

**A REVIEW OF THE HYDROGEOLOGY ELEMENT OF THE
GRIFFIN WIND FARM ENVIRONMENTAL STATEMENT**

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March 2005

Section 1

Location of the Griffin site

The Griffin site is located between Dunkeld and Aberfeldy.

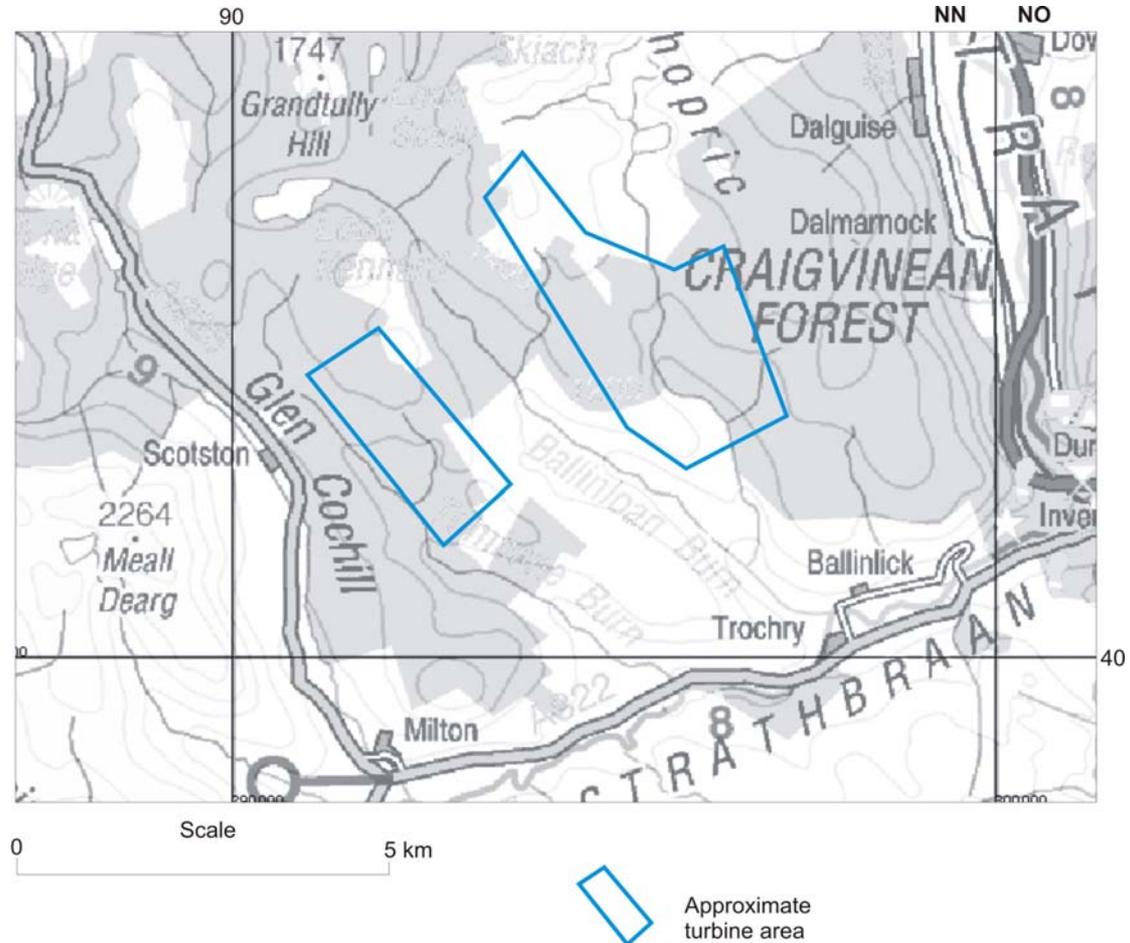


Figure 1: Location of the Griffin site

1 Geology

Superficial Deposits

Much of the middle and lower hill slopes are underlain by thin, patchy glacial till. This is a predominantly clayey, stony deposit with occasional coarser grained sand and gravel horizons. It varies in thickness from less than 1 m to more than 8 m locally. The proposed area for turbine installation, along the high ridge of the hills, is underlain either by very thin, patchy, superficial deposits or bedrock at surface.

Peat deposits are not extensive and occur in patches mainly in the north of the area but also in the south-east. Alluvium associated with the local surface water, (the Ballinloan Burn, the Tombane Burn and the Pitleoch Burn) also occurs within the site area. This comprises poorly consolidated sands, gravels, silts and clays and is likely to be generally less than 5 m in thickness.

Bedrock

Precambrian psammite and semipelite metamorphic rocks belonging to the Southern Highland Group underlie the whole site (Figure 2). Some minor igneous intrusions are also present. The Precambrian rocks are hard and fractured and have been subjected to heat and pressure to form complex structures. The upper few metres of the rock are normally highly fractured as a result of glacial activity and weathering processes.

