



Environmental issues at the Braes of Doune wind farm

A report prepared by

John Phillips, MA, CBiol, MBiol

August 2006

Circulation

This report is submitted to:

Allan Wilson MSP, Deputy Minister for Enterprise and Lifelong Learning, Sir Ken Collins, Chairman, Scottish Environment Protection Agency; Ian Jardine, Chief Executive, Scottish Natural Heritage and Keith Yates, Chief Executive, Stirling Council;

Andrew Wallace, Association of Salmon Fisheries Boards; Alexander Fell, Chairman, Forth Fisheries Foundation and Michael Baillie-Hamilton, Chairman, Forth District Salmon Fisheries Board.

It is copied to members of the UK and Scottish parliaments representing the area:

Bruce Crawford JP MSP, Dr Sylvia Jackson MSP, Anne McGuire MP, Brian Monteith MSP, Mark Ruskell MSP.

It will be circulated to local stakeholders and others in due course.



Water draining from a newly-constructed track road driven seven kilometres east of the Braes of Doune site to allow access to its grid connection. When this picture was taken, polluted run-off from the tracks was flowing unimpeded into local waterways before entering the Bullie Burn (above) and on into the River Teith Special Area of Conservation. (12 December 2005, NN 813 104.)

Introduction

In January 2006, SNH wrote to the author's solicitor that, 'On the basis of the information provided in the Environmental Statement, SNH concluded at that time that the development would not have a significant effect on the River Teith cSAC because of (i) its distance from the tributaries of the Teith . . .'

JOHN PHILLIPS learned of Airtricity's proposal for what was then a 98 MW wind-power project on the Braes of Doune at the same time as many other stakeholders – after the principal consent had been granted (5 October 2004).

In the event, it turned out to be a relatively early stage in the planning cycle, followed as it was by prolonged debate among executive and statutory bodies on mitigation and conditions. This included a little-known decision to remove at least temporarily 13 turbines from the scheme on the grounds of the risk they posed to ground stability.¹

In May 2005, SNH staff at its Stirling office asked Phillips to comment on method statements relating to the project. Partly in that light, he visited the site of the October 2003 bog slide in Derrybrien, Co Galway and, in a paper he submitted to SNH and others in September 2005, reported striking parallels between it and the Braes of Doune.² He concluded, *inter alia*, that:

- Drainage essential for the site's operation had increased the turbidity and silt load of streams;
- Straw-lined silt beds designed to filter run-off in a containment strategy reportedly approved by SEPA and SNH were failing – their use at the Braes of Doune would put the River Teith SAC and significant fishing beats at risk;
- The intense precipitation incidents that characterise the SW Grampians would exacerbate the problem and render the proposed filtration technique ineffective;
- The consequences of a peat or bog slide at the Braes of Doune, given its link with the River Teith SAC, could be severe.

Realistically, there was little or no prospect of any official rethink on environmental grounds given that construction started six months before the final implementing decision of 16 December 2005.³

The project was soon the subject of exchanges between stakeholders and statutory bodies on a range of issues. The exchanges did little to assure the former and, by late 2005, some of them were beginning to question the propriety of aspects of the planning cycle.

In April 2006, Phillips and Jennifer Braasch submitted a complaint about the project to the European Union's Environmental Commissioner, citing significant procedural irregularities and the wider issue of (Scottish) executive failure properly to transpose EU environmental directives into law.

They felt it was appropriate to have recourse to the Commissioner because the failures identified might well have put the integrity and conservation aims of the River Teith Special Area of Conservation (SAC) at risk: they had been advised by a freshwater fisheries expert, Dr Derek Mills, who has wide experience of the interaction of major construction works and fragile eco-systems. It

¹ A senior member of the site's management team has told a stakeholder that consent for the 13 turbines will shortly be forthcoming but it is not clear how seriously this should be taken.

² J Phillips, *Windfarm developments on blanket bog*, September 2005, available on www.swap.org.uk. Both sites lie on comparable terrain and are directly upstream of recently designated SACs protecting lamprey and other species.

³ See e.g. www.airtricity.com/england/wind_farms/scotland/in_construction/braes_of_doune.

is a commonplace that the wheels of EU commissions grind slow but the Environment Commissioner reports that it has decided to investigate the complaint.

Meanwhile, local people with, between them, many years of experience of moorland life in general and of the Braes of Doune in particular had been monitoring the site and its surroundings as thoroughly as their circumstances permitted. They have assembled a library of pictures covering a period of several months and, where appropriate, have drawn the attention of the environmental authorities to what they saw as noteworthy incidents.

The collection was not made in any planned way and certainly not with this report in mind: the various observers began only recently to exchange information as the scale and extent of the environmental issues posed by the project became clear. As public interest has intensified, the contractor has strengthened site security and it is now more difficult for lay people to maintain their scrutiny though not, as the aerial photographs below suggest, impossible.

It was an obvious step for Phillips to liaise with these observers, collate and edit their investigations and present them alongside expert opinion in a way that would assist the environmental bodies to take the steps necessary to ensure the protection of the area and its designated sites.

