Dornie quarry. The hydrological aspects of the road have been considered in parallel with the development of the quarry.

There are no other developments in the immediate area which may have potential for a cumulative impact with regards to hydrology.

9.9 Conclusions

This hydrology report details the existing hydrological and hydrogeological conditions along the route of the new forestry road. The potential impacts on hydrology due to formation of the new forestry road have been identified and assessed.

The mitigation measures which will be employed to ameliorate any adverse impacts identified are detailed in **Section 7.11**.

The report concentrates on identifying any impacts which may affect the Lon Leanachain SSSI and the adjacent low-lying area within the Parallel Roads of Lochaber SSSI. These sites have been identified as sensitive to pollution from particulate matter and sensitive to hydrological changes.

Reduction in Surface Water Volumes

The volume of water in the main watercourse (Watercourse 1) which flows through the development site and into the Lon Leanachain SSSI will not be significantly affected by the formation of the road or by mineral extraction in Dornie quarry. The majority of the water in Watercourse 1 is sourced from out-with the development site.

There may be a small reduction in water volume entering Watercourse 3 at the Northern side of the low-lying area, with the drainage swales adjacent to the new forestry road in this area trapping any overland flow which would have previously entered Watercourse 3. These swales 'flow' towards the East and the water trapped by the swales will enter the low-lying area and subsequently the Lon Leanachain SSSI, effectively replacing the surface water contained within Watercourse 3.

The remaining drainage swales over most the length of the road channel water towards the East to ensure overland flow is directed towards this area

The resultant impact on the Lon Leanachain SSSI is assessed as slight - negligible.

Particulate Matter

The road is designed with vegetated drainage swales to capture any run-off and trap any suspended solids. The risk of additional particulate matter entering the watercourses from the road or from the quarry site is negligible.

Pollution During Road Construction

The pollution prevention and control measures included in the Design and Construction Method Statement for the new forestry road will minimise the risk of pollution from fuels, oils and associated substances or sedimentation of the watercourses during the construction of the new forestry road (**Section 7.11)**.

The resultant impact is assessed as negligible.

Groundwater

There are no potential impacts identified with regards to groundwater quality, ground water sources or groundwater flows.

Overall Impact

The hydrological assessment concludes that the overall impact on surface water, groundwater and the Lon Leanachain SSSI from the formation of the new forestry road at Dornie quarry is predicted to be negligible in both the short, medium and long term.

10 PLANS

Plan Number	Title
DQR 01	Location Plan
DQR 02	New Road Line
DQR 03	Cutting locations
DQR 04	Section Locations
DQR 05	Long Sections
DQR 06	Cutting 'A' Cross Sections
DQR 07	Cutting 'B' Cross Sections
DQR 08	Cutting 'C' Cross Sections
DQR 09	Drainage Features
DQR 10	Peat Survey Points
DQR 11	Peat Survey Contours
DQR 12	Existing Hydrology
DQR 13	Road Hydrology
DQR 14	Hydrology - Phase 4 of Quarry Extraction
DQR 15	Hydrology - Phase 5 of Quarry Extraction

11 References

- Forestry Commission Standard Road Specification - Appendix 1 in The Design and Use of the structural pavement of unsealed roads, Forestry Commission / Timber Transport Forum(Updated 2014)
- Forests and Water, UK Forestry Standard Guidelines, Forestry Commission Edinburgh 2011.
- Floating Roads on Peat Forestry Commission Scotland / Scottish Natural Heritage (2010)
- The Water Environment (Oil Storage) (Scotland) Regulations 2006.
- Manual of Contract Documents for Highway Works Volume 1 Specification for Highway Works
- BS EN 1377: Soils for civil engineering properties: Part 4, Compaction related tests.
- Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended)
- SEPA Engineering in the Water Environment Good Practice Guide Temporary Construction Methods.(WAT-SG-29).
- Pollution Prevention Guidance (PPG 5) : Works and Maintenance in or Near Water.
- Scottish Government Guidance, Developments on Peatland : Site Surveys 2014.

APPENDIX 1 SCOPING RESPONSES

Scoping Report - Note from Scoping Meeting 12th Oct 2016
SEPA Response PCS149564 20th October 2016

Forestry Commission Scotland

EIA (Forestry)(Scotland) Regulations 1999
Dornie Quarry, Leanachan Forest Road
030 902106

Note from Scoping Meeting 12 Oct 2016

Present:
Gordon Williamson – Leiths
Corrina Mertens – SNH
Chris Tracey – FCS Lochaber Forest District
Richard Wallace – FCS

Background
This note is not a full scoping report but rather a summary of the points and issues raised that will need to be covered in the Environmental Statement for the replacement forest road.

