Trump International Golf Links
SCOTLAND

Dr. Tom Dargie
Boreas Environmental Consultancy

Main Precognition

Golf & Leisure Resort

Menie Estate, Balmedie, Aberdeenshire



Public Inquiry

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1.0 Introduction

1.1 My name is Thomas Dargie. I hold the degrees of Bachelor of Science (Botany and Geography) from the University of Hull and Doctor of Philosophy (Plant Ecology) from the University of Sheffield. I have a Diploma in Vegetation Survey from the International Training Centre for Aerial Photography and Remote Sensing (ITC) in the Netherlands. I am a Member of the Institute of Ecology and Environmental Management (IEEM) and a Chartered Environmentalist.

1.2 I have had two professional careers. I lectured in Ecology, Biogeography and Biological Resource Management in the University of Sheffield from 1971 to 1989. In that period I was also Visiting Professor (Adjunto IV) in the Federal University of Minas Gerais, Belo Horizonte, Brazil during 1986. I taught Ecological Impact Assessment in the University of Dundee and the Centre for Environmental Management and Planning in the University of Aberdeen in the early 1990s.

1.3 I have been a self-employed ecologist since 1988. I am based in Sutherland. I trade either under my own name or as Boreas Ecology which is a joint partnership with Monica Dargie. In the UK I have worked on coastal ecosystems and peatlands since 1969, the start of my postgraduate career. Abroad, I have researched and published or reported on semi-arid ecosystems in southern Spain, desert environments of the western Sahara and Sinai, monsoon forest in Sri Lanka, savanna and rain forest in Brazil, plus the impacts of illicit drugs cultivation on the montane ecosystems of Colombia.

1.4 I have published 38 peer-reviewed books and academic papers. I have produced, usually as sole contributor, about 60 major grey-literature reports and report sets relating to coastal, peatland and other wetland habitats for UK national conservation agencies. I have produced a further 40 or so major commercial-in-confidence reports to clients in the private sector which relate mainly to ecological management and monitoring. I have contributed habitat chapters or baseline information to approximately 20 environmental statements in Scotland, including that relating to this Inquiry. I am the main author of the UK Machair Habitat Action Plan (HAP) and I have produced a draft local machair HAP for Western Isles Council.

1.5 I have experience of dunes throughout Britain. My first studies were in Northern England between 1969 and 1976, including work for the Nature Conservancy. I surveyed approximately a sixth of all sites in the Sand Dune Vegetation Survey of Great Britain (SDVSGB), a habitat inventory undertaken by the Nature Conservancy Council (NCC) and later the Joint Nature Conservation Committee (JNCC). I wrote the national SDVSGB volumes for Scotland and Wales. These synthesised site results and were published by JNCC between 1993 and 1995. The work in Scotland was only a sample set of 34 sites. The SDVSGB work was based on draft versions of the National Vegetation Classification (NVC) which were issued in the late 1980s.

1.6 I undertook a near-complete survey of the remainder of dunes and machair in Scotland under contract to SNH between 1994 and 2000. Results were added to SDVSGB results to produce a full national result, the Sand Dune Vegetation Survey

of Scotland (SDVSS). Results were captured as a geographical information system (GIS). The Scottish dune and machair resource totals 50,000 ha. Results are published by SNH as 8 regional reports, each made up of 3 volumes. A national report was also produced synthesising the whole project but this is not easily available. The national report contains an atlas with >500 distribution maps of vegetation types around the coast of Scotland.

1.7 Since 2000 I have undertaken two vegetation mapping and monitoring studies on dunes at St. Fergus, on behalf of the St. Fergus Environmental Management Committee. I have also done further work in England, advising English Nature on the effects and remediation of intensive stock management on part of a Natura site, as well as the implications of vegetation change as recorded between different NVC surveys.

1.8 One site examined for habitat change was Sandwich Bay in Kent (2001), including Royal St George's (site of the British Open Championship in 2002) and two other large golf courses. I have walked and mapped the habitats of every links course in Scotland as part of the SDVSS project. I am therefore familiar with the way links golf courses in Scotland sit within and affect a dune habitat mosaic.

1.9 I have experience of very large habitat mitigation and environmental enhancement projects. I have acted as Project Ecologist (Ecological Clerk-of-Works) for three large wind farm construction projects in Scotland. This work has included the translocation of peat turf and restoration of damaged ground. These sites are regarded by the wind farm industry as examples of good practice. The extent of restored ground is approximately 75 ha, of which habitat translocation amounts to about 50 ha. I have recorded baseline conditions and installed monitoring transects for the three largest damaged raised bogs in England. These very large Natura and Ramsar sites are being enhanced via re-wetting, involving major modification of former peat cutting topography and hydrology. I have monitored the vegetation responses at two of these sites over 10 years for English Nature via quinquennial surveys.