What is presented herein must give grounds for concern about the long-term interests of the Braes of Doune moorland habitat, its renowned waterways and the communities that live by them. It seems likely that some, though, happily, not all, of Phillips's warnings have proved correct. The question of liability is outwith the author's competence but it is clear that construction activity has almost certainly led to the pollution of important habitats that should enjoy a high level of statutory protection.⁴

What is less clear is the degree, if any, to which the incidents logged have caused significant or irreversible damage to the conservation interests of the SAC or the reasonable and proper interests of its stakeholders. It is, as Dr Mills suggests, for the statutory agencies to make a priority of investigating the issues that Phillips has raised.

It is acknowledged that no baseline study has been made of the burns and that the criterion for recording was often merely that an experienced observer was struck by previously unseen pollution effects following a bout of rain. However, given the designation status of the River Teith and its tributaries, requisite control data are readily available.

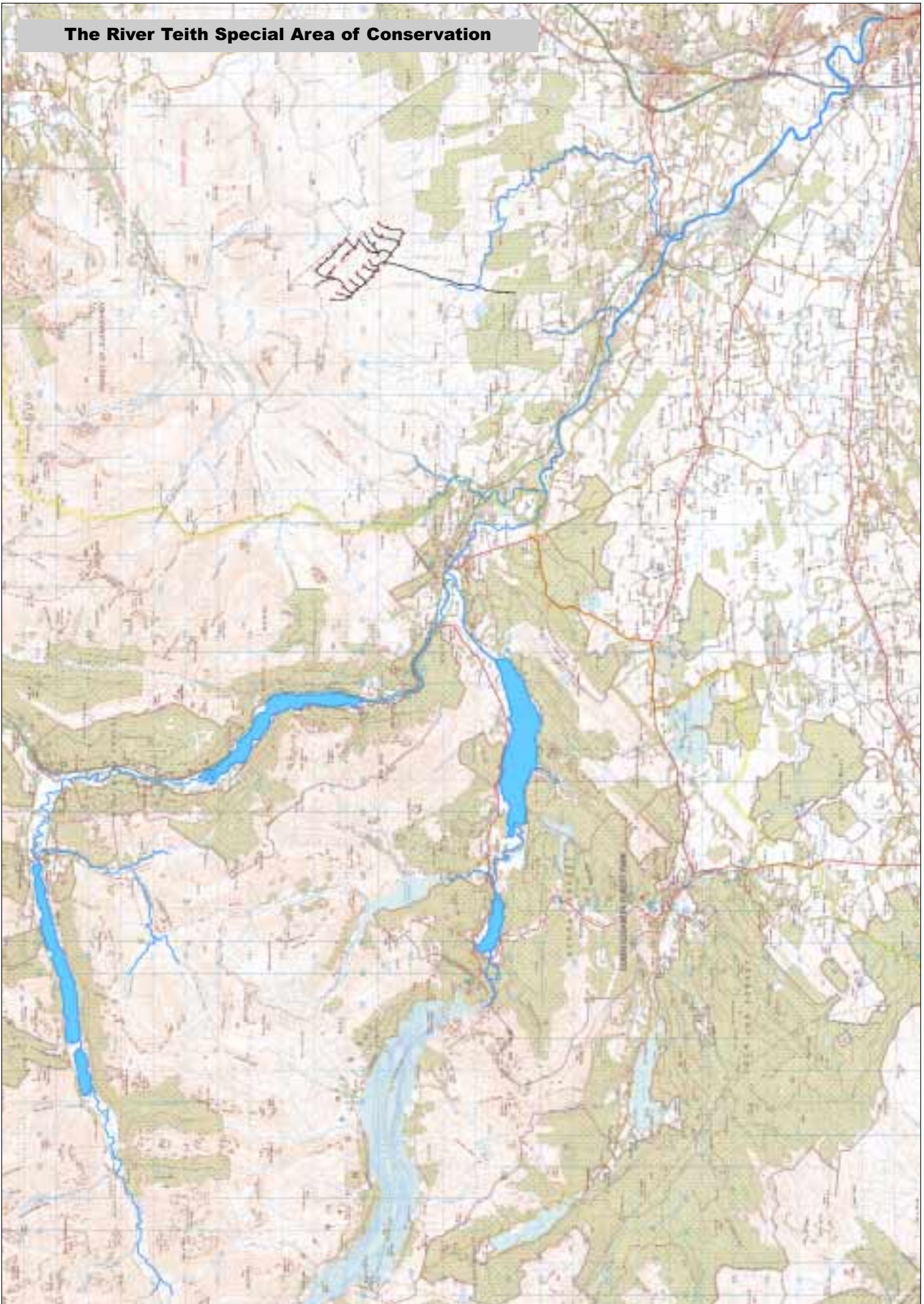
This paper is, in short, a compilation of hitherto scattered pictorial incident reports rather than a systematic study but, as there seems to be no other record in the public domain of the events it records, it speaks for itself.