Summary

1. The operation of the extension of the quarry will expose the geomorphology of the site
2. The formation of the replacement road has the potential to disturb and cover key features of the Parallel Roads SSSI and impact on drainage to the adjacent Lon Leanachain bog SSSI.
3. The new road will be built and operational before the existing quarry cross road is closed
4. Material from the existing quarry will be used in the road construction. No material should be brought in from elsewhere.
5. It was agreed that the revised line as presented and looked at on site is the best available subject to requirements as noted below.
6. A construction method statement will be required to be agreed with SNH and FCS. This will need to confirm the line, areas of cut and fill and detail of how this and the impact of constructing the road will be minimised. (In particular the width and formation of the sides beyond the running surface.) The key areas being the kames that the proposed roadline crosses and where cut is required.
7. A water management plan will be required to be agreed with SNH and FCS. This will show the current drainage and flow directions of water. It will also show how water will be managed both for the quarry extension and the new road to minimise any potential impact on water flow in terms of quantity and quality. The aim being to maintain the water flow to the bog but without any additional sediment load.
8. To prepare a peat management plan to be agreed with SNH.
9. To carry out protected species survey for in particular, otters and badgers. Discuss and agree the results and any appropriate measures with SNH and FCS.

Richard Wallace
Forestry Commission Scotland
Highland and Islands Conservancy

SEPA
Scottish Environment Protection Agency
Buidheann Dìon Àrainneachd na h-Alba

Our ref: PCS/149564
Your ref:

Richard Wallace
Forestry Commission Scotland

If telephoning ask for:
Cerian Baldwin

By email only to: Richard.Wallace@forestry.gsi.gov.uk

20 October 2016

Dear Mr Wallace

Environmental Impact Assessment (Forestry) (Scotland) Regulations 1999
Diversion of the forest road Dornie Quarry, Leanachan Forest Road

Thank you for inviting SEPA to the recent scoping meeting and for also consulting us on the scoping opinion for the above development proposal by your email received on 18 October 2016.

Advice to the planning authority

We consider that the following key issues must be addressed in the Environmental Impact Assessment process. To **avoid delay and potential objection,** the information outlined below and in the attached appendix must be submitted in support of the application.

a) Map showing assessment of all engineering works within and near the water environment including buffers.

b) Peat depth survey map and table detailing re-use proposals.

c) Map of proposed surface water drainage layout.

d) Schedule of mitigation including pollution prevention measures.

Further details on these information requirements and the form in which they must be submitted can be found in the attached appendix. We also provide site specific comments in the following section which can help the developer focus the scope of the assessment.

1. Site specific comments

1.1 As you are already, as the site drains to Lon Leanachain SSSI, it is important that the road drainage is designed to ensure silty water and other pollution will be prevented from entering the watercourse. The site layout should detail the location of the proposed drainage channels, where they will discharge to and where mitigation is proposed to prevention pollution entering the watercourse. The Schedule of Mitigation should refer to

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Graesser House, Fodderty Way,
Dingwall Business Park, Dingwall IV15 9XB
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www.sepa.org.uk • customer enquiries 03000 99 66 99

this plan and detail who will be responsible for monitoring drainage during, and after, construction.

1.2 In this case, where much of the site is on peat, we expect the application to be supported by a peat depth survey to demonstrate that the road avoids the deepest areas of peat and that what peat is excavated can be re-used sensitively within the site.

1.3 Given the important of this watercourse for Lon Leanachain SSSI, then we would expect a bridge crossing to be used for the watercourse crossing. Provided the watercourse crossing is designed to accommodate the 0.5% annual exceedance probability event and any other infrastructure is located well away from watercourses we do not foresee from current information a need for detailed information on flood risk.

Regulatory advice for the applicant

2. Regulatory requirements

2.1 Provided a bridge is proposed for the watercourse crossing then it will only require a registration under The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended). Management of surplus peat or soils may require an exemption under The Waste Management Licensing (Scotland) Regulations 2011.

2.2 Details of regulatory requirements and good practice advice for the applicant can be found on the Regulations section of our website. If you are unable to find the advice you need for a specific regulatory matter, please contact a member of the regulations team in your local SEPA office at Carr's Corner Industrial Estate, Lochybridge, Fort William PH33 6TL Tel: 01397 704426.

If you have any queries relating to this letter, please contact me by telephone on 01349 860415 or e-mail at planning.dingwall@sepa.org.uk.

Yours sincerely

Cerian Baldwin
Senior Planning Officer
Planning Service

ECopy to: Corrina.Mertens@snh.gov.uk; lucy.prins@highland.gov.uk; gwilliamson@Leiths-Group.co.uk;

Appendix 1: Detailed scoping requirements

This appendix sets out our scoping information requirements. There may be opportunities to scope out some of the issues below depending on the site. Evidence must be provided in the submission to support why an issue is not relevant for this site in order **to avoid delay and potential objection**.

If there is a delay between scoping and the submission of the application then please refer to our website for our latest information requirements as they are regularly updated; current best practice must be followed.

We would welcome the opportunity to comment on the draft submission. As we can process files of a maximum size of only 25MB the submission must be divided into appropriately named sections of less than 25MB each.

1. Site layout

1.1 All maps must be based on the Ordnance Survey 1: 10 000 scale or greater base mapping to provide an adequate scale with which to assess the information. Each of the maps below must detail all proposed upgraded, temporary and permanent site infrastructure. This includes all tracks, excavations, laydown areas, storage areas and any other built elements. Existing built infrastructure must be re-used or upgraded wherever possible to minimise the extent of new works on previously undisturbed ground.