2.0 Knowledge of the Development Site and the Remainder of Foveran Links SSSI

2.1 Prior to the announcement of this development I had visited parts of the dunes between Foveran and Blairton three times.

2.2 In 1994 I briefly checked parts of a 1990 SDVSGB Foveran survey during the time I was undertaking NVC survey of the Sands of Forvie. All ground visited was in the SSSI. I recall finding ground conditions as mapped in 1990.

2.3 In 1999 I quickly checked the 1990 SSSI area again. I noted evidence of stock grazing impacts in the SSSI as I mapped ground to the west outside, within the limit of blown sand. The 1999 work then undertook mapping south of the SSSI and the sector from Menie to Balmedie Country Park was done over two days.

2.4 In 2001 I undertook work recording site condition on sample lines of travel in Foveran Links SSSI. This was part of a SNH project testing condition recording methods for coastal habitats. I wrote the draft methodology for SNH and parts of this approach now make up the JNCC Common Standards Monitoring guidance for sand dune and other coastal habitats (documents T24 and T25). This draft methodology recorded 14 line segments with poor (unfavourable) condition out of a total of 45 recorded, mostly due to the impacts of winter stock grazing. Weedy vegetation made up of indicators of nutrient-enriched ground were locally abundant, with extensive animal dunging and much trampling damage around feeding areas.

3.0 Involvement with the development and my brief

3.1 My involvement with this development has varied. That requires explanation to understand my brief.

3.2 I initially learnt of the development in January 2006 when I agreed to be included in a tender for environmental work as part of an outline application. That bid was unsuccessful. I then contacted SNH coastal advisers. I was particularly worried because scoping opinion issued by Aberdeenshire Council on behalf of SNH made no reference to my 1999 NVC survey work on the east coast of Scotland. It appeared that SNH in Aberdeen only held information on Foveran Links SSSI and that was probably out of date (field survey in 1990, based on 1976 air photos, document T21).

3.3 I expressed my concern regarding the development in an e-mail to the SNH Area Manager and Area Officer in Aberdeen on 17th April 2006. I made them aware of the importance, to my mind, of the habitats south of the Foveran Links SSSI. I quoted the final paragraph of my 2001 SDVSS East Coast report to SNH for the sector Newburgh to Bridge of Don: "In addition to designated land at Foveran Links SSSI, much land in this site is of very high nature conservation interest. The mobile dune environments, acidic grasslands and acidic slacks are all notable. The conditions determining their distribution and quality are not replicated elsewhere in Gordon and every attempt should be made to keep existing semi-natural conditions in their present form and dynamism." I also suggested that this coastal stretch is probably the most dynamic set of dunes in Britain and that golf development was a very significant threat to site geomorphological and ecological integrity. I provided SNH with a coloured simplified habitat map of the coast, based on my own geographical information system (GIS) data.

3.4 I was approached in May 2006 by the environmental team working for the applicant. I was asked to undertake a full NVC survey of the development area. I made my views on the development clear to the team and the applicant. I asked the applicant to move the course inland, away from the SSSI and other dunes. It was explained that earlier work had considered but rejected this. The applicant required the dune ground due to its outstanding potential for a golf course.

3.5 I agreed to assist the project by providing habitat information and advice on its use for minimising the impacts of the development, in terms of routing and mitigation. In June 2006 I was asked to join the environmental team working with the golf course designer, Tom Fazio II. I then attended meetings involving SNH and later was asked to write material on the habitats and flora of the area for the project environmental statement (CD-G3). Since January 2008 I have been involved in several days of meetings and field discussion with the present course designer, Martin Hawtree, and his staff. This work has focussed on habitat and species mitigation for the revised course.

3.6 My brief throughout has been to provide, explain and use habitat information. Use of habitat data has included informing the course designers on areas which should be avoided if possible because it is of high nature conservation interest . I have explained to the applicant the reasons for deciding that much ground is high interest. I have also identified ground, of lower interest which could be used as part of mitigation. I have provided the applicant's teams with details of the direct impacts of the development upon habitats and species, in relation to an evolving course design.

3.7 I have also maintained a rare species database for notable plants found as part of habitat survey. This includes lichen information collected by national specialists. This information has also been included in information on ground best avoided by golf development. I have kept Aberdeenshire Council's ecological consultant aware of most rare plant discoveries as soon as they have been found.

