SECTION 1

GEOLOGY & SOILS

1.1 Introduction

1.1.1 This chapter presents an assessment of the potential impacts of the proposed An Camas Mòr development to the geology and geomorphology of the area. This Section is based on available desk study information and walkover surveys of the proposed development.

1.2 Consultations

1.2.1 The following consultees were contacted via email on the 9th December 2008 to comment on the scoping of the geology section of the ES:-

- British Geological Survey (BGS); and the
- Cairngorms National Park Authority (CNPA).

1.2.2 Response from the consulted parties that relate specifically to the geology of the site are provided in Table 1.1 below:-

Table 1.1: Scoping Response

Consultee	Response/Request
British Geological Survey	Email response on 13/01/2009:- I have discussed the area of interest with my colleagues, Jon Merritt (Project Leader, Sheet 74E Aviemore) and Dr Tom Bradwell (Team Leader, Quaternary Earth Systems), the three of us being familiar with the landscape at the site. We feel that although the features on the site represent clear examples of Lateglacial meltwater and ice retreat features, they are relatively common in the Aviemore and wider Strath Spey district. As such they do not represent sites of special significance in terms of the Quaternary geology. The scope of your EIA appears to be appropriate. Further we would be grateful if, prior to the commencement of works adjacent to or affecting the kettle holes, someone were able to photograph the larger kettle features, and email those images to myself with their locations. This would be useful for two reasons: in our reconstructions of glacial retreat up Strath Spey we may require images to illustrate this part of the glen; and also it may be the case that BGS would wish to core the kettle sites using a Russian Corer (narrow bore, hand-drilled), to retrieve potentially useful palaeoenvironmental information from kettle sediments. It would be important for us to do this before any disturbance of the sites by development, to minimise the possibility of contamination. It is more than likely that on seeing these photographs BGS would decide that these kettles are not worthy of further investigation, however it would be a great shame if they were potentially important and such an opportunity were lost.
Cairngorms National Park Authority	Email Response on 7/01/2009:- We have consulted with the earth science specialist at SNH and have the following brief comments to make: 1. The scope of the geology chapter of the EIA appears comprehensive. 2. We suggest that the evaluation of the specific features, as well as the total assemblage of landforms, should be placed in a local as well as a regional context – i.e. how they compare with other examples in the National Park and further a field if appropriate. 3. Opportunities for mitigating the impact should also be considered e.g. open areas or recreational areas fitted around the geomorphology (including making use of opportunities for interpretation), rather than any 're-landscaping' (which I am aware the indicative plan already considers).

1.3 The Study Area

1.3.1 The area designated for the proposed development occupies approximately 70 ha of relatively low-lying, flat to gently undulating terrain adjacent to the River Spey, on elevations ranging from approximately 220 m to 230 m Above Ordnance Datum (AOD).

1.3.2 A walkover of the site was carried out as part of the fieldwork and was limited primarily within the site / development boundary. However, a brief reconnaissance of areas outwith the site boundary was carried out to gain an appreciation of the site in relation to it geomorphological setting.

1.4 Baseline Conditions

1.4.1 The site is predominantly well-drained and is partially covered with a plantation forest, rough grasses and heather with areas containing sparse trees. Habitats are discussed in detail in Volume 2, Chapter 9, Section 4. A review of the available historical maps indicates that the land use of the area has not changed significantly since 1747. The land belongs to the Rothiemurchus estate and has been primarily used for forest plantations and coarse grazing. On this basis, the area can be considered a 'Greenfield' site, with no apparent source for contamination to be present. As such it is considered that no further investigation for contaminated land within the site of the proposed development is required prior to construction.

1.4.2 Based on the SNHi GIS datasets (http://www.snh.org.uk/snhi) there are no Sites of Special Scientific Interest (SSSI), Special Protection Areas (SPA) or Special Areas of Conservation (SAC) within the site boundary. However, it is noted that the River Spey to the immediate west of the site has been classified as both an SSSI and an SAC.