Contents

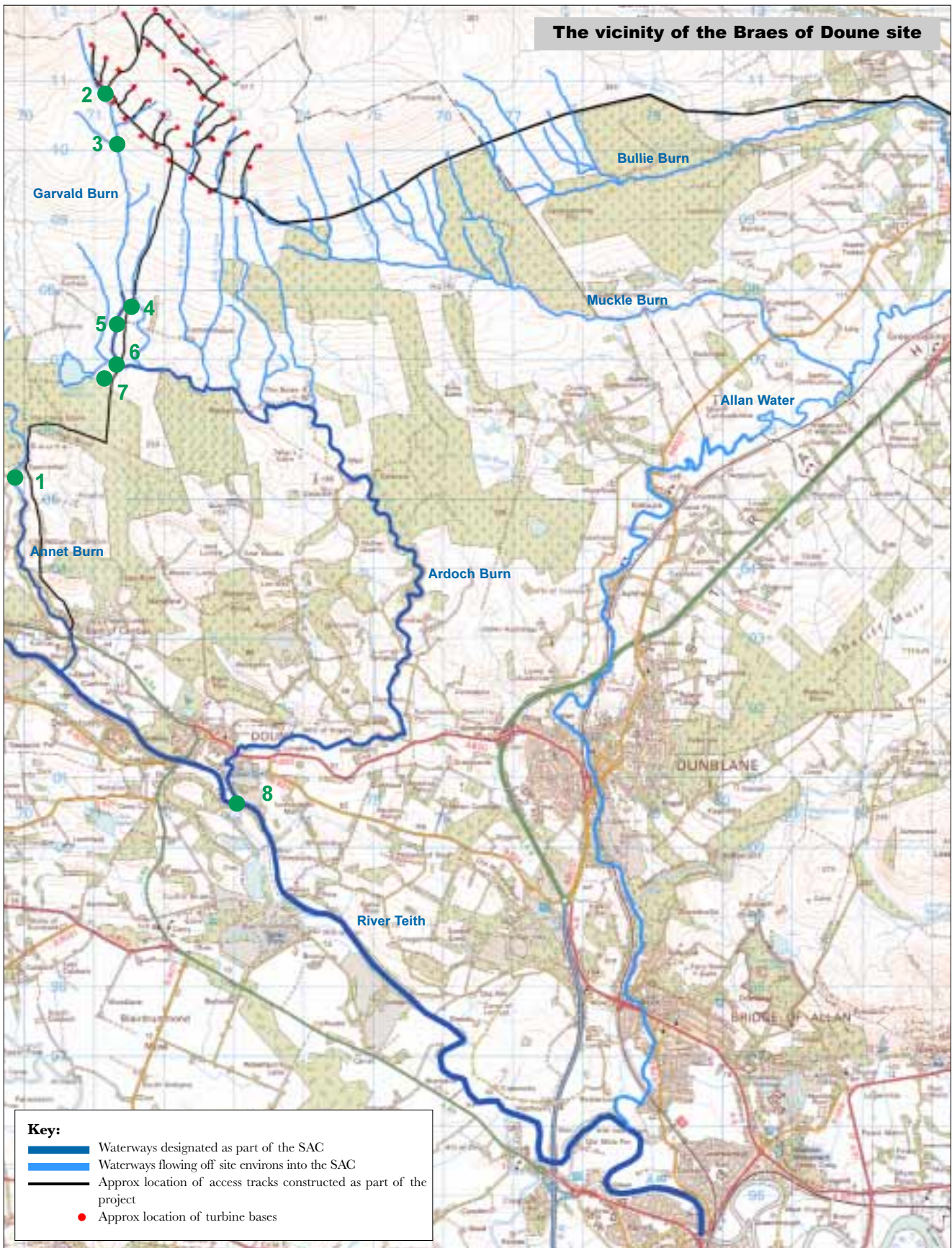
The maps of the River Teith SAC and the site vicinity set what follows in context. The second section reproduces the report by Dr Mills submitted with the complaint to the EU Commissioner and a brief supplement written in the light of the material included here. The third is a selection of pictures from the archive described above that either illustrate or are germane to the pollution of waterways draining the site into the River Teith Special Area of Conservation.

⁴ The issue is complex, not least because different parts of the site have been developed by different contractors, some of whom are reported as claiming that the consenting authorities insisted on inappropriate construction methods. SEPA's remit is apparently confined to tackling, rather than trying to prevent, pollution. It is not clear, at least to the public, how far the powers of the statutory bodies extend. And so on.

The River Teith Special Area of Conservation



Map 1: the River Teith SAC is an extended network of waterways that feed into the Teith and on into the Forth estuary, a Ramsar site. The purity of the water provides breeding grounds for lampreys and salmonids. (This map is derived from a low resolution original sent by SNH to riparian owners and there may be slight inaccuracies.)



Map 2. The southern reaches of the River Teith SAC are shaded dark blue, tributaries rising on or draining the site, light blue and access tracks, black. Material from the development has entered the River Teith via three routes: to the west, slurry from new or widened tracks driven north from the A84 washed down the Annet Burn. To the east, slurry from a seven kilometre track driven east to Braco entered the Teith from the Muckle and Bullie Burns via Allan Water. Pollutants from the site itself entered the Garvald and other tributaries of the Ardoch Burn. The green bullets indicate vantage points – the numbers are shown on the photographs that follow. See also map 3, page 26.