3.8 The views given in this evidence are those of an independent consultant with a remit to undertake an impartial ecological assessment of the proposed Trump International Golf Development at Menie, Aberdeenshire. The evidence conforms with the Code of Professional Conduct set by the Institute of Ecology and Environmental Management.

4.0 Scope of Precognition

4.1 The remainder of this precognition explains what I have done with my brief. This covers four components. Each component includes a focus on Foveran Links SSSI, to assist the Reporter in forming an opinion on likely impact on the SSSI.

4.2 My first component addresses the habitat and species baseline assembled as part of environmental work for the application. This covers the aims, methods and results of the habitat survey, including its validation and update of information. I show that soil and vegetation character at Menie is controlled by gradients of acidity and wetness, as a product of dynamic interplay between geomorphology, soil wetness, habitat succession and soil development over time. I also demonstrate that site management is a very strong modifier of the more natural processes, particularly within the southern part of the Foveran Links SSSI.

4.3 My second component addresses the valuation of habitats and species. This translates the habitat NVC information into types which are covered under Annex 1 within the EU Habitats Directive (CD-F2). I put the habitat and species information into local, regional and national context. I make a case that ground south of Foveran Links SSSI is also of SSSI quality. I assess the condition of habitats within the southern part of the SSSI and conclude that it is unfavourable declining, with important interest features almost eradicated due to inappropriate land management. I emphasise that, within the development area, dune ground south of the SSSI is in better condition than the more stable parts of the SSSI. There is also reference to the Foveran Links Site of Interest to Natural Science (SINS).

4.4 My third component examines the direct impacts of the golf development as so far evolved. There is a limited discussion of indirect effects. It includes reference to the effects of the course as submitted in the environmental statement. It provides information on the latest course design. I discuss the main changes in effects between the two course designs. I then assess the significance of the direct effects and state why these matter in a nature conservation context. This material is covered for different sectors of the development. Foveran Links SSSI is emphasised but land to the south is also included as a separate entity. I also mention the Foveran Botanical SINS. I also make reference to impacts on rare species and areas of lichen interest.

4.5 My fouth component addresses mitigation of direct and indirect effects. I show that sufficient ground of moderate or low interest is available on blown sand soils for full mitigation of direct effects, as long as mitigation techniques are successful. This ground of restricted habitat interest is distributed within and outside the SSSI. I conclude that successful mitigation is achievable via MEMAG. I estimate that translocation will be about 65% successful in the short term (1-5 years) and nearly 100% successful in the medium to long-term following further remediation. This will reduce the significance of direct impacts on habitats from severe adverse to minor adverse for the SSSI and blown sand ground outside. Continued sensitive management for golf and nature conservation could then result in sustainable key dune habitats, albeit with changes to the balance between types and an artificial component to their distribution in the development area. I emphasise that sustainable habitats will need careful long-term management to avoid adverse medium and long-term indirect effects.

5.0 The habitat and Species Baseline

5.1 My initial brief was to provide a habitat map of the development site for use by the applicant and the environmental team assisting with the planning application. The specification required survey using the National Vegetation Classification (NVC). Standard practice, especially the approach to identifying NVC types encountered in surveys, is given in document T38.

5.2 The NVC was the main recording system but areas of Menie Estate away from the dunes have non-NVC habitat (e.g. arable ground) and a different mapping classification was used (the JNCC Phase 1 Habitat Survey), plus types used in the Aberdeenshire Integrated Habitat Survey system. Parts of the dunes have been modified by forestry and this was recorded using the Phase 1 method. I discuss only the NVC work at this Inquiry.

An outline of habitat classification in the NVC system

5.3 The NVC is the official UK classification of natural and semi-natural vegetation types. Its development and publication took 25 years from inception in the mid-1970s to production of the last of five books in 2000. It was initiated by the Nature Conservancy Council and completed by the Joint Nature Conservation Committee (JNCC). The JNCC has responsibility for its maintenance and further development.

5.4 Drafts for individual NVC habitats (e.g. woodland and scrub, mire, heath, sand dune and shingle) were issued in the late 1980s. A draft similar to the published version for sand dune and shingle was issued in 1989 and used by the SDVSGB for site survey, including Foveran Links SSSI in 1990 (document T21). The full supporting text and final allocations of numbering and names were published in 1991 (mires and heaths, including dune heath, document T35) and 2000 (sand dune and shingle, document RSPB 28. There are small disparities in codes and names between the NVC drafts and the final published versions of the NVC. These disparities affect NVC mapping for Foveran Links SSSI in document T21.

