Donich Hydro-scheme

Assessment of impact on the bryophyte interest

Summary
A bryophyte survey of the site was carried out by Gordon Rothero (29th May, 2012), and the following points are taken from the full report.

The site as surveyed has some 120 bryophyte species (41 liverworts, 79 mosses, listed in Annex 2), an average total for a wooded ravine in this area and one which reflects the mainly acidic nature of the rocks and the cover of conifers and Rhododendron. There are 14 oceanic species, all listed in Table 3, a modest total for a ravine in Argyll and which is probably indicative of the management history of the site and the rhododendron in the lower sections. There are four oceanic ravine indicator species on the site, each scoring one, giving a site total of four, below the threshold for a site of national importance. All of the other oceanic species are common in the west of Scotland. The ground affected by the proposed pipeline and powerhouse has a limited bryophyte flora composed of robust and common species that can tolerate the disturbance involved in commercial forestry The significance of the medium amount of change due to the scheme on the low bryophyte interest on the site, using the criteria set out in the matrix in Table 2, is classed as **minor**.

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1. Introduction

1.1. This report consists of a summary, a description of the assessment methods, a report on the bryophyte communities and species on the site and their significance, followed by an assessment of the impact of the scheme on this bryophyte interest. Annex 1 has all the target notes with grid references and Annex 2 has full species list for the site as surveyed. In this report, nomenclature for the bryophytes follows Hill et al, 2008 (A checklist and census catalogue of British and Irish bryophytes, British Bryological Society). The definition of 'oceanic species' follows Hill & Preston (Hill MO & Preston CD, 1998. The geographical relationships of British and Irish bryophytes. Journal of Bryology, 20: 127-226). Definitions of nationally rare and scarce species are taken from lists published by the Biological Records Centre.

1.2. The proposal is for a run-of-the-river hydro scheme on the Donich Water with an intake on the main tributary, the Allt Coire Odhair, at c. NN2229.0241 and powerhouse and outfall at Inveronich at c. NN2040.0211. The pipeline route runs down the north side of the burn, for most of its length close to the existing track before dropping steeply to the powerhouse.

1.3. The Donich Water is an upland watercourse initially flowing down steep slopes with frequent cascades and low falls. The bed of the watercourse is predominantly of slabby bedrock in the waterfalls and cascades and of rocks, sometimes huge, stones and gravel in the easier angled sections. The rock is mainly a smooth, acidic Dalradian schist, but the rocks are locally somewhat more base-rich . All of the affected section of the watercourse runs through production forest, part of which has been recently clear-felled and there is also a serious Rhododendron infestation, particularly in the lower section. There are narrow strips of broadleaves along the burn, very humid but often heavily shaded.

1.4 The area involved in the proposed scheme has no sites designated for conservation.

2. Assessment methods

2.1. A standard Phase 1 walkover method was used to assess the bryophyte populations along the section of the burn that will have reduced flow ie. from the potential powerhouse

sites, as indicated on the map supplied, to the intake. Target notes were made along the burn and the banks on either side, describing the general bryophyte communities present and any species of interest.

2.2 A similar survey was made of a corridor along the line of the proposed pipeline route options down to the powerhouse site options, although parts of this route were inaccessible because of wind-throw, clear-fell brash and Rhododendron jungle.

2.3 The criteria used to assess the magnitude of the effects of the hydro scheme are based on the scale of the impact on the site, the sensitivity of the bryophyte populations and the duration of the effect.

Table 1. Scale for magnitude of ecological impact

Magnitude of impact	**Definition**
High	Wholesale change to most of a site or species population.
Medium	Substantial but partial change to a site or species population; or large change to small fraction of the site or species
Low	Minor change to part of a site or species population, or loss of a very small proportion of a site or population.
Negligible	Minimal change on a very small scale.