A consideration of the probable impacts of the Braes of Doune wind farm on the Ardoch Burn, River Teith and elsewhere

by Derek Mills, M.Sc., Ph.D., F.I.F.M., F.L.S.

Introduction

I have been asked by John Phillips to consider the likely adverse effects of the proposed Braes of Doune wind farm development on the Ardoch Burn and River Teith, both being embraced in the recently established Special Area of Conservation (SAC). My qualifications for undertaking this assessment are as follows:

I have been involved in freshwater ecology and freshwater fisheries for 50 years, part of the time as a scientist at the Freshwater Fisheries Laboratory, Pitlochry and, for over 35 years, as a lecturer/senior lecturer/fellow at the University of Edinburgh.

I was an adviser on fisheries and freshwater environment matters to the North of Scotland Hydro-electric Board/Scottish Hydro-electric, to the British Gas Corporation on the effects of pipeline construction through Scotland, to the Wye River Authority on the environmental impact assessment of the proposed water transfer scheme on the rivers Wye/Severn/Ystwyth/Thames/Avon, to the Water Resources Department of Grampian Regional Council on water resources in the Grampian Region and water abstraction schemes on the Dee and Spey, to the Central Scotland Water Development Board on proposed water abstraction schemes on the Forth/Teith, Clyde, Tay and Leven, to Fife Regional Council on water abstraction schemes on the Earn and Devon and to Mott Macdonald for water supply to Chapelcross from rivers Annan and Border Esk.

I was a member of the South-east Regional Board of the Nature Conservancy Council (Scotland)/Scottish Natural Heritage and a member of the Scientific Advisory Committee of Scottish Natural Heritage. I served on the River Tweed Purification Board, was a trustee of the Tweed Foundation and Cromarty Firth Fisheries Trust and was consultant biologist to the Anglers' Co-operative Association, which represents anglers aggrieved by instances of water pollution resulting in fish mortalities.

The proposed development

I understand that it is proposed to erect 49 wind turbines on the Braes of Doune subject to planning permission being granted. The terrain on which this wind farm is to be constructed is very fragile and relatively unstable, being mainly wet modified bog and blanket bog with very small areas of flush and marshy grassland. The area is on a south-facing slope and is drained by numerous interconnecting ditches which eventually reach a number of small but significant watercourses including the Garvald Burn, Allt a Bheithe, Allt na Criche and Allt na Cuile, all of which join west of The Bows to form the Ardoch Burn which forms part of the River Teith Special Area of Conservation (SAC).

Situated on the Braes of Doune is Loch Mahaick, which is an SNH Site of Special Scientific Interest (SSSI). The site maps available to me give no indication how close the development is to Loch Mahaick. It is not known whether it is the intention of the contractors to pipe water from this loch to furnish their needs during construction of the concrete foundations and as a water supply for the work force. Permission for such an operation might be required. I have no information on provisions for waste disposal.

The wind farm site therefore is planned to be sited between an SSSI at Loch Mahaick and a Ramsar Site on the Forth estuary with an SAC immediately downstream of the development.

Probable deleterious effects of the development

With the onset of work at the site, the terrain will be immediately disturbed through road construction and a network of floating roads, the erection of site offices, the arrival of heavy machinery, excavation of drainage channels, the provision of hard-standing, laying of concrete foundations and electric cables and the erection of the wind turbines. Such intensive activity will, not surprisingly, have a profound effect on the stability of the fragile peat terrain. The breaking of the top mat and acrotelm and excavating drainage channels during all aspects of construction and general on-site activity will lead to serious erosion and almost certainly peat slide and general instability. During periods of rainfall, liquid peat will enter existing drainage channels and watercourses and, under storm conditions, one can expect major peat movements.

Where drainage channels and foundations have reached a depth to expose the catotelm and mineral deposits, erosion and transport of mineral and colloidal material will add to that of peat entering watercourses. The erosion of such drainage channels will be an ongoing event, meaning that, where slope occurs, some of these channels will be of considerable depth.¹ Where roads break through to the underlying mineral substrate, continuous erosion will occur with silt run-off occurring at each rain event. Peat silt entering the watercourses will settle out on the streambeds between the stone and gravel interstices and gradually result in compaction of the gravel. The Peat Silt Research Group in Ireland has found that high concentrations of peat silt in a river reduce the bottom fauna density. The silt may also eliminate certain invertebrate species by altering the habitat, increase the mortality of fish ova through low oxygen levels and affect the growth of young fish. It was noticed that larger fish were not affected by the presence of peat silt *except where concentrations were very high*.