5.5 The NVC uses a four tier hierarchical classification to describe British vegetation. The upper tier covers major habitat types which are indicated by a one or two letter code. Habitats at Menie include the following types: H Heaths; M Mires; MG Mesotrophic (neutral) grassland; OV Vegetation of open ground; U Calcifugous (acidic) grasslands and montane communities; S Swamp and tall-herb fen; SD Sand dune and shingle; SM Saltmarsh; W Woodland and scrub.

5.6 Each of these habitats is then divided into a set of communities as the second tier. Each community is numbered and accompanied by one or more Latin names for their most characteristic species, sometimes with a brief name describing habitat character. An example is SD6 (Marram Grass) *Ammophila arenaria* mobile dune.

5.7 A community can then be divided into sub-communities. A sub-community is allocated a small case letter and named after its most characteristic species. An example is SD6e *Ammophila arenaria* mobile dune, (Red Fescue) *Festuca rubra* sub-community. Many communities are not divided into sub-communities.

5.8 A few sub-communities are further divided into variants, the fourth and lowest hierarchical level. These do not apply at Menie and are not discussed further.

Presenting habitat data to the Inquiry

5.9 The published NVC system contains 286 communities and approximately 560 sub-communities. This is a complex system for non-specialists to understand. The shorter list of all types present at Menie is still long. I therefore avoid use of the full numbering and names for NVC types found at Menie in this precognition. Instead, I use more general habitat names to describe the vegetation and ecology of Menie dunes. These names are: strandline and outer foredune; mobile dune; dune slack; fixed dune grassland ('grey dune'); dune heath; swamp, standing water and running water; wet grassland and flushes.

5.10 Strandline and outer foredune includes the NVC communities SD4 and SD6. This habitat zone occurs on the highest beach levels and outer dune face, with only a slight extension inland beyond the outer dune crest. It receives sand blown up the beach onto the coastal foredune.

5.11 Mobile dune includes SD6 which is usually made up of pure Marram and includes bare moving sand on the Menie sand sheets ('domes') and marginal areas. This category represents rapidly changing ground caused by the dynamics of blown sand away from the coastal edge, marking internal re-distribution of sand.

5.12 Dune slack covers SD13 and SD16. A dune slack is a depression within sand hills, often with the floor under the influence of the dune watertable. At Menie dune slacks mark ground which has had dry sand blown away until wet sand is exposed, preventing further sand removal. The floor of the depression can be flooded in winter but is usually dry or damp in summer. Young dune slack has a very varied amount of plant cover. Older forms which are wet can have a high cover of mosses. Mature slack is dominated by Dune Willow *Salix repens* and there are transitions to wet dune heath in the oldest areas, with much Crowberry *Empetrum nigrum*.

5.13 Fixed dune grassland ('grey dune') covers SD12, some OV27 and perhaps small amounts of SD11. Sand sedge *Carex arenaria*, Common Bent-grass *Agrostis capillaris* and Sheep's Fescue *Festuca ovina* are typical species. A high lichen cover is found in some areas. These areas mark ground receiving little or no blown sand, with a stable surface, allowing a more species-rich dune turf to develop compared with mobile dune conditions.

5.14 Dune heath is equivalent to H11. It refers to ground dominated by heath species, with Crowberry *Empetrum nigrum* commoner than Heather *Calluna vulgaris* at Menie. It forms on former fixed dune grassland areas once soils conditions are sufficiently acid, or as a result of the heath species acidifying the soils themselves.

5.15 Swamp is represented mainly by S5 but also includes a Soft Rush *Juncus effusus* type which is not described in the NVC. The S5 Sweet Grass *Glyceria maxima* type is an indicator of higher nutrient status and occurs around and in permanent streams passing through the Menie dunes. These waters are probably carrying increased nutrients from agricultural land inland.

5.16 The category Wet grassland and flushes covers MG10, MG13 and M23 NVC types. These include Soft Rush grasslands and areas with Creeping bent-grass *Agrostis stolonifera* and Silverweed *Potentilla anserina*. These vegetation types are often

indicators of past disturbance (e.g. ditching) and the more extensive areas at Menie might represent ground which was once cultivated.

5.17 Samples representing sub-communities and possible new NVC types mapped at Menie are given in Appendix 7-1 of the EIA (CD-G3).