2. Engineering within the water environment

2.1 The scheme must be designed to avoid impacts upon the water environment wherever possible. Where activities such as watercourse crossings, watercourse diversions or other engineering activities in the water environment cannot be avoided then the submission must include a map showing:

a) All proposed temporary or permanent infrastructure overlain with all lochs and watercourses.

b) A buffer of at least 10 m drawn around each loch or watercourse. If this minimum buffer cannot be achieved each breach must be numbered on a plan with an associated photograph of the location, dimensions of the loch or watercourse, drawings of what is proposed in terms of engineering works.

c) Detailed layout of all proposed mitigation including all cut off drains, location, number and size of settlement ponds.

2.2 Further advice and our best practice guidance are available within the water engineering section of our website. Guidance on the design of water crossings can be found in our Construction of River Crossings Good Practice Guide.

2.3 Refer to Appendix 2 of our Standing Advice for advice on flood risk. Watercourse crossings must be designed to accommodate the 0.5% Annual Exceedance Probability (AEP) flows, or information provided to justify smaller structures. If it is thought that the development could result in an increased risk of flooding to a nearby receptor then a Flood Risk Assessment must be submitted in support of the planning application. Our Technical flood

risk guidance for stakeholders outlines the information we require to be submitted as part of a Flood Risk Assessment.

3. Surface water drainage

3.1 As detailed above as the site drains to Lon Leanachain SSSI, it is important that the road drainage is designed to ensure silty water and other pollution will be prevented from entering the watercourse. A site layout plan must be submitted detailing:

a) the location of the proposed drainage channels and where they will discharge to; and

b) what treatment is proposed and where this will be located.

3.2 The Schedule of Mitigation should refer to this plan and detail who will be responsible for monitoring drainage during, and after, construction.

4. Disturbance and re-use of excavated peat and other carbon rich soils

4.1 The planning submission must a) demonstrate how the layout has been designed to minimise disturbance of peat and consequential release of CO_2 and b) outline the preventative/mitigation measures to avoid significant drying or oxidation of peat through, for example, the construction of access tracks, drainage channels, cable trenches, or the storage and re-use of excavated peat.

4.2 The submission must include:

a) A detailed map of peat depths (this must be to full depth and follow the survey requirement of the Scottish Government's Development on Peat: Site Surveys and Best Practice) with all the built elements (including peat storage areas) overlain to demonstrate how the development avoids areas of deep peat and other sensitive receptors such as watercourses.

b) A table which details the quantities of acrotelmic, catotelmic and amorphous peat which will be excavated for each element and where it will be re-used during reinstatement. Details of the proposed widths and depths of peat to be re-used and how it will be kept wet permanently must be included.

4.3 To avoid delay and potential objection proposals must be in accordance with Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and Minimisation of Waste and our Regulatory Position Statement – Developments on Peat.

4.4 Dependent upon the volumes of peat likely to be encountered and the scale of the development, applicants must consider whether a full Peat Management Plan (as detailed in the above guidance) is required or whether the above information would be best submitted as part of the schedule of mitigation.

5. Pollution prevention and environmental management

5.1 One of our key interests in relation to developments is pollution prevention measures during the periods of construction, operation, maintenance, demolition and restoration.

5.2 A schedule of mitigation supported by the above site specific maps and plans must be submitted. These must include reference to best practice pollution prevention and

construction techniques, regulatory requirements, the daily responsibilities of ECOWs, how site inspections will be recorded and acted upon and proposals for a planning monitoring enforcement officer. Please refer to the Pollution prevention guidelines.

APPENDIX 2 ECOLOGY REPORT

Proposed Forestry Road Protected Mammal Species Survey
Report prepared on behalf of Leiths (Scotland) Ltd.
By Kate Proctor, Highland Ecology

February 2017

Dornie Quarry, Torlundy, Fort William
Proposed Forestry Road Protected Mammal Species Survey

Report prepared on behalf of Leiths (Scotland) Ltd.
By Kate Proctor, Highland Ecology

November 2016

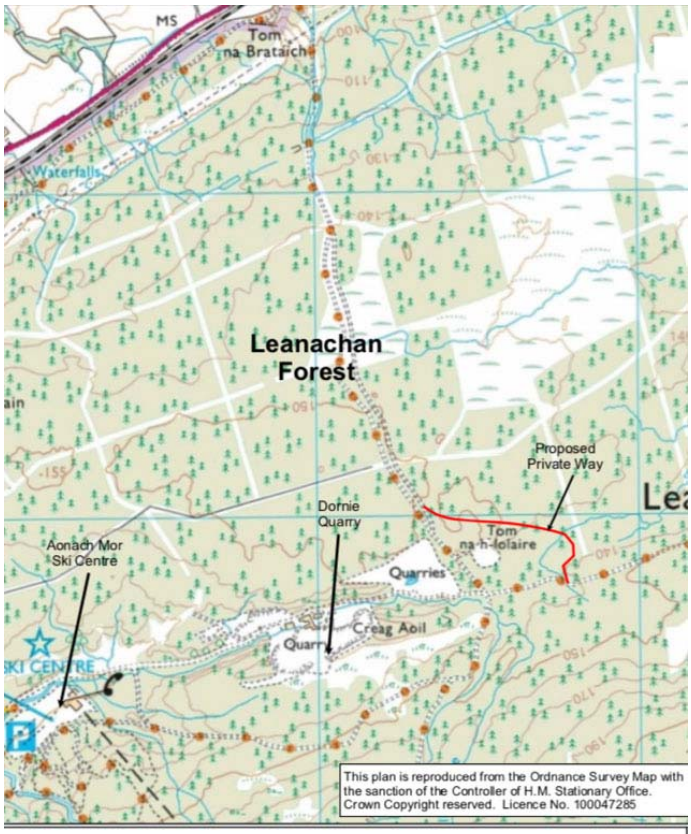
Highland Ecology
www.highlandecology.com