2.4 The sensitivity of a bryophyte feature is broadly related to its ecological and conservation interest, with bryophytes of international and national significance having high sensitivity and those of more local significance having medium sensitivity. However, the local knowledge of the surveyor may lead to some variation in the use in these categories and this is explained in the text where necessary. The bryophyte interest in woodlands and ravines in the oceanic west of Scotland is normally assessed by reference to the number of oceanic species, as listed by Hill & Preston (1998), as well as to the presence of nationally rare or scarce species. The best of these wooded ravines are of international importance as the bryophyte communities they contain are rare in Europe and may contain some species which are globally rare. This conservation interest can be assessed by the occurrence on the site of a number of indicator species which are given a score according to rarity and threat level and this score aggregated for the site (Averis et al, 2011). This list of oceanic ravine indicator species also includes rare or scarce riparian species which may occur in sites away from the oceanic west. The current threshold level for a nationally important site using this watercourse bryophyte assessment is a score of six. An evaluation of the bryophyte flora on this site is given in section 4 below.

2.5 The change in the pattern of discharge down the rivers will presumably continue indefinitely and so any impact on the bryophytes as a result of this change is likely to be permanent giving a medium impact as defined in Table 1. The matrix for determining the impact of the scheme on the bryophyte interest is given in Table 2.

Table 2. Matrix for determining the Significance of an Ecological Impact related to Sensitivity of the Feature and Magnitude of Change

Sensitivity of bryophyte interest	**Magnitude of Change**			
	High	**Medium**	**Low**	**Negligible**
High	Major	Major	Moderate	Minor
Medium	Major	Moderate	Minor	Minor
Low	Moderate	Minor	Minor	Minor
Negligible	Minor	Minor	Minor	Minor

*Shaded cells indicate a significant impact

3 Baseline conditions

3.1. A detailed and localised account of the bryophyte populations that will be affected by the proposed scheme is given in Annex 1 as target notes, and Annex 2 has a bryophyte species list for the site.

3.2. **Background to bryophytes in the Cowal area**.

The Cowal area has an oceanic climate and the surrounding hills, woodlands and ravines have a rich bryophyte flora, especially on the steeper slopes. In particular, the area is rich in oceanic species, those bryophytes limited to the western fringes of Europe, many of which are rare in European terms and some are globally rare. The ravines and woodland around Loch Fyne are in the area of the west of Scotland which has the best development of this oceanic flora.

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3.3 Description of the bryophyte interest in the areas affected by the scheme.

3.3.1 The riparian bryophytes in and by the burn are patchily abundant on stable substrates over much of the river but absent where scouring is severe and where rocks are mobile. Common species in the river and inundation zone are *Racomitrium aciculare*, *Sciuro-hypnum plumosum, Marsupella emarginata, Scapania undulata*, *Pellia epiphylla*, *Hyocomium armoricum*, *Rhizomnium punctatum*, *Plagiochila porelloides* and *Diplophyllum albicans*; there is little variation in this typical flora over the whole of the affected section. Some gravel-covered rocks have stands of *Scapania subalpina* and locally there are good patches of *Lejeunea patens* and rarely *Aphanolejeunea microscopica*, most often on steep and sheltered rock faces in and by the burn.

3.3.2. The steep banks with a broadleaf canopy have an abundance of common woodland floor species like *Thuidium tamariscinum*, *Rhytidiadelphus loreus*, *Rhytidiadelphus triquetrus*, *Eurhynchium striatum*, *Pseudoscleropodium purum*, *Polytrichum commune*, *Sphagnum capillifolium*, *Dicranum majus*, *Hylocomium splendens*, *Loeskeobryum brevirostre* and occasionally *Plagiochila asplenioides*. The north-facing banks are wetter and have much more *Sphagnum*, including large stands of *Sphagnum quinquefarium* and *Sphagnum girgensohnii*.

3.3.3. Most of the crags and large rocks are disappointing with little more than *Amphidium mougeotii*, *Isothecium myosuroides var. myosuroides*, *Metzgeria conjugata*, *Pellia epiphylla*, , *Diplophyllum albicans* and *Mnium hornum* but locally *Plagiochila spinulosa* can be abundant. Occasionally there are richer rocks with stands of *Anoectangium aestivum*, *Saccogyna viticulosa*, *Neckera crispa*, *Gymnostomum aeruginosum* and *Tortella tortuosa*. Larger rocks by the burn have some *Diplophyllum albicans*, *Racomitrium fasciculare*, *Andreaea rupestris*,

Isothecium myosuroides var. myosuroides.