5.18 The fixed dune habitat ('grey dune') type needs further definition. The term 'grey dune' is usually used here in the same sense as vegetation covered by the definition for the category 2130 Grey Dunes (*Priority) in Annex 1 of the Habitats Directive (CD-F2). For the Atlantic biogeographical region, this type covers all dry dune grasslands which are not part of mobile dune complexes which belong to the Annex 1 type 2120 White Dunes (Mobile dunes). It includes fixed and semi-fixed calcareous, neutral and acidic dune grasslands (SD7, SD8, SD9, SD11 and SD12 in the NVC).

5.19 There is an alternative use of the term 'grey dune' which has a long history in descriptive British and Dutch dune ecology. It refers to fixed dune grassland with a high cover of grey-coloured lichen, usually from species of the genus *Cladonia*. This is probably covered by only one NVC type (SD11). The British definition is therefore much narrower than the Habitats Directive. The status (distribution and extent) of the NVC SD11 type in Britain is uncertain and has been subject to recent research (document T36). The published SD11 NVC account (RSPB document 28) places it mainly on the coast and on the inland palaeodunes of Breckland in East Anglia. There are two outliers, one in Kent and one, well distant, in North-east Scotland (probably Sands of Forvie). The alternative use is not used here unless discussing the recent research (document T36).

5.20 This use of habitat names follows a similar approach used in the EIA (Section 7.3.2, document CD-G3). I am content to discuss the NVC types in detail under cross-examination.

5.21 The NVC types, their 2006 mapped distribution, extents, supporting data and accounts of their ecology are given in the applicants EIA (CD-G3): Chapter 7 (Section 7.3.2, Figure 7.3) and Appendix 7-1.

Productions supporting this precognition

5.22 My precognition material on habitats is supported by two productions (documents T4 and T50) which update and explain in more detail information included in the EIA (CD-G3).

The content of Production T4

5.23 The habitat content in T4 contributes to the revised Hole-by-Hole Analysis submitted to the Inquiry. It includes Tables 1 to 7 which summarise the impacts on Menie dune habitats of golf development, concentrating on the Hawtree Course (Document T2). Tables 1 to 6 include habitat extents for ground before development. Tables 1 to 3 inclusive give totals for ground with blown sand soils in the development area. Table 4 gives habitat totals for Foveran Links SSSI, based on digitised GIS data taken from the 1990 NVC survey (document T21), together with NVC habitat data for the Menie dunes sector of the SSSI based on survey in 2006 and amendments in 2008. Table 5 gives habitat details for the Menie dunes sector of Foveran Links SINS, based on 2006 and 2008 work. Table 6 gives habitat details for Menie dunes south of the SSSI and SINS sectors. All extent data are derived from GIS datasets. Data on likely direct

impacts for golf development were obtained by GIS overlay analysis using a digital version of the Hawtree Course (T2).

The content of Production T50

5.24 Production T50 first divides survey ground into several components, concentrating on habitats which are present on wind-blown sand. It then gives details on survey methods for the Menie work and earlier studies.

5.25 Document T50 reviews the accuracy of Menie habitat work, including data capture as mapped boundaries and the identification of NVC types. This is necessary to be confident on the amount and types of ground which will be affected by the development. A standard practice method for deciding NVC type is given in document T38 but this cannot be applied to all types recorded and mapped at Menie.

5.26 Document T50 explains why habitat survey of sand dune vegetation in Scotland has to use non-standard methods for deciding on the NVC status of some vegetation types. The NVC system is not fully comprehensive and there are types of vegetation on dunes in Scotland which are not described in the published system. Some of these types are acknowledged in a review of NVC coverage (document T37). The full set of potential new types is described in document T29 and samples for each new type are given in the regional reports of the SDVSS.

5.27 Document T50 includes reference to other sources which have used non-standard methods to identify NVC type from surveys samples. T50 cautions against using a method published by RSPB (document T52). This has been used to attack NVC survey results from the Western Isles. T50 stresses that the RSPB technique could undermine the credibility of the UK NVC system. It refers to a detailed rebuttal of the RSPB case (document T19) which demonstrates errors and very serious flaws in the method of RSPB's expert. It is essentially a non-quantitative method based on a species selection process which ignores key species groups which underpin the NVC classification. T19 also discusses difficulties in using standard practice to decide the NVC type of samples. The difficulties relate to vegetation types which have not been included in the published NVC set.