SUMMARY

- The site of the proposed new forestry road was surveyed for evidence of use by protected mammal species, primarily comprising otter, and badger.
- No evidence of use by otters or badgers was found.
- No evidence of use by European Protected Species (EPS) found.
- Significance of development on all species surveyed was considered **low**.

1. INTRODUCTION

The survey is for a proposed forestry track in association with the development of Dornie Quarry, near Torlundy, Fort William. Proposed track layout (as shown in the provided Figure DQPN.01 below).



Dornie Quarry - Prior Notification for Private Way	
Location Plan	Figure : DQPN.01
	July 2016
Scale 1:12,500	LEITHS

As part of the development of Dornie quarry near Torlundy (approximately ½ mile from Nevis Range Ski Centre), a new section of forestry road around the perimeter of the quarry is proposed. The new proposed forest road is approximately 850m in length and will replace an existing forest road of approximately 375m in length which will be removed by the quarry development.

The area is predominantly clear felled conifers which were felled in the last five years.

The quarry and proposed road are located in the Parallel Roads of Lochaber SSSI and close to the Lon Leanachan Bog SSSI. The proposed road crosses two small watercourses, which are minor and mainly uniform ditch-like streams.

A detailed ecological assessment was undertaken for the quarry in late 2008 and no signs of protected species were identified.

As recommended by SNH for this development, surveys for protected species were carried out on the 28th of October 2016 by Kate Proctor of Highland Ecology. The survey assessed the presence and activity of otter and badger and checked for other mammals and habitat suitable for European Protected Species (EPS).

1.2 Aims and objectives

The aims of this study were to:

(i) Assess use of the study area by otter and badger

(ii) Identify resting sites of the above species that may be disturbed or damaged either during construction or by any medium term or permanent changes;

(iii) Provide the necessary data to determine potential need for licenses for disturbance of target species and/or to inform mitigation needs; and

(iv) Record signs of any other mammal species that may be using the site.

2. FIELD SURVEY METHODOLOGY

2.1 Otters

The site envelope was surveyed for signs of otter using the 'walkover' and standard spraint technique (Chanin 2003b). This involved visual searching for signs of otter activity and signs along the track corridor and all water courses within the site to a minimum distance of 100m either side of the proposed track. A hand-held GPS was used to record target note positions.

- Signs indicating the presence of otters are:
- Holts – underground features where otters live.
- Lie-ups – above ground resting up sites, sometimes covered.
- Spraints (dung) – often deposited on prominent places such as boulders or tree stumps to mark territory;

- Pawprints and runs/tracks through the vegetation; and
- Sightings of animals.

2.2. Badger

The survey area was also systematically walked and searched for any evidence of use by badgers. Signs searched for include:

- Setts. These can be present as single holes or more which are likely to be interconnected underground.
- Scratching posts at the bottom of trees. Bark becomes noticeably marked and scratched.
- Footprints
- Hairs, which often get caught on fences or brash.
- Snuffle holes where badgers have foraged for insects, roots and worms.
- Paths.
- Faeces, usually occurring in excavated latrine pits.

3. RESULTS

There was no evidence of current use by either badger or otter over the survey area. Both species are known to be recorded in the wider area.

4. LEGAL STATUS

4.1 Otter

Otters are a European Protected Species (EPS) protected under Annex II and IV of EC Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (the Habitats Directive). The Habitats Directive is transposed in Scottish law by the Conservation (Natural Habitats &c.) Regulations 1994. Otter is listed on Schedule 2 of the Conservation Regulations 1994. The Conservation (Natural Habitats, &c.) Amendment (Scotland) Regulations 2007 enhanced this protection. It is now illegal to:

- deliberately or recklessly kill, injure or take (capture) an otter;
- deliberately or recklessly disturb or harass an otter ;
- damage, destroy or obstruct access to a breeding site or resting place of an otter (i.e. an otter shelter) .

Thus, otter shelters are legally protected whether or not an otter is present.