3.3.4. The epiphytic flora is often abundant but usually consists of a few common species like *Hypnum cupressiforme*, *Hypnum andoi*, *Isothecium myosuroides var. myosuroides*, *Dicranum scoparium*, *Frullania tamarisci* and *Ulota bruchii*, with, more locally, some *Plagiochila spinulosa* and *Plagiochila punctata*. A few of the larger ashes and hazels upper part of the site (see Notes 12, 13 and 14) have a rather better flora with good stands of *Isothecium myosuroides var. myosuroides*, *Scapania gracilis*, *Plagiochila spinulosa*, *Plagiochila punctata*, *Frullania tamarisci*, *Metzgeria consanguinea*, *Ulota bruchii*, *Lejeunea patens*, *Zygodon conoideus*, *Neckera pumila* and more locally the oceanic ravine indicator species *Harpalejeunea molleri* and *Plagiochila exigua*. One small group of sallows has a small stand of the ravine indicator species *Colura calyptrifolia*.

3.3.5. Where there are stands of conifers or Rhododendron infestation and in areas of clear-fell, the bryophyte interest is very limited, though bryophytes can be abundant where enough light penetrates. Common species here include *Plagiothecium undulatum*, *Thuidium tamariscinum*, *Polytrichum commune*, *Pseudotaxiphyllum elegans*, *Dicranum majus* and in the clear-fell, *Campylopus flexuosus*, *Campylopus pyriformis*, *Hypnum cupressiforme* and *Polytrichastrum formosum*.

4. Evaluation of the bryophyte flora

4.1. The site as surveyed has some 120 bryophyte species (41 liverworts, 79 mosses, listed in Annex 2), an average total for a wooded ravine in this area and one which reflects mostly acidic nature of the rocks and the cover of conifers and Rhododendron. There are 14 oceanic species, all listed in Table 3, a modest total for a ravine in Argyll and which is probably indicative of the management history of the site and the rhododendron in the lower sections. There are four oceanic ravine indicator species on the site, each scoring one, giving a site total of four, below the threshold for a site of national importance. All of the other oceanic species are common in the west of Scotland. The ground affected by the proposed pipeline and powerhouse has a limited bryophyte flora composed of robust and common species that can tolerate the disturbance involved in commercial forestry.

4.2. Bryophytes are abundant on the site and but over much of the site the flora has limited diversity and is composed of species that are very common in the local area. There are some small areas of the site with more diverse flora and some oceanic ravine species but overall, the sensitivity of the bryophyte flora is low.

Table 3. Oceanic species recorded in the area surveyed

Oceanic species (14 taxa)	
Breutelia chrysocoma	*Plagiochila exigua* (1)
Aphanolejeunea microscopica (1)	*Plagiochila punctata*
Campylopus atrovirens	*Plagiochila spinulosa*
Colura calyptrifolia (1)	*Saccogyna viticulosa*
Harpalejeunea molleri (1)	*Scapania gracilis*
Hyocomium armoricum	*Ulota phyllantha*
Lejeunea patens	*Zygodon conoideus*

**Figures in () are ravine indicator species scores*

5. Potential impacts of the scheme

5.1 There are two main areas of impact of the scheme on the bryophytes. There will be the

various effects of the reduced flow of water down the main watercourse and there will be the direct impact of the construction of the intakes, pipelines, powerhouse and access tracks. The effect of these changes will be different in each case.

5.2 In the burn, the ecology of the species concerned suggests that the reduced flow will lead to a long-term shift of some centimetres by the riparian species towards the new base water level. It seems likely that there will be some increase in bryophyte cover as a result of a reduction in the frequency of scouring and a possible reduction in the mobility of the rocks in the river. It seems likely that the frequency of *Racomitrium aciculare*, *Sciuro-hypnum plumosum* and *Marsupella emarginata* will increase as there is less frequent scouring but, overall, it seems unlikely that the composition of the flora will change a great deal.

5.3. For most of the species above the water channel, the reduction in flow in the burn will make very little difference as most are not dependant on irrigation and humidity derived from the main burn. It is likely that any effect of the hydro scheme will be small in comparison to changes due to forest operations, particularly clear-fell and hopefully Rhododendron eradication.

5.4 Direct damage to the bryophyte interest from the construction of the intake is likely to be small as the flora consists of species that are very common locally and which are robust and will recover quite quickly. Similarly, the pipeline route options run through commercial forestry and the few associated species are very common in the area.