5.28 Menie sample data for key NVC types is then assessed for accuracy using a non-standard method. This allows potential new NVC types to be objectively compared with published NVC types using all species in samples and the NVC tables. The non-standard method in T50 is based on UK-wide studies by the Countryside Council for Wales (CCW) on 'grey dune' (*sensu* lichen-rich grassland) and heath (document T36). The CCW work examines the status of lichen-rich dune grassland (NVC SD11) in NVC surveys. The T50 method extends the CCW approach, explaining the underlying soil gradients which relate to CCW samples, before using it to assess the accuracy of Menie NVC determinations.

5.29 Document T50 also discusses scrutiny of Menie habitat data by SNH. It presents a revision of the 2006 habitats baseline which corrects some 2006 errors identified by SNH. A revised NVC habitat map is included in the document at two scales: all of the development area and an enlargement restricted to Foveran Links SSSI and Foveran Links SINS.

Habitats and soil gradients at Menie

5.30 The work in document T50 demonstrates several important points regarding the ecology of Menie habitats and their interrelationships. This supplements information and interpretation in section 7.3.2 of the applicant's EIA (CD-G3). It is relevant in considering the nature conservation value of Menie habitats and mitigation of development.

5.31 T50 analysis places Menie samples for dune heath, dune grassland and dune slacks on gradients representing soil acidity and soil wetness. This is illustrated in Figure 2 of document T50. The gradients are objectively derived using species scores for acidity and wetness which are published for the United Kingdom (document T34). These two gradients appear to be the major controls of variation in Menie dune vegetation.

5.32 Referring to published NVC types, Menie samples for dune grassland and dune heath vegetation fit the range of acidity and wetness conditions occupied by the published types. This probably confirms correct identification.

5.33 Menie samples for potentially-new NVC types are mainly displaced from gradient positions for published NVC types. The direction of displacement fits their differences from the published NVC and supports their allocation to likely new NVC types.

5.34 Slack samples are a poorer fit with published NVC slack types. Menie samples are displaced towards more acidic soil conditions and this is understandable. The published NVC slack types are taken from sites in England and Wales which have sands with a higher shell carbonate content than the Menie site. No Scottish samples are included in the published NVC data.

5.35 Dune slacks at Menie are separated in the EIA (CD-G3), document T4 and document T50 into two types: SD13 young dune slack and SD16 mature slack. These overlap in Figure 2 of T50. There is also notable overlap for published NVC slack types. This poor discrimination in relation to soil wetness and acidity simply reflects the absence of a third dimension, successional time, on which these two types would be clearly separated.

5.36 Menie samples for dune grassland, dune heath and more mature slack vegetation are distributed mainly along the acidity gradient of T50 Figure 2. There are two important displacements in relation to moisture. A grassland type with high lichen cover occurs in drier conditions, but it is usually not sufficiently dry to represent the main lichen-rich dune NVC type (SD11). This type represents the driest grassland conditions found at Menie. A dune heath type found on dune slack floors is generally notably wetter than dry dune samples and seems to have been derived by habitat succession from an acidic form of dune slack.

5.37 There are two near-parallel lines of Menie samples for dune grassland, dune heath and more mature slack in T50 Figure 2. Each represents a time trend in which soils become more acidic as they age. The lower line (from SD7 semi-fixed dune to H11 dune heath) represents a sequence on dry dunes. The upper line (from SD16x acidic slack to H11 wet dune heath) represents a sequence on the higher floors of Menie dune slacks, probably for habitats which are rarely flooded but dry out in the summer. Each line is a separate trend, sloping upwards from right to left. This probably reflects

increasing organic matter over time, which will increase soil water retention and soil acidity due to humic acid production. The upper line scatter shows higher moisture in slacks and probably also reflects an increased rate of organic matter accumulation.

5.38 There is not a clear link between the age of slack (young, mature) and soil acidity in Figure 2 of T50. Soil acidity in slacks at Menie may be controlled by water quality (cation content), with the wetter slack samples showing least acid soils. This suggests a different sequence of soil changes over time in dune slacks after initial stabilisation.

5.39 To summarise Figure 2 of T50, it demonstrates a strong relationship between vegetation samples, NVC types and soil acidity – wetness gradients. Three sets of different trends are present in Menie vegetation: a dry dune sequence; a parallel but wetter sequence on the higher margins of mature slacks which are rarely flooded, involving the development of dune wet heath; and, finally, trends in slack floors subject to winter flooding.

5.40 The trends are the result of two sets of contrasting processes: surface instability and surface stabilisation. Surface instability is driven by dynamic geomorphology which creates and maintains young dune soil types above the beach and in internal areas of mobile dune. Surface stabilisation covers vegetation and soil changes which occur once blown sand no longer affects an area. Increased soil acidification and organic matter development are therefore important trends after a surface is stabilised, with distinct wet and dry sequences now known for Menie.