This legislation means that otters are fully protected in Scotland, and that any planned activity, which may affect them, requires prior consultation with the appropriate statutory nature conservation organisation (SNH). Licences may be granted for certain purposes that would otherwise be illegal; such licences for development work must be applied for from the Scottish Government. However, under Regulation 44 (2e) of the Conservation

(Natural Habitats, &c.) Regulations 1994, licences may be granted for preserving public health or public safety or other imperative reasons of overriding public interest including those of a social or economic nature and beneficial consequences of primary importance for the environment. A licence will not be granted unless, under Regulation 44 (3), the appropriate licensing authority is satisfied there is no satisfactory alternative and that the action authorised will not be detrimental to the maintenance of the population of the species concerned at a favourable conservation status in their natural range.

4.2 Badger

Badgers and their setts are protected by the Protection of Badgers Act 1992 (as amended by the WANE Act 2011).

As such it is an offence to:

- wilfully kill, injure, take or attempt to kill a badger
- possess a dead badger or any part of a dead badger
- cruelly ill-treat a badger
- use badger tongs in the course of killing, taking or attempting to kill a badger
- dig for a badger
- possess, sell or offer for sale any live badger
- mark, tag or ring a badger.

It is also a crime to interfere with a badger sett by intentionally or recklessly causing or allowing:

- damage to a sett or any part of it
- destruction of it
- sett access to be obstructed, or any entrance of it
- a dog to enter it
- disturbance to a badger when it is occupying it.

A person attempting to commit an offence under the Act is guilty of that offence.

Note: A badger sett is defined in law as any structure or place which displays signs of current use by a badger.

5. MITIGATION

5.1 Otter

No holts or otter lie-ups were identified within the survey corridor. No signs of usage by otters were present but it should be noted that they are known to utilise habitats associated with larger watercourses nearby.

The impact of this development on otters is therefore considered to be **low**.

Mitigation during Construction

Although no signs of otter were found during survey the following mitigation should be adopted as a precautionary measure:

- All staff directly involved in track construction should be made aware of otter legal status and potential risks to otter associated with construction.
- Ensure that no organic rubbish/waste food is left lying around the site that may attract otter or other wildlife into the construction area.
- If any new signs of otter (e.g. holts, lie-ups or animals) are encountered, work within 30m must cease, and advice sought from an Ecologist or SNH. A site inspection and further mitigation may be required.
- During construction, it should be ensured that best practice is employed at all times, with specific regards to those on-site hazards which could affect otter. This includes covering all deep pits/trenches whilst not in use, or providing exit ramps, to prevent otter from being trapped/injuring themselves.
- Any harmful substance or materials should be secured whilst unattended.

5.2 Badger

No signs of badgers were found within the survey corridor.

The impact of this development on badgers is therefore considered to be **low**.

Mitigation during Construction

Although no signs of badger were found during survey the following mitigation should be adopted as a precautionary measure:

- All staff directly involved in track construction should be made aware of the legal status of badgers and potential risks to badger associated with construction.
- Ensure that no organic rubbish/waste food is left lying around the site that may attract badger or other wildlife into the construction area.
- If any new signs of badger (e.g. setts or animals) are encountered, work within 30m must cease, and advice sought from an Ecologist or SNH. A site inspection and further mitigation may be required.
- During construction, it should be ensured that best practice is employed at all times, with specific regards to those on-site hazards which could affect badger. This includes covering all deep pits/trenches whilst not in use, or providing exit ramps, to prevent badger from being trapped/injuring themselves.
- Any harmful substance or materials should be secured whilst unattended.

APPENDIX 3 FORESTRY COMMISSION STANDARD ROAD SPECIFICATION

Appendix 1 from Timber Transport Forum, The design and use of the structural pavement of unsealed roads (Updated 2014)

Appendix 1. Forestry Commission Standard Road Specification

FORESTRY COMMISSION ROAD SPECIFICATION WITH REFERENCE TO THE Department for Transport HIGHWAYS AGENCY *DESIGN MANUAL FOR ROADS AND BRIDGES* (DMRB) AND *MANUAL OF CONTRACT DOCUMENTS FOR HIGHWAY WORKS* (MCHW)

This specification is the standard for forest roads built by outside parties on FC land. Any reduction in this standard is to have the FC Engineer's written approval before construction starts. Road survey and design should also have taken place before felling takes place.

Design speed	25 km/h.
Design loading	Full C&U (currently 44 tonnes).
Road Width	3.4 m running width (+/- 200 mm) - widened on inside of bends to suit radius (see table page 3).
Road alignment	Roads shall fit into the landscape and be constructed to a uniform horizontal and longitudinal profile. They shall avoid unstable ground and any features that require preserving.
Felled width	25 m average recommended.
Max gradient	<8% in general to be preferred, but gradients up to 10% acceptable. Small lengths (<200m) up to 12.5% may be permitted provided that they are contained within an overall gradient of 10%. For restrictions on gradient on bends, see table.
Min gradient	2% except over short sections on crests and sags. (This is an important requirement.)
Passing places	20m long and at least 3m wide with 10m splays. Spaced to be inter-visible with a maximum spacing to be agreed.
Bridge approaches	Minimum approach straight is 20m.
Turning places	Turning "T's" to be 26m in overall length (i.e. from far edge of road to end of 'T'), 4m wide with 11m radii.
Harvesting facilities	Ramps and stacking areas supplied as required. For guidance: ramps provided every 40m; stacking areas 30m by 3m provided every 200m. Surfaced where there is a risk of erosion.