5.5. The significance of the medium amount of change due to the scheme on the low bryophyte interest on the site, using the criteria set out in the matrix in Table 2 above, is classed as **minor**.

6 Mitigation.

6.1 Some spate flows will continue down the burn and so the changes to the hydrology of the burn will be limited to that extent and this may be sufficient to give enough erosion and scouring to keep habitat open for some of the smaller species like *Lejeunea patens* and *Aphanolejeunea microscopica*.

6.2 The proposed intake is in an area with very limited bryophyte interest and requires no mitigation and similarly the powerhouse site is near existing buildings and is disturbed already.

6.3. The proposed pipeline route runs through commercial forestry; this ground has bryophytes that are common over much of the local area and thus requires no mitigation.

6.4. Sympathetic restocking after clear-felling and a programme of eradication of Rhododendron would be of long-term benefit to the bryophyte flora.

7 Residual impacts

7.1 The reduction in flow will have a residual impact in that the distribution of bryophyte populations on rocks in and by the burn is likely to change though it seems unlikely that species composition or diversity will be much altered; the continuation of occasional spates will moderate this process somewhat.

7.2 The construction of the powerhouse, pipeline and intake should have only a very local residual impact on the bryophytes. At least initially, it is likely that bryophyte diversity over the section of the pipeline route through plantation woodland will be increased by the

disturbance.

8 References

A.B.G. Averis, N.G. Hodgetts, G.P Rothero & D. Genney (2011). Commissioned Report 449 *Bryological assessment for hydroelectric schemes in the west Highlands. Scottish Natural Heritage*.

Hill MO & Preston CD, 1998. The geographical relationships of British and Irish bryophytes. Journal of Bryology, 20: 127-226.

Hill MO, Blackstock TH, Long DG & Rothero GP. 2008. A Checklist and Census Catalogue of British and Irish Bryophytes. British Bryological Society.

Annex 1:- Donich Water Hydro Scheme. Target notes

Donich Water

1) NN2040.0207. Outfall area. Steep banks and cascades over large rocks in the burn. *Racomitrium aciculare* and *Sciuro-hypnum plumosum* are frequent on the rocks in the burn and in the inundation zone are *Marsupella emarginata*, *Hyocomium armoricum*, *Rhizomnium punctatum* and *Pellia epiphylla*. Larger rocks at the edge have *Isothecium myosuroides var. myosuroides*, *Scapania gracilis*, *Plagiochila porelloides* and *Lejeunea patens*. The N bank is dominated by conifers and Rhododendron and has a limited flora but on the S side hazel has *Frullania tamarisci*, *Ulota bruchii*, *Hypnum andoi* and *Ulota phyllantha* with *Rhytidiadelphus loreus*, *Thuidium tamariscinum*, *Hylocomium splendens* and *Pseudoscleropodium purum* on the ground.

2) NN2042.0204. Cascades over bedrock and boulders all heavily scoured and with few bryophytes. More sheltered spots and in the inundation zone are *Racomitrium aciculare*, *Sciuro-hypnum plumosum*, *Marsupella emarginata*, *Diplophyllum albicans*, *Pellia epiphylla*, *Scapania undulata* and *Hyocomium armoricum*. Larger rocks and the banks have *Isothecium myosuroides var. myosuroides*, *Campylopus flexuosus*, *Kindbergia praelonga*, *Rhytidiadelphus squarrosus* and *Thuidium tamariscinum*. Rhododendron jungle and conifers on both sides have a poor ground flora; the occasional birch has *Frullania tamarisci*, *Isothecium myosuroides var. myosuroides*, *Metzgeria furcata* and *Dicranum scoparium*.

3) NN2051.0201. Above the waterfall leads to a narrow slot in the bedrock with crags at the sides. Little change in the riparian flora but *Hyocomium armoricum* is very abundant here; boulders at the side have *Racomitrium aquaticum*, *Scapania nemorea*, *Mnium hornum*, *Lejeunea patens*, *Diplophyllum albicans*, *Saccogyna viticulosa* and *Trichostomum tenuirostre*. On the banks are *Sphagnum girgensohnii*, *Sphagnum quinquefarium*, *Rhizomnium punctatum*, *Hookeria lucens*, *Mnium hornum*, *Thuidium tamariscinum* and *Kindbergia praelonga*. No access to burn above this.