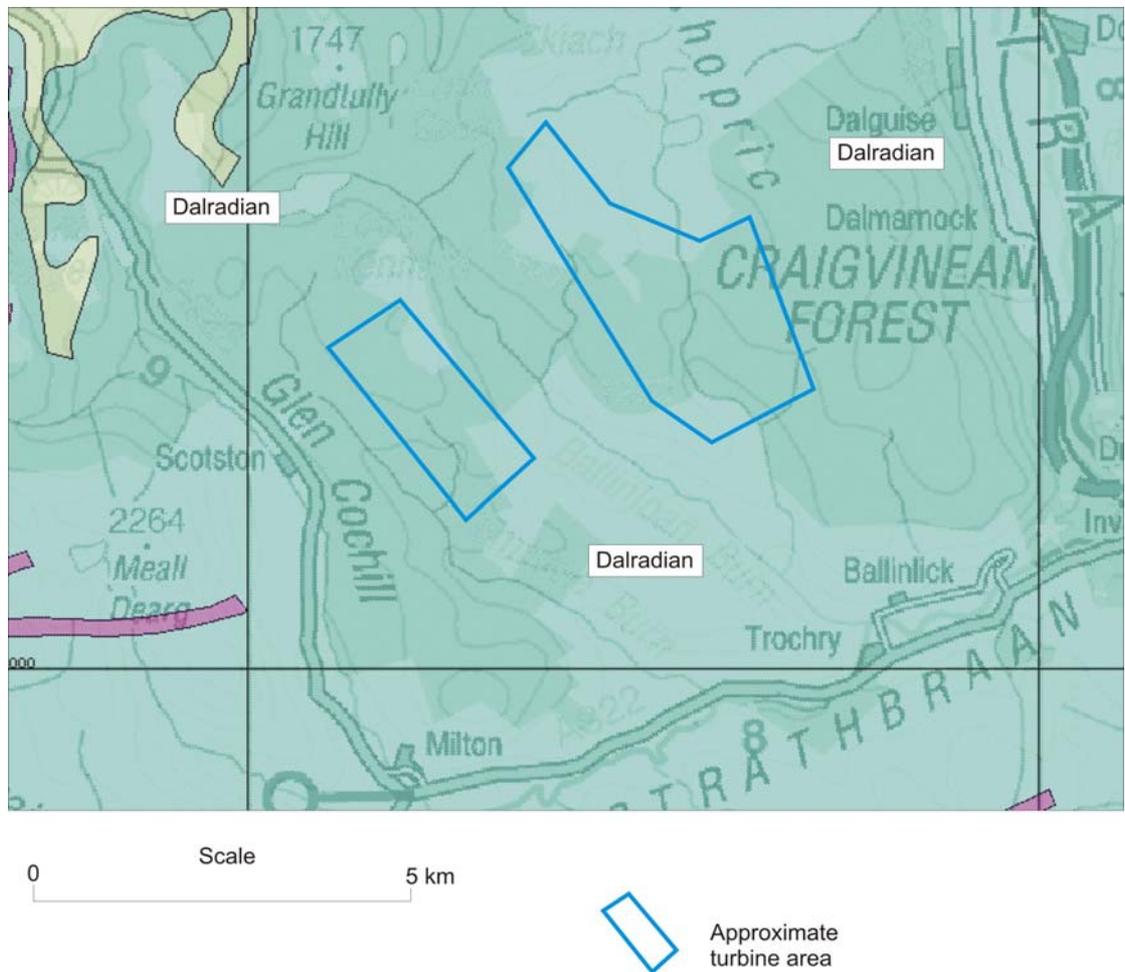


Figure 2: Bedrock geology

Hydrogeology

Superficial deposits

Small amounts of groundwater are present, mainly within sandy, gravelly beds interbedded with till deposits. These are common in the area, particularly on the lower slopes of the valleys where significant flows of groundwater can occur at shallow levels. These can form useful, but vulnerable, domestic supplies. However, the main body of till itself can also have a significant permeability owing to the sandy nature of the material and the presence of fissures and fractures.

The groundwater flow paths in till are very localised and can be complex according to the presence of higher-permeability beds of sand and gravel which may occur sporadically. BGS has limited data on the hydrogeology of the project area, obtained during a brief site visit. Groundwater is also present in the alluvial deposits and is likely to contribute significant baseflow to the rivers.

Areas of peat can, in places, be supplied with groundwater from springs emanating in upland tills.

Bedrock

Groundwater is present in small quantities within the psammite and semipelite, occurring where fractures are present. However, it is the shallow weathered zone at rockhead, below the superficial cover, that is the principal layer where groundwater is present. Rainfall infiltrates from the surface to this zone where rock is exposed at surface, in addition to moving downwards from the basal beds of the till and peat to enter the relatively high-permeability fractured zone. From here, groundwater moves down slope to appear at springs. Many shallow wells are dug into this layer to intercept the water table.

Section 2: The Environmental Statement review

The ES has been produced by Green Power Ltd and is dated April 2004.

The proposal is for the construction of up to 82 turbines on properties known as Griffin, Scotston and Ballinloan in Perthshire, Scotland (NN 936 438).