Earthworks	Earthworks will be undertaken in accordance with Clauses 601 & 602 of the MCHW. Unsuitable materials to be stripped and removed. The formation shall be shaped to keep it free of standing water. Minimise disturbance of peaty soils to retain the stored carbon.
Cuttings	Cutting slopes must be stable and free of overhangs and loose rock. The maximum slope to be 30% for slopes up to 2m high. For slopes more than 2 m high, the maximum slope to be 1 in 2 (50%) for fine grained soils, 1 in 1½ (67%) for other soils, and 1 in 1 for rock slopes.
Embankments	Unless agreed beforehand, the fill material to be free draining and non-cohesive, placed in layers and effectively compacted in accordance with Clause 612 of the MCHW. Slopes as for cuttings.
Roadside drains & ditches	A roadside ditch shall be provided on the uphill side of a road and on both sides where the road formation is at or below the adjacent ground. Drains shall have a depth of not less than 150 mm below the formation edge and a longitudinal gradient of not less than 2%. Ditches and drains shall not lead directly into watercourses. Filters will be provided in and adjacent to the drains and culverts to avoid pollution and sedimentation of watercourses. Drains can help in temporary storage of flood water.
Culverts	All pipes shall be to Clause 501 of the MCHW - excavated in accordance with Clause 502; bedded, laid and surrounded in accordance with Clause 503; and backfilled in accordance with Clause 505. Laid in natural ground or in bed of original watercourse where applicable. Aim for bed continuum, for flora and fauna. Minimum size 300 mm although 450 mm preferred. Inlets to be provided with erosion protection. Outfalls should be so constructed as to eliminate possible erosion. Ditch relief culverts should be spaced as required with a maximum spacing of 200m. Where appropriate, culverts to be designed for 1 in 50 year storm. Where the diameter is greater than 1.2 m, the culvert to be designed for 1 in 100 year storm. Bridges are preferred, including for flora and fauna riparian zones.
Geosynthetics	Used as necessary over silty clay and peat formations.
Road construction	Capping layer of durable rock or road base to Clause 613 of MCHW to improve subgrade CBR to a minimum of 5%. Road metal Granular Sub-base Type 1 to Clause 803 and laid in accordance with Clause 801 of MCHW. Material for the running surface shall have a minimum Magnesium Sulphate Soundness Value of 85. Principal or arterial

	forest roads shall have a minimum compacted surfacing thickness of 100mm of hard wearing well bound continuously graded aggregate	
Road metal thickness	<u>Subgrade</u>	<u>Min. Road Construction Depth</u>
	5% CBR	450 mm
	7% CBR	325 mm
	10% CBR	250 mm
	>10% CBR	To be agreed by FC Engineer, but 100 mm minimum.
Cross slope (camber or crossfall)	The surface shall be cambered with 5% falls from the crown, or with a 5% crossfall sloping inwards on steep side slopes.	
Water Guidelines	UKFS Guidelines on Forests and Water (FC) Account must also be taken of any requirements of EA/SEPA.	
Fuel spillage	A written procedure to be in place prior to work start.	
Signs	The site to be adequately signed.	
Blasting	Excavation of rock by blasting shall only be undertaken by suitably qualified personnel appointed in writing.	
Quarrying	The method of working (and re-instatement where applicable) of borrow pits and quarries must be in accordance with the *Quarries Regulations 1999,* and approved by the Forestry Commission.	