4) NN2058.0204. Cascades and huge boulders, all very acidic and heavily scoured and little change in the riparian flora from Note 2. It is very humid and *Hymenophyllum wilsonii* and *Plagiochila spinulosa* occur here on rocks at the side with *Diplophyllum albicans*, *Amphidium mougeotii* and *Conocephalum conicum*. On hazel are *Frullania tamarisci*, *Isothecium myosuroides var. myosuroides*, *Metzgeria consanguinea*, *Lejeunea patens* and *Aphanolejeunea microscopica*; on the banks are *Atrichum undulatum*, *Kindbergia praelonga*, *Thuidium tamariscinum*, *Polytrichum commune* and *Mnium hornum*. No access immediately above this.

5) NN2062.0198. Large bouldery cascade with *Racomitrium aciculare* and *Sciuro-hypnum plumosum* very abundant in the inundation zone with *Marsupella emarginata Hyocomium armoricum*, *Diplophyllum albicans*, *Pellia epiphylla*, *Scapania undulata* and *Nardia scalaris*. On the bank and logs are *Nowellia curvifolia*, *Scapania gracilis*, *Plagiochila spinulosa*, *Polytrichastrum formosum*, *Lepidozia reptans*, *Tetraphis pellucida*, *Isothecium myosuroides var. myosuroides*, *Dicranum scoparium*, *Hypnum cupressiforme*, *Scapania nemorea*, *Leucobryum glaucum*, *Plagiothecium undulatum* and *Mnium hornum*. Frequent hazel here but very heavily shaded with just *Frullania tamarisci*, *Hypnum andoi* and *Isothecium myosuroides var. myosuroides*. Again no access above this.

6) NN2068.0200. More open on N side in land-slip area but rocky above with *Racomitrium aciculare*, *Sciuro-hypnum plumosum*, *Marsupella emarginata*, *Hyocomium armoricum*, *Thamnobryum alopecurum*, *Lejeunea patens* and *Trichostomum tenuirostre*. Just N of this is a strip of hazel with *Frullania tamarisci*, *Isothecium myosuroides var. myosuroides*, *Metzgeria consanguinea*, *Zygodon conoideus*, *Plagiochila punctata*, *Radula complanata*, *Lejeunea*

patens; boulders here have *Scapania gracilis*, *Plagiochila spinulosa*, *Loeskeobryum brevirostre*, *Dicranum majus*, *Amphidium mougeotii*, *Rhytidiadelphus loreus*, *Thuidium tamariscinum*, *Conocephalum conicum*, *Gymnostomum aeruginosum* and *Isothecium myosuroides var. myosuroides*. The S side is steeper and has much *Sphagnum girgensohnii*, *Sphagnum quinquefarium*, *Hylocomium splendens*, *Ptilium crista-castrensis* and *Sphagnum capillifolium*.

7) NN2081.0198. By old weir; little change in the riparian flora but *Hymenophyllum wilsonii* is frequent on rocks at the side with *Plagiochila spinulosa*, *Scapania gracilis* and *Isothecium myosuroides var. myosuroides*. The hazels have more *Plagiochila punctata* and in addition *Aphanolejeunea microscopica*. The banks have *Hylocomium splendens*, *Thuidium tamariscinum*, *Rhytidiadelphus loreus*, *Polytrichum commune*, and on the crags *Anoectangium aestivum*, *Saccogyna viticulosa*, *Fissidens adianthoides*, *Conocephalum conicum* and *Diplophyllum albicans*. Limited access above this but little change in the flora.

8) NN2093.0192. The rocks are less acidic here and *Loeskeobryum brevirostre* and *Rhytidiadelphus triquetrus* are locally abundant. On the crags here are *Amphidium mougeotii*, *Fissidens dubius*, *Saccogyna viticulosa*, *Conocephalum conicum*, *Ctenidium molluscum* var *molluscum* and *Dicranodontium denudatum*. The epiphytes on hazel and ash are as in Note 6 but with much more *Plagiochila punctata* and *Lejeunea patens*, and on birch are *Plagiochila spinulosa*, *Scapania gracilis* and *Plagiochila punctata*.