Habitat gradients and vegetation zonation at Menie

5.41 The two processes of surface instability and surface stabilisation generate the range of acidity and wetness conditions which are summarised in Figure 2 of T50. Those conditions in turn are responsible for the vegetation zonation and habitat mosaic at Menie, as summarised by the habitat maps in T50. I turn now to the distribution of habitats at Menie, as they reflect geomorphology and the different conditions created during stabilisation.

Surface stabilisation and the habitat mosaic on dry sand

5.42 Dry blown sand above the beach strandline is usually stabilised initially by Marram Grass. Young mobile dune vegetation (SD6) with near-neutral or alkaline soils is maintained in two locations by fresh sand deposition. The first is the outer foredune ridge and for a short distance inland. This is rapidly stabilised and either moves directly into SD12 acidic dune grassland or passes through a narrow SD7 semi-fixed dune zone. There is little shell carbonate in most Menie soils and this explains the rapid switch to acidic dune grassland types when walking inland from the foredune ridge. This zone is therefore mainly confined either to the coastal edge of the dunes. The second type of location is patchy on or around the edges of the large sand sheets ('domes') present at Menie. The mobile dune vegetation zone encircles the southern sand sheet at Blairton but is more discontinuous around the two northern sand sheets.

5.43 There is usually a rapid switch to fixed acidic dune grassland at Menie, once blown sand deposition is negligible. The fixed acidic dune grasslands contain their own subtle acidification sequence and four types are recognised (three are not included in the NVC), together with mosaics containing both acid grassland and dune heath.

5.44 The least acid grasslands have a high Marram *Ammophila arenaria* cover and these usually occur immediately inland of the outer coastal dune ridge. This is best seen in the centre of the Menie site. In the south of the site, on tall dunes recorded by specialists as important for lichen interest, there is an excellent mosaic of lichen-rich grassland and young dune heath establishing as circular patches of colonising Crowberry *Empetrum nigrum*. Both habitats still have plentiful Marram. These represent the next two stages of acidification on very dry dunes at Menie. A further acidic dune grassland type is present in the south, on the western side of blown sand, with abundant Wavy Hair-grass *Deschampsia flexuosa*. This probably represents the most acidic type of dune grassland which can develop at Menie. It is separate from other types, west of H11 dune heath with mature Heather *Calluna vulgaris*. It is possible that it marks a former area of heath that was burnt in the past by a very hot fire, killing the Heather and allowing Wavy Hair-grass to become dominant with some Marram.

5.45 Further north (NJ986204) dune relief is very subdued and fixed acidic dune grassland is present with little Marram. Vegetation here is very similar to the published NVC, but grassland in hollows is slightly under the influence of the watertable and samples are wetter than NVC variation which is mainly taken from warmer and perhaps drier sites in England and Wales. Vegetation here is the wettest type of fixed dune grassland at Menie.

5.46 SD12 acidic grassland similar to the NVC also occurs in the north of the site on much steeper dunes, within Foveran Links SSSI. This probably represents the Marram Grass *Ammophila* variant, with most Marram now removed by winter stock grazing, probably within the last decade.

5.47 Dune heath at Menie (H11 vegetation) spans quite a range of soil acidity. The least acidic samples are placed in acidic fixed dune and represent grassland under initial invasion by heath shrubs. This is almost always invasion by Crowberry. In general Heather at Menie has much reduced frequency and cover compared to the published NVC, except for mature stands in the south. Crowberry grows in circular patches which eventually coalesce.

Surface stabilisation and the habitat mosaic on wet sand

5.48 The movement of the northern and southern sand domes maintains large quantities of mobile dunes further inland. The progressive northward movement of the northern sand sheet inundates and kills vegetation along its northern front but leaves a zone of bare wet sand in its rear. Stabilisation here occurs on wet ground.

5.49 This wet ground is progressively colonised by SD13 young slack, with the speed and detailed species content varying considerably with surface wetness and surface character. This partly explains the great spread of SD13 samples in Figure 2 of T50. Some young slack surfaces are very dry and formed on glacial till rather than sand, exposed after sand removal by wind.

5.50 The young slack surface is invaded by Dune Willow *Salix repens* and on drier ground by Crowberry too. These expand as circular patches, eventually coalescing as a more uniform dwarf shrub cover to the surface, forming a mature dune slack. There is a considerable seasonal litter drop by Dune Willow and this assists organic matter accumulation in the soil. There is not a strong layer of typical dune slack mosses under these shrubs at Menie and the scattered but low cover of Fog Grass *Holcus*

lanatus suggests that the vegetation at this stage is best placed in the NVC SD16 type, as mature dune slack.