Results from personal research has also revealed high mortalities of salmon eggs as a result of heavy silting from soil erosion.² While engaged in research on the River Elan, a tributary of the River Wye, it was found that high levels of peat silt were being released from the Elan Valley Treatment Works. This peat originated from land bordering some of the Elan Valley reservoirs that supply water to Birmingham. It was noticed that practically the whole riverbed was covered with peat silt and that it was only where there was considerable turbulence that the riverbed was clean and that it was in these few clean areas that the majority of the salmon parr occurred. The numbers of invertebrate organisms and salmon fry in these areas were very low.³

Silt deposition can be insidious and gradually lead to permanent compaction and cementing of the gravel that will result in low invertebrate numbers and prevent salmon and lampreys from spawning. A personal observation on a tributary of the Aberdeenshire Dee revealed that much of the presumed spawning ground had, unknown to the Dee salmon proprietors or landowners, become compacted as a result of run-off of silt from a nearby unmetalled access road to the moors used by shooting interests. This is a further example of a source of silt emanating from construction work.

Special care will have to be taken when concreting is in progress as, when cement flour enters a watercourse, large fish mortalities can occur and all sizes of fish are affected. Provisions for waste disposal are unknown but care will obviously have to be taken and there should be no discharge of untreated waste, such as sewage, to any watercourse.

It is apparent that the wind farm construction and the after effects of same are going to seriously affect the conservation aims of the Teith/Ardoch Burn SAC which are to protect the salmon and three species of lamprey. As the main effect is that of silting, it is going directly against the purpose

¹ Fairbairn, W.A. 1967. Erosion in the Findhorn valley, *Scottish Geographical Magazine*, 83 (1), 46-52;
MacVean, D.N. and Lockie, J.D. 1969. *Ecology and Land Use in Upland Scotland*, Edinburgh University Press;
Mills, D.H. 1980. Scottish salmon rivers and their future management (pp. 70-81) in *Atlantic Salmon: Planning for the Future* (ed. A.E.J. Went), Fishing News Books, Farnham.

² Mills, D.H. 1968, Fish Populations in Forest Streams. *Report on Forest Research*, p. 158.

³ Mills, D.H. 1974. (unpublished) Final Fisheries Report. Craig Goch Joint Committee. Craig Goch Reservoirs Investigations.

of the SAC. This is because the life cycles of the four fish species to be protected depend on silt-free spawning gravel and well-oxygenated water with an abundant food supply and, in the case of the lampreys, fine organic mud in the quieter areas of the river or stream. For example:

Salmon spawn in the autumn and form nests or redds in the gravel in which to deposit their eggs. The eggs are then covered with gravel by the fish. The eggs remain in the gravel where they develop over the winter months relying on well-oxygenated water which is free from silt. The young fish, or alevins, hatch in the spring, remaining in the gravel for about a month gaining nourishment from their yolk sac. Once this food supply is used up they emerge from the gravel and commence feeding on small invertebrates.

Sea Lampreys enter the rivers early in the year and spawn from early spring to early summer. They move on to the spawning grounds where they prepare 'nests' which are grooves in the bed of the river surrounded by stones. The fish construct their nests by moving the stones with their suctorial mouths. After the eggs are laid they are covered with stones by the fish. Soon after hatching, the larva assumes a form known as an *ammocoete*. The larva is blind and toothless. It spends one or two years in the quiet backwaters lying in the fine mud where it feeds by filtering out organic matter. It metamorphoses into the adult form and migrates to sea in the autumn.

River Lampreys have a similar life cycle to the Sea Lamprey although their spawning migration is from the end of September to the following February. Spawning takes place in April and May. Small shoals of 10 to 50 individuals assemble together for this purpose, and several couples work together to form a 'nest', which is a shallow groove in the gravel bed of the river. The eggs hatch as *ammocoetes* and live in the mud for three to five years. Transformation into the adult stage begins in the autumn after which the fish migrate to sea.

Brook Lampreys are the smallest of the three species and do not go to sea. They have a similar life cycle to the other two species but do not remain as ammocoetes for very long.

It is very apparent from the above descriptions that peat and mineral silt deposition will adversely affect the successful life cycle requirements of these fish permanently in the Garvald and Ardoch Burns and partially reduce them on the River Teith.

So far I have only considered the effects of the wind farm development with respect to the River Teith SAC. However, one must also look at the probable adverse effects it will have further downstream, namely with regard to the Ramsar Site in the Forth estuary. Inevitably, significant quantities of peat silt will be transported downstream and will eventually settle out in the estuary blanketing the natural bed harbouring the invertebrate organisms on which the wading birds feed and smothering estuarine plants (e.g. *Zostera spp.*) which are the food of certain wildfowl species.

A consideration of the proposed measures to mitigate the effects of construction

The construction methodologies and mitigation measures outlined in the Peat Stability Assessment Report are theoretical and would not be of practical use to the contractor. A construction site inevitably develops into a rather disorganised scene owing to the work schedules of various sub-contractors and frequently a lack of communication between foremen. The work becomes even less easily supervised in inclement weather and if time limits are imposed. Where aspects of work fall behind schedule, certain precautions are often overlooked or ignored. All work can quickly go awry if there is vehicle breakdown (e.g. a heavy earth-moving machine becoming literally bogged down) and forbidden practices have to be followed to extricate machinery, etc. My long experience of construction sites can confirm these 'predictions'.