9) NN2099.0190. *Racomitrium aciculare*, *Sciuro-hypnum plumosum*, *Marsupella emarginata*, *Hyocomium armoricum* and *Rhizomnium punctatum* are all common in the inundation zone with *Scapania subalpina*, *Anomobryum julaceum*, *Scapania undulata*, *Lejeunea patens* and *Trichostomum tenuirostre*. The large boulders have *Racomitrium aquaticum*, *Scapania gracilis*, *Isothecium myosuroides var. myosuroides*, *Hymenophyllum wilsonii*, *Scapania nemorea*, *Polytrichastrum formosum*, *Hypnum callichroum* and *Plagiochila spinulosa*. Broken crags have *Saccogyna viticulosa*, *Dicranum majus*, *Plagiochila spinulosa*, *Hookeria lucens*, *Pellia epiphylla* and *Conocephalum conicum*. On hazel and ash are *Isothecium myosuroides var. myosuroides*, *Frullania tamarisci*, *Metzgeria consanguinea*, *Ulota bruchii*, *Lejeunea patens*, *Zygodon conoideus* and *Neckera pumila*.

10) NN2117.0186. A more open section which is very dull bryologically with similar species in smaller amounts to Note 9. On the banks are *Hylocomium splendens*, *Pseudoscleropodium purum*, *Pleurozium schreberi* and *Dicranum scoparium*.

11) NN2135.0181. Little change in the flora in the fall above the main confluence; *Campylopus atrovirens* and *Mnium hornum* occur in the inundation zone. *Diplophyllum albicans* is abundant on the drier rocks with *Hypnum cupressiforme* and under the conifers and Rhododendron on the bank are *Hypnum jutlandicum*, *Campylopus flexuosus*, *Polytrichastrum formosum*, *Dicranum majus*, *Sphagnum capillifolium*, *Sphagnum quinquefarium*, *Rhytidiadelphus loreus* and *Dicranum fuscescens* on tree bases.

12) NN2144.0187. Bouldery cascades with *Racomitrium aciculare*, *Sciuro-hypnum plumosum* and *Marsupella emarginata* all abundant and *Dichodontium flavescens* and *Rhizomnium punctatum* on gravel. There is a line of broadleaves on the steep bank with conifers above; on the ground are *Loeskeobryum brevirostre*, *Hylocomium splendens*, *Rhytidiadelphus loreus*, *Thuidium tamariscinum*, *Plagiochila asplenioides*. On trees are *Isothecium myosuroides var. myosuroides*, *Scapania gracilis*, *Plagiochila spinulosa*, *Plagiochila punctata*, *Frullania tamarisci* and *Hymenophyllum wilsonii*. *Plagiochila spinulosa* is locally abundant on the rocks with *Saccogyna viticulosa*, *Bazzania tricrenata*, *Scapania nemorea*, *Scapania gracilis*, *Tortella tortuosa*, *Ctenidium molluscum* var *molluscum*, *Eurhynchium striatum* and *Fissidens dubius*.

13) NN2156.0187. The flora in the burn is similar to Note 12; rocks at the side have *Metzgeria conjugata*, *Isothecium myosuroides var. myosuroides*, *Thamnobryum alopecurum*, *Plagiochila spinulosa*, *Amphidium mougeotii*, *Dichodontium flavescens*, *Saccogyna viticulosa* and *Anoectangium aestivum*. On hazel are *Harpalejeunea molleri* and *Plagiochila exigua* and the latter also occurs on some rocks with *Tritomaria quinquedentata* and *Tortella tortuosa*. On the banks are *Rhytidiadelphus loreus*, *Ptilium crista-castrensis*, *Thuidium tamariscinum*, *Scapania gracilis*, *Eurhynchium striatum*, *Rhytidiadelphus triquetrus* and *Hypnum callichroum*. This good flora carries on for some distance upstream with *Tortella tortuosa* and *Ctenidium molluscum* var *molluscum* frequent on the crags.