1.5 Geomorphology

1.5.1 The geomorphology of the area is controlled by the glacial history. Field evidence (Young, 1977), suggests that the Aviemore area was once submerged beneath thick glacial ice (at least 600 m), which down-wasted in-situ, releasing meltwaters that carried large volumes of debris into and under the glacier ice. Evidence of these meltwater channels is visible on current aerial

photography across the site. Gradually, the ice sheet wasted away completely, leaving large areas of dead ice topography, forming 'kettle holes' across the valley terrain. Subsequently, the River Spey cut into the meltwater debris (glacio-fluvial) deposits, forming terraces and a floodplain within the valley.

1.5.2 Kettle holes are formed as a consequence of relict blocks of ice from the margins of a receding glacier. The blocks of ice are subsequently buried by glacio-fluvial deposits from the melting of the glacier; the kettle hole is then formed by the collapse of the glacio-fluvial cover when the buried glacier ice finally melts in-situ.

1.5.3 The topographical depressions identified at the site are considered to be common features of the 'kame' and 'kettle' topography that are present within the valley landscape of the Aviemore area. Aviemore has been built on 'kame' and 'kettle' topography, much of which has been destroyed by construction (Young, 1977).

1.5.4 The kettle hole features found at the site are relatively small, compared to examples that form large kettle hole lakes, such as Loch Pityoulish, Loch Mallachie and Loch Garten. Many other small kettle holes are also present along the valley and have been mapped (Young, 1977); these include Loch Dallas, Loch Dubh, Loch Vaa and many other smaller depressions, with and without water, that are unnamed.

1.6 Superficial Geology

1.6.1 According to the British Geological Survey (BGS) Solid and Drift Geology map, the superficial geology of the site comprises alluvial terrace deposits of sand and gravel. Deposits are likely to have significant thickness across the site, potentially greater than 5m in thickness. The deposits have been reworked by the River Spey in the past, forming the terraces or escarpments to the west and south of the site boundary.

1.6.2 An inspection of the superficial deposits across the site would suggest that the sand and gravel was reasonably well compacted and appeared to be free draining. Localised areas of soft peat deposits were noted at some locations, particularly within gentle troughs in the landscape morphology and within a 'kettle hole' identified at the southwest of the site (identified as KH1 on Figure 1.1).

1.6.3 The Macauley Institute Soil Survey Map indicates that the soils originated from glacio-fluvial sands and gravels, derived from acid rocks. The soils within the site are described as humus-iron podzols comprising peaty gleys and humic gleys, forming mounds and ridges with gentle to steep slopes. The vegetation is described as acid bent-fescue grassland; Atlantic and boreal heather moor; rush pastures and sedge mires.

1.7 Solid Geology

1.7.1 No rock outcrops were found during the walkover survey, and bedrock is believed to be at such a depth not to be encountered by the development. However, based on an interpretation of BGS information, the central area of the site is likely to be underlain by interbanded gneissose psammitic and subsidiary semi-peltic rocks of the Central Highland Migmatite Complex. The remaining underlying rock types are anticipated to be predominantly psammitic, with beds of semi-peltic rocks, schists and quartzites. Felsite, quartz porphyry and granophyre veins are also present locally to the northeast of the site. A major fault, the Ericht-Laidon Fault, is indicated to be present running beneath the site parallel to the alignment of the River Spey. With reference to 'Eurocode 8 seismic hazard zoning maps for the UK, Seismology and Geomagnetism Programme, Technical Report CR/07/125 Issue 3.0, 2007', the risk of potential seismic impact is shown to be very low with Peak Ground Acceleration less than 0.02 g for a 475 year return period. However, near-fault seismicity may present an increase in this value, as illustrated by the magnitude 2.7 earthquake which was felt at Aviemore on 28 August in 1995. Nevertheless, it is considered that with the absence of any mechanism the presence of the development would not increase risk to the existing environment with respect to the affects of any seismicity.