In order to overcome some of these predictable happenings, SNH outlined to Mr. Phillips measures they and SEPA would plan to impose. These include:

- i) Use of straw bales to construct settlement lagoons and for trapping silt to prevent it entering watercourses;
- ii) Road construction will use crushed rather than ‘as dug’ rock which has significantly less dust associated with it. Any dust washed off will be caught in the drainage system;
- iii) All water from the drainage will be released over vegetated non-peat land;
- iv) Only a small amount of vegetated top mat will be reserved to dress hag and road sides;
- v) The developers are designing a peat slide contingency plan;
- vi) SNH is content that methods for the construction of floating roads will not result in significant increases in the risk of a bog slide;
- vii) There will be no parallel drainage.

The use of straw bales is rather risky as they can be unstable and are easily dislodged by vehicles; bales can become waterlogged and seepage could become a problem; the release of water over vegetated non-peat land is rather alarming. How close will this non-peat land be to the source of the released water? Any plan should be available for scrutiny. The measures are rather skeletal and give one little confidence.

While advising British Gas during the construction of three pipelines down the east of Scotland from St. Fergus to Stirling and from St. Fergus across the Firth of Forth to East Lothian, I had experience of many instances of pollution emanating from badly-constructed roads, inadequately maintained settlement lagoons, pollution of watercourses, poor reinstatement of river banks at river crossings, poor supervision of the work force and inadequate liaison with land and river owners.⁴

Conclusions

This development would appear to override the regulations set up to protect Special Areas of Conservation. However, the EU Habitats Directive would seem to protect such action (Article 6 (4)):

If, in spite of a negative assessment of the implications for the site and in the absence of alternative solutions, a plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature, the Member State shall take all compensatory measures necessary to ensure that the overall coherence of Nature 2000 is protected. It shall inform the Commission of the compensatory measures adopted.

Where the site concerned hosts a priority natural habitat type and/or a priority species, the only considerations which may be raised are those relating to human health or public safety, to beneficial consequences of primary importance for the environment or, further to an opinion from the Commission, to other imperative reasons of overriding public interest.

As SACs were set up to protect biodiversity, the government’s action is a retrograde step. It is surprising that SNH, the established guardians of our wildlife and natural environment, should be taking such a *laissez faire* attitude.

Derek Mills

22 November 2005

⁴ Mills, D.H. 1976. The impact of the British Gas Corporation pipeline project on Fisheries: Precautions and Claims. Fisheries Management, 7, (4), 78-79.

**Braes of Doune Wind Farm –
an assessment of recent developments and the way forward**

It was disturbing to learn of some apparent oversight in the observance of the guidelines set by SNH and SEPA for the contractors in developing the wind farm site. The aerial photographs show clearly the careless way in which the access road has been constructed and the random placing of straw bales intended to intercept run-off of sediment. An inspection of the photographs depicting vain attempts to intercept the heavily silted water from reaching the watercourses (p. 19 & pps. 32-33) is dismaying but predicted. The photographs of the burns in spate show the water carrying a high sediment load that undoubtedly comes from the wind farm site.

A number of questions need to be asked and certain actions taken, namely:

- (a) As SNH was responsible for setting the conditions which the contractors had to observe if the scheme was to go ahead, it is obvious that one has to ask it (through contact at the highest level):
 - i) How often have their area officers inspected the site?
 - ii) If they have noted any contravention, what action have they taken?
 - iii) After any 'disciplinary' action, have they returned to see that their instructions have been observed?
 - iv) Has any field officer inspected the burns to look for evidence of sedimentation and/or fish mortality?

- (b) SEPA has a statutory duty to inspect the waters in their area and, on a regular basis, undertake routine sampling of the prevailing physical, chemical and biological conditions.

As the burns in this area are of particular importance, being in an SAC, SEPA should be asked (through their Chief Inspector) for copies of their analyses of these parameters before work on the site started and the results of their analyses since.

One should ask, in particular, for suspended solid levels, BOD (biochemical oxygen demand), invertebrate composition and any observations on evidence of sedimentation. If there has been no collection of data since work started, the big question is *why not?*

Possibly as a result of the actions of the contractors, there is a high probability that the Ardoch Burn environment has been degraded to the detriment of the fish fauna that were designed to be protected through designation of the site as a Special Area for Conservation.

However, the state of the environment and the presence or absence of the fish fauna requires investigation by SEPA, which has a statutory responsibility for the aquatic environment, and SNH, the guardian of the SAC.

If these actions have not been undertaken, these authorities have not fulfilled their duties.

Derek Mills
18 August 2006

The Annet Burn

1



22 December 2005: location NN 699 063

A series of photographs taken from a bridge over the Annet Burn immediately south of a site depot and close to the site's main access road suggest significant silt loading at least from December 2005 to March 2006.



14 March 2006



The Annet Burn after a lengthy dry spell. There is no apparent turbidity though there seems to be residual sedimentation on the river bed.

Note:

The pictures are grouped by location. The circled numbers at the top left corner of the first picture in each group correspond to numbered points on map 2 (page 6, locations 1 to 8) and map 3 (page 27, locations 9 to 13). Within a group, pictures are ordered chronologically.