Chapter 9: Hydrology Impact Assessment

Geology

9.2 provides a short geological description of the bedrock, with a further mention of bedrock in 9.6.2.6.

Overall, an accurate summary, although a more detailed description of the types and distribution of superficial deposits (alluvium, peat and till) is required.

Hydrogeology

9.6.2.6 provides a description of the hydrogeological conditions across the site. Recognition of the relatively low amount of groundwater held in storage in the bedrock is made and that groundwater may occur where the rock is fractured or weathered. It is also recognised that significant quantities of groundwater may occur within the coarser grained horizons within the till and contribute to baseflow in nearby rivers.

Although reference is made to groundwater in tills, no description of the location of these deposits is given. Also, no mention is made of the potentially significant shallow groundwater present in the alluvium. This could be very important when considering the potential impact on surface waters. Many boreholes provide water supplies in other parts of Scotland from similar rocks. Abstraction of groundwater can be made from water-bearing fractures over 60 m below surface.

Groundwater vulnerability

No mention is made of groundwater vulnerability.

SEPA's latest vulnerability maps, produced by the BGS, indicate that fractured bedrock with thin or no sandy till cover is highly vulnerable to pollution. However, these maps are not available to consultants yet. The fractured nature of the aquifer can lead to rapid flow of water and the aquifer is therefore vulnerable to contamination from the surface.

Receptors

Private water supplies:

Section 9.4.2. states that Perth and Kinross Council have identified 40 private water supplies around the proposed wind farm site and a further 26 properties that are not registered but have water supplies that could be effected by the development. The locations of these supplies are not illustrated. Scottish Water is now supplying 13 of the properties from a source outside the area.

9.4.2.2 states that Green Power propose to carry out a survey of the remaining supplies that have not transferred to Scottish water for their supply, to identify the type and locations of the sources of water supply.

It is important to determine the location and nature of these water supplies. It is likely that some of the properties are supplied from shallow groundwater in the sand and gravel horizons that occur within the Till.

A site visit made by BGS to the Ballinloan area identified several private water supplies, including three boreholes. Whilst it is unlikely that there will be an impact on these supplies from the development, it will be very important to accurately record the exact locations of these supplies, particularly ant spring supplies located on the slopes of Druim Mor and Creag Dhubh. The description of the impacts on private water supplies (Section 9.6.2.6) makes generalisations as to the likely impacts of the development on groundwater, but much additional work is required to make more accurate and detailed assessments. This work should include a comprehensive map of the locations of all private water supplies, with descriptions of the sources.

Where the bedrock is locally fractured and weathered it has the potential to provide significant quantities of water. Due to the fractured nature of the bedrock, rapid flow can occur and sources some distance away may be affected by the proposed development, although it is unlikely that any deep abstraction boreholes located more than 2km from the margins of the development would be affected.

Surface water:

Sections 9.2 and 9.4 describes in detail the hydrology of the area. Section 9.6 describes the impacts on the hydrology of the proposed construction and Figure 32 illustrates the areas that are considered to be hydrologically sensitive and could be affected by construction and maintenance works associated with the proposed scheme.

Section 9.6.2.5 includes a consideration of the impact of the proposed construction work on private potable water supplies. The impacts on those from the Tombane Burn and the Ballinloan Burn are considered to be of only minor significance and the probability of occurrence to be low.

The BGS considers that groundwater baseflow to the streams may be significant. Therefore, the construction of tracks and pits some distance from the burns may have

a temporary effect on the quality of water in them and also the water supplies of any properties that use surface water for water supply. This is unlikely to be significant, but the role of shallow groundwater flow in bedrock and superficial deposits as baseflow to surface streams should be recognised.

Groundwater-dependent ecosystems

Chapters 6 and 7 comprise impact assessments for vegetation and flora and protected mammals respectively.

BGS consider that there may be a minor, localised, impact on surface waters during construction, from the discharge of sediment into nearby water bodies from surface water run off during construction, operation and decommissioning but that this is considered to be low risk.

Monitoring

No mention of a groundwater monitoring programme is included in this report.

The BGS considers that routine quality inspections of sensitive environmental features within the site and the vicinity should be carried out along with monitoring of all private water supply sources that could be affected by the proposed development works.

Monitoring should incorporate sampling for flow and water chemistry prior to any construction work in order to measure background levels.

Conclusions

- The proposed survey of private water supplies should be carried out to identify the type and locations of the sources of water supply in the vicinity of the site and to highlight any supplies that are considered to be at risk from the proposed development.
- Shallow groundwater in the sandy till and weathered bedrock zone may be providing significant amounts of groundwater as baseflow to streams and the springs.
- Whilst the BGS consider the overall risk to groundwater receptors as low, there may be local impacts on shallow groundwater with temporary reductions in water quality.
- Routine quality inspections of sensitive environmental features within the vicinity of the site should be carried out with monitoring of all private water supplies that could be affected by the proposed development works both pre-during and post construction.

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