1.8 Hydrogeology

1.8.1 The BGS Hydrogeological Map of Scotland indicates that the site is underlain by Quaternary sands and gravels. The superficial deposits comprise silts, sands, gravel and cobbles and form terraced and gently undulating terrain. The groundwater potential varies, based on the thickness of saturated material. Boreholes have been known to typically yield 10 L/s, with to 15 L/s in some cases. The groundwater chemistry is variable, but mineralisation is typically weak. The exposed shallow nature of the groundwater places it at risk from diffuse and point source pollutants.

1.8.2 The underlying solid geology comprising psammites, schists and gneisses is described to have little potential for groundwater storage and transport, other than in cracks and joints associated with tectonic features or near surface weathering.

1.9 Assessment methodology

1.9.1 The assessment comprised the following key stages:

- Desk studies and field surveys to ascertain the current baseline conditions of the site;
- Considerations of the possible interactions between the proposed development and the current site conditions, plus identification of potential impacts;
- Assessment of the significance of potential impacts, taking into account the sensitivity of receiving environment, the potential magnitude of each impact and the likelihood of the impact occurring; and
- Identification of measures proposed to avoid, minimise or mitigate against identified impacts.

1.10 Data Sources

1.10.1 The following information was reviewed for the desk study:

- Extracts from historical maps from 1747 – present;
- Badenoch & Strathspey (1997) and Highland Council Local Plans (1997);
- Digital Aerial Photograph of the area (0.25 m resolution), Getmapping.com;
- Ordnance Survey Maps (1:25,000 scale), digital;

- Digital Terrain Model - NextMap Britain (5 m resolution);
- Topographic contour data;
- British Geological Survey - Solid Map Sheet 74E - Aviemore, (1:50,000 scale);
- British Geological Survey – Geological Memoir for Sheet 74E;
- Eurocode 8 seismic hazard zoning maps for the UK, Seismology and Geomagnetism Programme, Technical Report CR/07/125 Issue 3.0, 2007
- Macauley Institute - Soil Survey Map Sheet 36 (1:50,000 scale);
- British Geological Survey - Hydrogeological Map of Scotland (1:625,000 scale);
- Young, J.A.T. (1977). Glacial Geomorphology of the Aviemore – Loch Garten Area;
- Scottish Natural Heritage – Natural Spaces SNHi GIS Datasets - http://www.snh.org.uk/snhi/; and
- An Camas Mòr - Indicative Land Use Plan.

1.11 Field Survey

1.11.1 The field survey was carried out following the desk study to gain a visual appreciation of the geology and geomorphology of the site. Geomorphological features, identified from the digital aerial photograph and topographical maps, were then confirmed in the field. Findings of pertinent features observed on site are shown in Figure 1.1 and summarised in Table 1.2 below.

Table 1.2: Pertinent Geological and Geomorphological Features of the An Camus Mòr Site

Feature Reference	Feature Type	Estimated NGR or general location	Description
KH1	Small Kettle Hole	NH 90552 12235	Circular topographic depression within forest, with an approximate diameter of 35 m. The depression is pronounced, estimated to be 2 m depth and is filled with an unknown depth of very soft and saturated peat.
KH2	Small Kettle Hole	NH 90903 12720	Elliptic shaped topographic depression with approximate dimensions of 25 m x 30 m with a depth of approximately 3m.
KH3	Small Kettle Hole	NH 91171 12919	Circular topographic depression with an approximate diameter of 30 m. The depression is well-rounded and approximately 2 m in depth. The base of the depression appeared to be free draining.
KH4	Small Kettle Hole	NH 91064 12912	Circular topographic depression with an approximate diameter of 20 m with a depth of approximately 2.5 m.
KH5	Large Kettle Hole	NH 91251 12964	Large elongated topographic depression, estimated to be 100 m x 40 m x 4 m. The base of the depression appeared saturated and soft, possibly infilled with peat.
KH6	Large Kettle Hole	NH 90833 12356	Large topographic depression in the landscape, approximately 80 m x 70 m in size with an estimated depth of 6 m. The depression appeared well drained and was covered in grass.
KH7	Small Kettle Hole Lake/Pond		Circular topographic depression filled with water with an approximate diameter of 40 m. The pond sits at the bottom of a larger overall topographic depression. The surrounding terrain morphology indicates that the original kettle hole may have been larger at this location, but has been disturbed and reworked in the past, a concrete hardstanding and shed is located next to the pond.
T1	Terrace	South of the site boundary	The terrace has been formed by the erosion of the glacio-fluvial sands and gravels by the River Druie.
T2	Terrace	West of the site boundary	The terrace to the west of the site boundary has been formed by the erosion of the glacio-fluvial sands and gravels by the River Spey.
C1	Meltwater channels	West of the site boundary	Evidence of glacial meltwater channels are visible from the aerial photograph to be adjacent to the gently sloping fields west of the site boundary.