The Garvald and Ardoch Burns



The view looking north up the Garvald (right) and Ardoch Burns. The depot in the foreground (pt 7) lies at the southwest of the site just east of Loch Mahaick – much of the land between is an SSSI (inset). The southerly quarry (pt 4, p 19) is in the middle of the picture. The northerly quarry (pt 2, opposite) and the confluence of the Garvald and Ardoch Burns (pt 6, p 24) are circled. A map sent by SNH to riparian owners shows the southernmost stretch of the Garvald (not the Ardoch) as part of the SAC though this may just be a trivial clerical error. Whatever, it places the SAC's local northern limit at about the level of the dotted line. Note the excavated peat deposited by the side of track.

2



9 July 2006: approx location NN 714 103

The northerly of two quarries ('borrow pits') and peat dumps. It lies proximate to the Garvald Burn, probably about two kilometres upstream of the SAC boundary (the location of the boundary is unclear – see opposite).



A close-up of the turbine excavation in the above picture. Note the depth of excavated peat, the turbidity of the undrained water and the proximity of the site to the Garvald Burn, into which the excavation drains by design.



A tributary joins the Garvald Burn just downstream of the northerly quarry. The clear stream drains an area to the west, remote from construction activity.



The top left picture is viewed from the west bank of the burn and the other two from the east bank.



30 June 2006: approx location NN 713 084

The Garvald Burn after moderately heavy rain. This fall lies south of the northerly quarry but upstream of the second. (The grid reference is approximate.)



21 June 2006

A pool at the foot of the waterfall shown above, a few metres to the south.



The same waterfall and pool ten weeks after the previous pictures. Pollution is still evident even after light showers and over a year since the developer reports the start of construction activity.



Airtricity Scotland's claim (*Sunday Express*, August 6) that 'there had been only one "isolated incident" in June following heavy rainfall and that "water courses are being monitored daily"' may merit scrutiny.

4



9 July 2006: location NN 714 078

A general view of the southerly quarry and peat lagoon showing how it drained into the Garvald Burn by design. The highlighted area is shown below. (It is possible that this arrangement has since been modified.)



The drainage scheme for the peat dump where attempts have been made to arrest silt being carried off. The bales are manifestly ineffective and have, in places, been displaced.



12 August 2006

Much of the bed of the burn is covered by a film of silt up to two mm deep. This was apparent to one degree or another for as far south as observers were able to inspect.



Pollution is evident at low water in the burn immediately below the quarry and peat dump pictured above.

5



21 June 2006: location NN 713 075

The Garvald Burn, seen from the side of the bridge on Severie Farm on 21 June.



30 June 2006

Looking north up the Burn from the same bridge on 30 June.



The same stretch of the burn photographed after a lengthy dry spell. Although the water is, for now, clean, dried sedimentation is evident on rocks clear of the water and the river bed is also contaminated.



Site traffic, which passes nearby constantly, suggests the quantity of material that will eventually be washed down the local waterways.



A stone lifted from the location on 12 August 2006: it was proud of the water at the time. Note the sedimentation left over from immersion at higher water levels. (The steps on the scaling rod are five cms long.)



For comparison, a stone lifted from the Coldruich Burn which lies about 100 metres west of the Severie bridge. It appears to be unpolluted.



The Severie Bridge (cf page 21) seen here on 19 August, a week after the picture on page 22. Despite only light precedent rainfall, the burn is clearly loaded with silt.



Left: the Coldruich Burn, about 100 metres west of the Garvald. Although it also ran high on June 21, its waters were characteristically clear, as they were on August 19 (right). This contrasts with the Garvald Burn on the same dates.



9 July 2006: approx location NN 713 069

The Garvald Burn as it approaches the Ardoch Burn confluence (between points 5 and 6).



9 July 2006: location NN 713 069

And, flowing from the left, as it joins the Ardoch Burn. Silt load in the former is evident, despite light precedent rainfall.