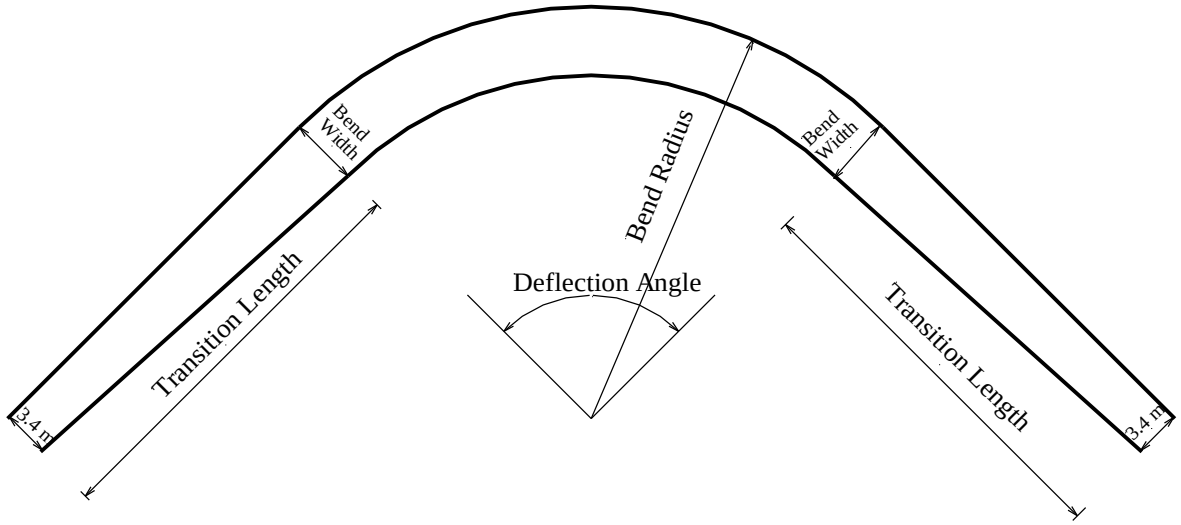
Forestry Commission

HORIZONTAL BEND RECOMMENDED WIDTHS AND GRADIENTS

Outside Radius	Minimum Widths For Maximum Angle of Deflection (°)				Transition Straight Length	Maximum Gradient on Outside Radius
	15	45	90	180		
	Running surface width					
m	m	m	m	m	m	%
90	3.8	3.8	3.8	3.8	-	10
60	4.0	4.0	4.0	4.1	20	8
45	4.0	4.2	4.5	4.5	20	7
30*	4.0	4.7	5.0	5.1	25	6.5
25		4.8	5.1	5.3	30	5
20		5.0	5.6	5.9	30	4.5
15			6.3	7.0	40	4
10**				10.0	40	3

* Preferred minimum radius

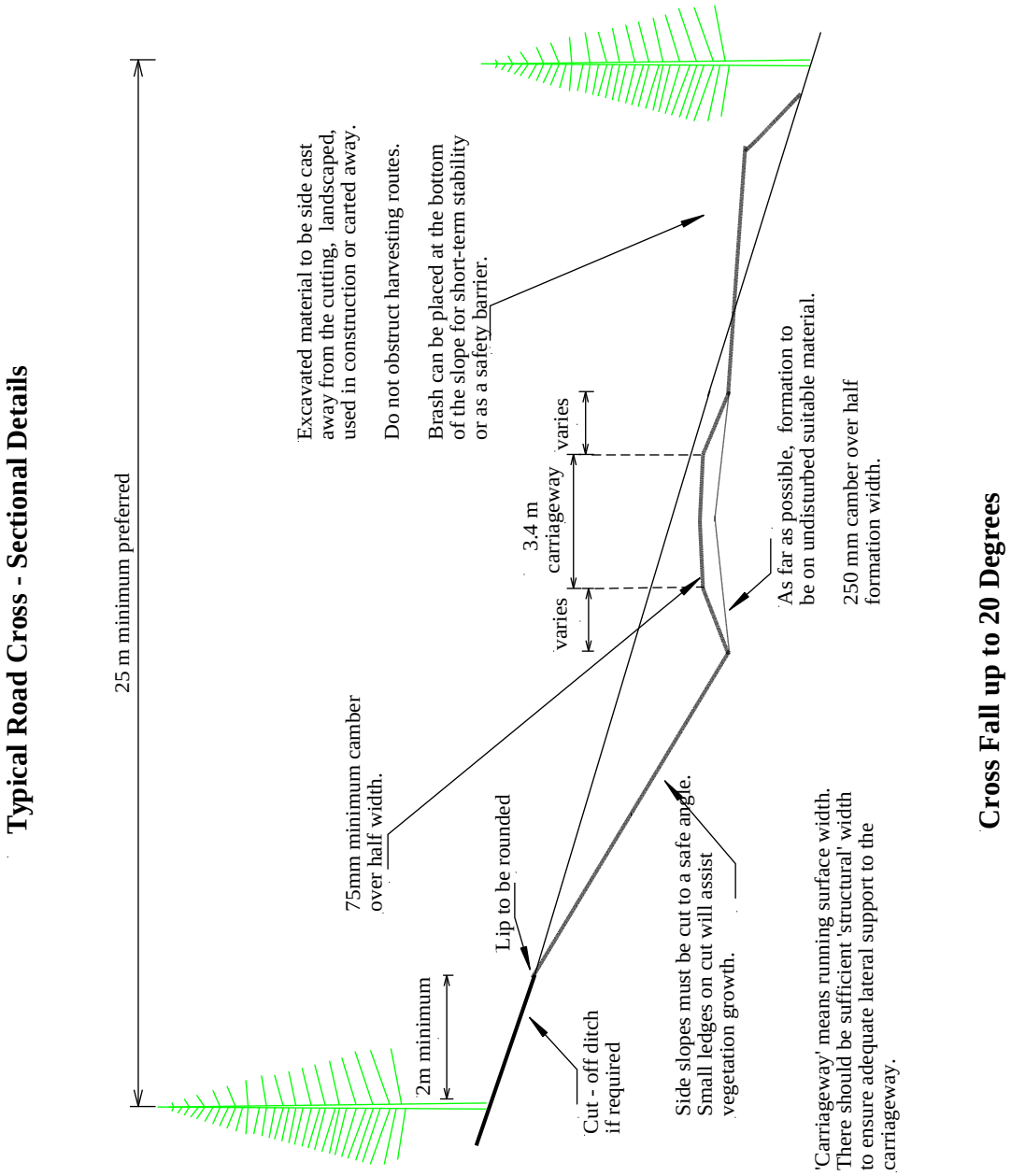
** Absolute minimum hairpin



Bend Widening

Forestry Commission

EXAMPLE CROSS SECTION



Appendix 2 Higher Standards of Construction

1. The design loading for roads is usually expressed in terms of Standard Axles (SA) of 80kN. A normal articulated 6-axle vehicle loaded to 44 tonnes will equate to something like 4.4 SAs and will carry a payload of about 29 tonnes.