1.12 Significance Criteria

1.12.1 The significance criteria of the potential impacts from the proposed development have been assessed by taking into account the following:-

- The potential magnitude of the expected impact; and
- The sensitivity of the baseline environment.

1.12.2 The magnitude is defined in Table 1.3 below.

Table 1.3: Geology / Geomorphology: Definition of Magnitude

Magnitude (positive or negative)	Definition
Major	Fundamental change to the geological / geomorphological features resulting in temporary or permanent change
Moderate	Detectable change to the geological / geomorphological features resulting in non-fundamental temporary or permanent change
Minor	Detectable but minor change to the geological / geomorphological features
Negligible	No perceptible change to the geological / geomorphological features

1.12.3 The impact has also been assessed in relation to the sensitivity of the receiving environment to change. The sensitivity has been classified as high, medium, low or negligible based on professional judgement, as shown in Table 1.4.

Table 1.4: Geology / Geomorphology: Definition of Sensitivity

Sensitivity	Definition
High	Sites designated as a Geological Site of Special Scientific Interest (SSSI) by SNH, e.g. rare examples of geological features or geomorphological landforms in pristine condition
Medium	Examples of large to moderately sized geological features or geomorphological landforms that may have local importance
Low	Poor or relatively common examples of geological features or geomorphological landforms
Negligible	No significant geological features or geomorphological landforms present

1.12.4 The magnitude and sensitivity of the potential impacts are combined to define the significance of the impact, as shown in Table 1.5. This table provides a guide to assist in decision making, however, it should not be considered to be a substitute for professional judgment and interpretation. In some cases the magnitude of impacts or sensitivity of receptors may be unclear and professional judgment remains the most effective manner for identifying the potential significance of an effect. Predicted effects of major or moderate significance equate to potentially significant impacts in terms of the EIA (Scotland) Regulations 1999.

Table 1.5: Geology / Geomorphology: Impact Significance Matrix

Magnitude	Sensitivity			
	Negligible	Low	Medium	High
Negligible	Insignificant	Insignificant	Insignificant	Insignificant
Minor	Insignificant	Insignificant	Minor	Minor
Moderate	Insignificant	Minor	Moderate	Moderate
Major	Insignificant	Minor	Moderate	Major

1.13 Effects

Assessment of Construction Impacts

1.13.1 An assessment of the potential impacts and mitigation options to minimise the impact to the geological and geomorphological features identified within the site is discussed in this section.

1.14 Potential Impacts

1.14.1 To determine the potential impacts of the proposed development upon the geological and geomorphological features within the An Camas Mòr site, and the immediate vicinity, the extent of construction activities are based on the Indicative Land Use Plan, Period D 2027.

1.14.2 The main features that have been identified within the site are the topographic depressions (or kettle holes) within the glacio-fluvial deposits. Additionally, terraces within the glacio-fluvial deposits and meltwater channels have been identified at the west and south of the site boundary.

1.14.3 No construction or earth works are proposed where 'kettle hole' features where identified, these features would remain as natural landscape features within the development. Based on the significance criteria tables above the impact of the development upon the 'kettle hole' features has been assessed as Insignificant.

1.14.4 Development of the site is anticipated to generate earthwork material. It is expected that the glacio-fluvial sand and gravel deposits are likely to be suitable for re-use during the site constructions works, particularly for leveling areas of the site or landscaping. The suitability of the glacio-fluvial deposits for use in construction would be dependent upon their properties, which would be confirmed by testing of samples.