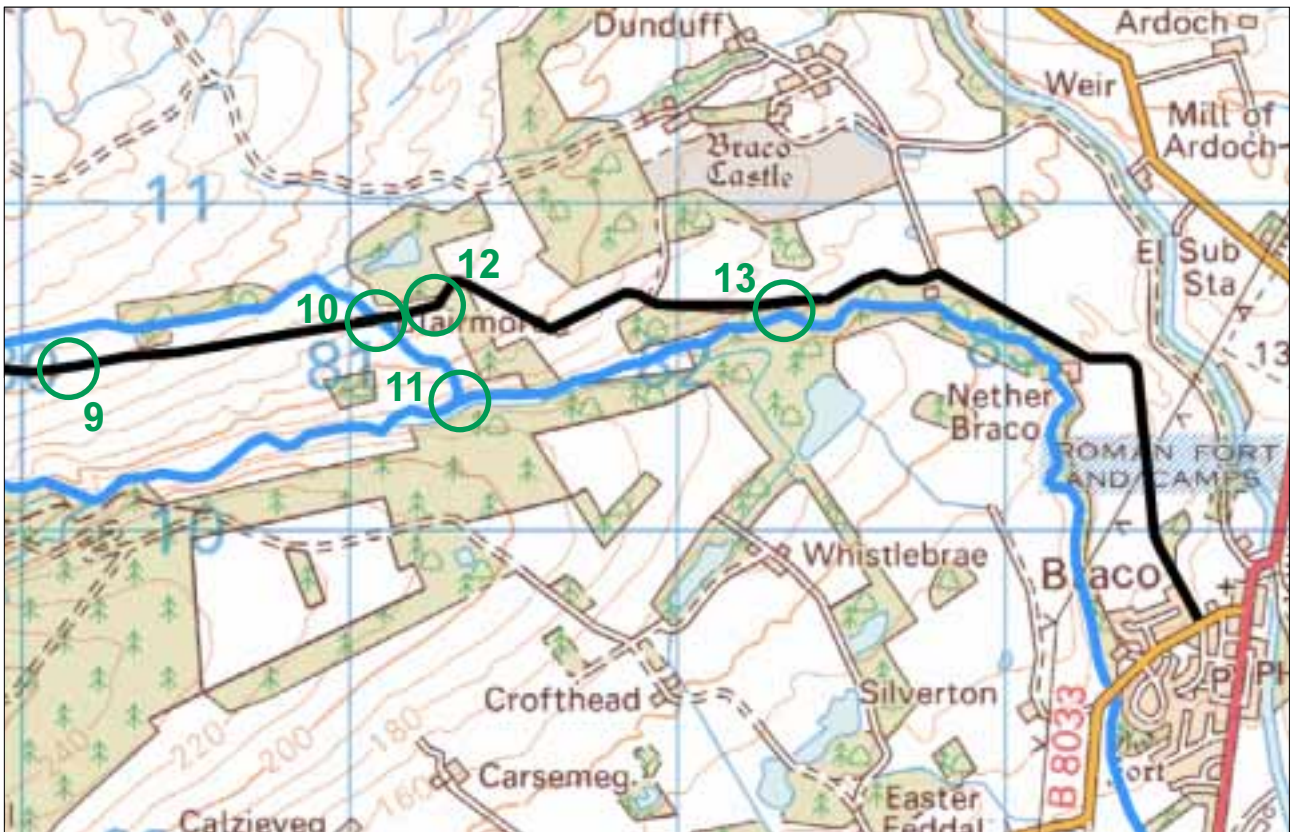
8



9 July 2006: location NN 730 007

The Ardoch Burn flows south into the River Teith. Turbidity is pronounced despite light precedent rainfall.

The Bullie Burn



Map 3: the eastern end of the grid connection access track (see map 2). The Bullie Burn and its tributaries are shown in blue, access track in black. The green circles indicate vantage points or locations in the photographs below.



12 December 2005: approx location NN 800 105
Looking east from point 9. The design of the road is such that water is collected on the upslope side and runs via a deep ditch (with no silt barriers) into a natural water course. No effort was made to release water at intervals onto the downside grass and bracken area which would have acted as a natural silt trap. The results are shown below.



Location NN 811 107

The road crosses a burn at point 10. The evident scouring marks show that water runs from the road down the embankment into the burn.



Location NN 813 104

Left: the burn as it continues past point 10 carrying now heavily silted water and (right) as it enters the Bullie Burn (point 11). It is recorded as a spawning burn.



Looking back up the burn as it enters the Bullie Burn.



12

Location NN 813 107

Point 12. Just east of point 10, the road passes through a wood before descending for about a kilometre to point 13 where runoff channelled into ditches and pipes was collecting.

13



11 Jan 2006: location NN 823 107



Point 13: the road at this point is barely 20 metres from the Bullie Burn. The top picture shows silted water being discharged from the road through the intervening wood into a silt catching system (middle and bottom). At least on the day these pictures were taken, it was manifestly failing. All this water ends up in the Bullie Burn.



12 December 2005



Two shots of the Bullie Burn taken close to point 13 show pronounced colour even at low water.

Straw bales for silt control



The developer is known to have been importing many tonnes of straw bales onto the site continuously since last year. The picture shows a temporary depot for storing large bales to be used as silt traps. Note how peat excavated during construction is disposed of by deposition alongside access tracks. These will oxidise and emit CO₂ over time.



Attempts to arrest silt with bales. The area of bare ground above ensure that these measures are overwhelmed as soon as there is heavy rain.



As above.



Approx location NN 715 102

The excavation for a turbine base and the adjacent access road. The red box is a pump moving turbid water into a terram dam with small bales intended to catch silt downstream.

About the Author

John Phillips, MA (Agric), CBiol, MIBiol:

1959-1964 Owned and ran a small farm in Fife;

1965-1971 Game Adviser, Eley Game Advisory Service, Fordingbridge, Hampshire;

1971-1974 Game Adviser, Economic Forestry Group;

1974-1984 Self-employed wildlife manager and game consultant. Conducted a definitive research programme on the epidemiology of *Ixodes ricinus* and louping ill;

1984-2003 Founded and directed *The Heather Trust* which specialises in the management and rehabilitation of heather moor and peatland;

1996-present Owns and runs a small arable farm in west Perthshire;

2003-present Consultant in moorland and upland wildlife management and hill-farming.

John Phillips can be contacted at jp.longbank@tiscali.co.uk