14) NN2169.0189. Area of large rock-fall into burn. No change in the riparian flora but *Scapania undulata* is more abundant. On the rocks above are *Racomitrium lanuginosum*, *Neckera crispa*, *Plagiochila spinulosa*, *Hypnum cupressiforme*, *Scapania nemorea*, *Dicranum majus*, *Fissidens taxifolius*, *Plagiothecium succulentum* and *Diplophyllum albicans*. On the banks are *Loeskeobryum brevirostre*, *Eurhynchium striatum*, *Rhytidiadelphus triquetrus* and the flora on hazel is not as rich as Note 13 but *Lejeunea patens* is frequent. Access above is blocked by huge boulders.

15) NN2183.0187. A more open and less incised section with the conifers down closer to the burn. In the inundation zone are *Racomitrium aciculare*, *Sciuro-hypnum plumosum*, *Marsupella emarginata*, *Scapania undulata*, *Racomitrium ericoides*, *Nardia scalaris*, *Atrichum undulatum*, *Pogonatum urnigerum* and *Scapania subalpina*. The open banks have bracken with *Rhytidiadelphus squarrosus*, *Pseudoscleropodium purum*, *Rhytidiadelphus loreus*, *Hylocomium splendens*, *Pleurozium schreberi* and *Sphagnum capillifolium*. On logs are *Scapania gracilis*, *Mnium hornum*, *Nowellia curvifolia*, *Campylopus flexuosus*, *Scapania umbrosa*, and on rock *Racomitrium aquaticum*, *Diphyscium foliosum*, *Campylopus atrovirens*, *Trichostomum tenuirostre*, *Pohlia nutans*, *Isothecium myosuroides var. myosuroides*, *Kiaeria blyttii*, *Scapania gracilis* and *Andreaea rupestris*. Little change in this flora for some distance upstream.

16) NN2208.0213. A group of sallows on the bank have *Frullania dilatata*, *Microlejeunea ulicina* and *Colura calyptrifolia*. There is clear-fell on the N side by the burn and conifers close by on the south for some distance giving very little other bryophyte interest.

17) NN2222.0226. Slabby bedrock cascade on bends with *Racomitrium aciculare*, *Sciuro-hypnum plumosum*, *Marsupella emarginata*, *Scapania undulata* and *Nardia scalaris*. Crags on the S side are very acidic and have only *Diplophyllum albicans*, *Pellia epiphylla*, *Nardia scalaris*, *Sphagnum capillifolium*, *Pseudotaxiphyllum elegans* and *Dicranum majus*. On the banks here are *Sphagnum capillifolium*, *Sphagnum fallax*, *Polytrichum commune*, *Breutelia chrysocoma*, *Dicranum majus*, *Hylocomium splendens*, *Anastrepta orcadensis*, *Rhytidiadelphus loreus*, *Plagiothecium undulatum* and *Thuidium tamariscinum*.

18) NN2223.0230. Large area of windthrow across the burn with impossible access; there will be limited bryophyte interest here.

19) NN2229.0241. Approximate area of intake; this upper stretch of the burn all very similar, incised and with conifers above giving a limited bryophyte flora. In the burn are *Racomitrium aciculare* and *Marsupella emarginata* and rocks above have *Campylopus atrovirens*, *Pohlia nutans*, *Lophozia ventricosa*, *Racomitrium lanuginosum* and *Diplophyllum albicans* and on the banks are *Sphagnum capillifolium*, *Sphagnum fallax*, *Hylocomium splendens*, *Rhytidiadelphus loreus*, *Pleurozium schreberi*, *Dicranum scoparium* and *Hypnum cupressiforme*.

Pipeline route.

20) The initial part of the pipeline route to the area of windthrow is similar to the intake; small crags have *Amphidium mougeotii*, *Ctenidium molluscum* var *molluscum*, *Fissidens dubius* and *Campylopus atrovirens* but otherwise just common pleaurocarpous and *Sphagnum* species.

21) The route through the area of clear-fell has a predictably poor flora; species include *Campylopus flexuosus*, *Polytrichastrum formosum*, *Campylopus pyriformis*, *Plagiothecium undulatum*, *Dicranum scoparium*, *Polytrichum juniperinum* and *Hypnum cupressiforme* on stumps and logs, occasionally with *Barbilophozia floerckii*.