1.14.5 Additionally, topsoil across the site is likely to be affected by construction activities; being stripped where construction is to take place and stockpiled. Onsite topsoil would be potentially re-used for landscaping of public areas and private gardens within the development. The Significance of potential construction impacts upon the upper soil layers is considered to be Insignificant, based on the poor quality of the soil at the site, i.e. generally used for coarse grazing and planting of fast growing conifers. The sensitivity of the soil is considered to be Negligible, while the Magnitude of construction activities upon the soils is considered to be Major.

1.14.6 The construction of roads would impact upon the glacio-fluvial terraces at the south and northwest of the site. However, the glacio-fluvial terraces and meltwater channels are considered to be relatively common features of glacial terrain. Based on the significance criteria tables above the impact magnitude is considered Moderate, while the sensitivity of is considered to be Low. Therefore, the effect on these features from the construction of the road would is considered to have an overall Minor impact.

1.14.7 A summary of the assessment of the potential construction impacts is given in Table 1.6 below.

Table 1.6: Summary of Potential Construction Impacts

Effect	Assessment of Construction Effects		
	Sensitivity	**Magnitude**	**Significance**
Kettle holes	Low	Major	Not Significant (Minor)
Kettle holes	Low	Insignificant	Not Significant (Insignificant
Glacial terraces	Low	Moderate	Not Significant (Minor)
Meltwater Channels	Low	Major	Not Significant (Minor)
Soils	Negligible	Major	Not significant (Insignificant)

1.15 Mitigation

1.15.1 Due to the nature of the geological / geomorphological features on the site, and the extent of proposed development, mitigation options are limited to avoidance of development on such features. However, based on the assessment of construction effects (summarised in Table 1.6) the option to avoid building on the features is not considered necessary.

1.15.2 The effects of construction impacts upon the topsoil and sub-soils within the site can be reduced using a construction environmental management plan (CEMP) that details good-practice construction methodologies and preventive measures would help alleviate the overall impact upon soils at the site, e.g. separation and storage of topsoil and sub-soils, temporary storage bunds and method statements covering prevention of run-off from spoil heaps.

1.16 Residual Effects

1.16.1 The residual effects from the construction activities affecting the geological and geomorphological features are considered in this section.

Table 1.7: Summary of Potential Residual Impacts

Effect	Mitigation	Assessment of Construction Effects		
		Sensitivity	**Magnitude**	**Significance**
Kettle holes	None – Infilling of the kettle hole or lost due to landscaping.	Low	Major	Not Significant (Minor)
Kettle holes	Construction activities around the kettle hole should adhered to the CEMP	Low	Insignificant	Not significant (Insignificant)
Meltwater channels	Construction of playing fields and other areas of the sports development no mitigation possible	Low	Major	Not significant (Minor)
Glacial terraces	Construction of roads with cut through terrace deposits - No mitigation possible	Low	Moderate	Not Significant (Minor)
Soils	Soils managed under usage and reinstatement plans.	Negligible	Major	Not significant (Insignificant)

1.17 Cumulative Effects

1.17.1 An assessment for cumulative effects for Geology & Soils is considered to be not relevant.

1.18 Summary

1.18.1 The impacts upon Geology & Soils all occur during the construction phase.

1.18.2 An assessment of the impacts / effects on the geological and geomorphological features of the site for the proposed An Camas Mòr development, demonstrates that the overall significance of the effects of the development to be Insignificant or Minor, these effects are not significant.

1.18.3 It has been proposed that the 'kettle hole' features within the site would be left intact, forming natural landscape features within the development. Therefore, the impact upon these features is considered to be Insignificant, i.e. not significant.

1.18.4 The remaining features comprise glacio-fluvial terrace deposits and evidence of meltwater channels (only visible from aerial photographs). These features are also considered to have Low sensitivity due to their common occurrence in the Aviemore area.

1.18.5 The effects of construction impacts upon the topsoil and sub-soils within the site can be reduced using a construction environmental management plan (CEMP).