2. On the basis of the above figures, 500,000 SAs is about equivalent to 113,600 vehicle movements of fully loaded 44 tonne vehicles (i.e. all other movements including empty running etc. have been ignored for the purpose of this simplistic analysis).

3. This, in turn, is about equivalent to the movement of 3,300,000 tonnes of timber.

4. In any major forest, it should be possible to work out the likely movement of timber over the assumed timescale for the life of the road. If it appeared that the road would wear out before it was economically sensible to reconstruct it, it could well be cheaper to construct to a higher standard immediately.

5. The following table gives an indication of the total thickness of pavement that will be required for the various CBR values for 1,000,000 SAs. It will be obvious that the increase in thickness over a design life of 500,000 SA is not very large.

Typical material	**CBR (%)**	**Pavement Thickness (mm)**
Peat, silt	<2	>1000 (consider excavation to firmer subgrade or use of geosynthetic)
Silty clay	2	750
Heavy clay	3	600
Sandy clay	4	500
Saturated sand	7	350
Fine sand	10	275
Graded sandy gravel	20	175
Rock	250+	Min. 100 to allow grading of surface

APPENDIX 4 PEAT PROBE DATA

Data from 18th November Peat Survey

Dornie Quarry Forestry Road

Peat Probe Data
18th November 2016

Leiths (Scotland) Ltd.
Rigifa,
Cove
Aberdeen
AB12 3LR

Appendix 4 Peat Probe Depth Table

Point Reference	Easting	Northing	Depth
1	218802	777812	0.18m
2	218800	777830	0.26m
3	218799	777850	0.24m
4	218804	777871	0.58m
5	218803	777874	0.42m
6	218802	777877	0.30m
7	218845	777892	0.15m
8	218843	777896	0.24m
9	218873	777903	0.12m
10	218872	777907	0.20m
11	218889	777909	0.30m
12	218886	777913	0.60m
13	218891	777906	0.10m
14	218892	777920	0.80m
15	218895	777931	0.55m
16	218900	777931	0.46m
17	218889	777931	0.56m
18	218882	777953	0.31m
19	218886	777956	0.36m
20	218890	777957	0.26m
21	218894	777957	0.25m
22	218900	777958	0.46m
23	218881	777967	0.60m
24	218878	777970	0.90m
25	218871	777965	1.38m
26	218877	777972	0.97m
27	218859	777974	1.78m
28	218861	777980	1.51m
29	218862	777984	1.41m
30	218863	777987	1.50m
31	218863	777989	0.80m
32	218838	777984	1.78m
33	218840	777989	1.92m
34	218842	777982	2.22m
35	218845	777985	0.90m
36	218848	777989	0.30m
37	211851	777984	1.40m
38	218826	777997	1.04m
39	218805	778011	0.20m
40	218806	778013	0.39m
41	218800	778020	0.44m

Appendix 4 Peat Probe Depth Table

Point Reference	Easting	Northing	Depth
42	218795	778028	0.53m
43	218712	778025	2.52m
44	218717	777992	1.88m
45	218716	778001	0.64m
46	218733	777997	0.62m
47	218741	778005	0.52m
48	218740	778018	0.54m
49	218735	778024	1.18m
50	218703	778022	1.75m
51	218688	778020	1.05m
52	218644	778035	1.34m
53	218619	778021	1.24m
54	218550	778023	0.30m
55	218557	778050	0.25m
56	218520	778026	0.35m
57	218476	778031	0.50m
58	218457	778020	0.94m
59	218420	778038	0.30m
60	218422	778026	0.40m
61	218404	778030	0.35m
62	218368	778037	0.50m
63	218348	778043	0.94m
64	218320	778073	0.80m
65	218547	777778	0.50m
66	218540	777799	0.60m
67	218578	777810	1.00m
68	218595	777829	0.60m
69	218600	777860	0.50m
70	218624	777875	0.80m
71	218640	777911	2.22m
72	218656	777927	2.60m
73	218687	777924	1.00m
74	218716	777941	0.50m
75	218755	777945	1.68m
76	218805	777940	1.10m
77	218843	777964	0.90m
78	218779	777949	1.25m
79	218773	777942	1.00m
80	218758	777922	1.20m
81	218735	777910	1.30m
82	218697	777875	1.25m

Appendix 4 Peat Probe Depth Table

Point Reference	Easting	Northing	Depth
83	218666	777850	0.70m
84	218629	777825	0.70m
85	218605	777809	0.83m
86	218591	777779	0.40m
87	218561	777767	0.52m
88	218384	777887	2.15m
89	218402	777856	1.29m
90	218431	777820	0.85m