22) NN2148.0210. The route now runs through plantation woodland locally laced with Rhododendron. Bryophytes are only prominent where there is more light, common species here are *Pseudotaxiphyllum elegans*, *Thuidium tamariscinum*, *Plagiothecium undulatum*, *Polytrichum commune*, *Dicranum majus* and *Kindbergia praelonga* and in wetter areas *Sphagnum capillifolium* and *Sphagnum girgensohnii*; the best development being under the larches. Tree bases here often have *Diplophyllum albicans*, *Lepidozia reptans*, *Dicranum scoparium*, *Dicranum fuscescens*, *Pseudotaxiphyllum elegans* and *Plagiothecium undulatum*.

23) NN2040.0211. Powerhouse area. Disturbed ground by existing tracks and buildings has a poor bryophyte flora, the only common species being *Calliergonella cuspidata* and *Rhytidiadelphus squarrosus*.S

Annex 2: Donich Water Hydro Scheme
Bryophyte species list

Mosses (79 taxa)

Amphidium mougeotii
Andreaea rupestris
Anoectangium aestivum
Anomobryum julaceum s.l.
Atrichum undulatum
Aulacomnium palustre
Bartramia pomiformis
Blindia acuta
Brachythecium rutabulum
Breutelia chrysocoma
Bryum pseudotriquetrum
Calliergonella cuspidata
Campylopus atrovirens
Campylopus flexuosus
Campylopus pyriformis
Ctenidium molluscum var. molluscum
Dichodontium flavescens
Dichodontium pellucidum s.l.
Dicranella heteromalla
Dicranodontium denudatum
Dicranum fuscescens
Dicranum majus
Dicranum scoparium
Eurhynchium striatum
Fissidens dubius
Fissidens taxifolius
Gymnostomum aeruginosum
Heterocladium heteropterum var. heteropterum
Hookeria lucens
Hylocomium splendens
Hyocomium armoricum
Hypnum andoi
Hypnum callichroum
Hypnum cupressiforme var. cupressiforme
Hypnum jutlandicum
Isothecium myosuroides var. myosuroides
Kiaeria blyttii
Kindbergia praelonga
Leucobryum glaucum
Loeskeobryum brevirostre
Mnium hornum
Neckera crispa
Neckera pumila
Oligotrichum hercynicum
Plagiomnium undulatum
Plagiothecium succulentum
Plagiothecium undulatum
Pleurozium schreberi
Pogonatum aloides
Pohlia nutans
Polytrichastrum formosum
Polytrichum commune
Polytrichum juniperinum
Pseudoscleropodium purum
Pseudotaxiphyllum elegans
Ptilium crista-castrensis
Racomitrium aciculare
Racomitrium aquaticum
Racomitrium fasciculare
Racomitrium lanuginosum
Rhizomnium punctatum
Rhytidiadelphus loreus
Rhytidiadelphus squarrosus
Rhytidiadelphus triquetrus
Sciuro-hypnum plumosum
Sphagnum capillifolium s.l.
Sphagnum denticulatum
Sphagnum fallax
Sphagnum girgensohnii
Sphagnum palustre
Sphagnum quinquefarium
Tetraphis pellucida
Thamnobryum alopecurum
Thuidium tamariscinum
Tortella tortuosa
Trichostomum tenuirostre
Ulota bruchii
Ulota phyllantha
Zygodon conoideus

Liverworts (41 taxa)

Anastrepta orcadensis
Aneura pinguis
Aphanolejeunea microscopica
Barbilophozia floerkei
Bazzania tricrenata
Calypogeia muelleriana
Cephalozia bicuspidata
Colura calyptrifolia
Conocephalum conicum
Diplophyllum albicans
Frullania dilatata
Frullania tamarisci
Harpalejeunea molleri
Jungermannia atrovirens
Lejeunea patens
Lepidozia reptans
Lophocolea bidentata
Lophozia ventricosa
Marsupella emarginata
Metzgeria conjugata
Metzgeria consanguinea
Metzgeria furcata
Microlejeunea ulicina
Nardia scalaris
Nowellia curvifolia
Pellia epiphylla
Plagiochila asplenioides
Plagiochila exigua
Plagiochila porelloides
Plagiochila punctata

Plagiochila spinulosa
Radula complanata
Riccardia multifida
Riccardia palmata
Saccogyna viticulosa
Scapania gracilis
Scapania nemorea
Scapania subalpina
Scapania umbrosa
Scapania undulata
Tritomaria quinquedentata