5.51 Dune Willow remains dominant on ground which is wet (but not flooded) all year or is flooded in winter. Crowberry becomes dominant on higher ground in slacks, colonising in circular patches in the same manner as in dry dune heath. Four-leaved Heath *Erica tetralix* then enters as the surface becomes more acidic on ground which was formerly mature slack. This is therefore a wet heath form which is only weakly shown in the published NVC. The dunes at Menie also have many small patches of tall willow scrub, forming a slack wet woodland habitat which is quite rare in Scotland. Most is found in the older slacks which contain wet dune heath.

5.52 Habitat change in dune slacks and dry dune environments following stabilisation of earlier dynamic surfaces is termed a primary succession in plant ecology and Menie provides excellent examples of wet and dry sequences which are called a psammosere in classical ecological literature.

The condition of habitats in Foveran Links SSSI

5.53 The 1990 habitats of Foveran Links SSSI are briefly described in document T21. The extents represented by the vegetation map in T21 are listed in Table 4 of document T4, together with habitat extents mapped in 2006. The area is dominated by bare mobile sand in the south, with good extents of mobile dune vegetation and a notable area of young dune slack in 2006. The northern sections are dominated by acidic fixed dune grassland and mature dune slack.

5.54 Surface stabilisation and soil development are not the only causes of habitat change at Menie. There is strong evidence for extensive change due to land management in the Menie sector of Foveran Links SSSI.

5.55 The northern parts of the Menie SSSI sector show, in certain habitats, clear change from habitats mapped in a 1990 NVC survey (document T21). These areas of change seem unaffected by blown sand from the northern ‘dome’, although that is responsible for other habitat loss further south, including wet dune heath.

5.56 Eight examples of habitat change, referring to complete polygons mapped in 2006, are given in Table 3 of document T50. Three polygons (total area 4 ha) show a change from what was probably a wet variant of H11 dune heath to SD16 dune slack. The H11a mapped in T21 is in fact H11b, due to a change in sub-community code in the final NVC publication. Grazing seems to have been responsible for this change, increasing nutrient levels and perhaps reducing acidity as a result of winter feeding, allowing Dune Willow to replace Crowberry and Heather. Some of these changes were reported to SNH in 2001 as part of testing site condition monitoring procedures.

5.57 Two patches (area 2.4 ha) of former SD12 fixed dune grassland have been completely destroyed and changed to weed-dominated ground due to dunging, trampling and nutrient inputs from winter feeding of stock. There is also extensive damage to fixed dune vegetation on steep slopes from animal trampling, and frequent vehicle tracks marking access for winter feeding. I have already indicated that I suspect that stock grazing has removed much Marram Grass from the fixed dune grassland on steep dunes around slacks within the SSSI.

5.58 Tree planting was recorded in 2006 on the northern boundary of Menie ground. Elsewhere pond excavations had taken place to create duck shoots, all since 1990 survey. These operations should have required permission from SNH.

5.59 The losses of dune heath as a result of excessive winter grazing are of a larger magnitude than dune heath losses to burial by blown sand. Together, these losses have reduced dune heath cover in the SSSI to almost nothing. A total of 4.3 ha of dune heath was recorded in 1990 in the SSSI, all of it in the Menie sector. Only 0.1 ha was recorded in 2006.

5.60 The eight examples of vegetation change are material evidence of unfavourable condition of the Menie sector of Foveran Links SSSI. The scale of change due to excessive winter feeding of stock is probably sufficient to be classed as unfavourable declining and even partly destroyed, using JNCC Common Standards Monitoring Guidance (document T25).

The condition of ground in Foveran Links SINS

5.61 The SINS area suffers the same problems as the SSSI and the northern grazed Menie sector of the SINS can be considered to be in poor condition.

The condition of ground outside SSSI and SINS

5.62 Ground south of the SSSI and SINS sectors is in generally good condition, due to lack of winter stock grazing and supplementary feeding. There has been habitat damage from an excessive number of vehicle tracks to help service bird breeding pens in the recent past. Shooting from fixed positions for several years has also concentrated shot, some of it lead. There are probably patches of lead-polluted soil in this sector.

Species interest

5.63 Document T50 updates information on plant species data for the survey area. Table 5 in T50 gives the status of higher plants based on the Scottish Biodiversity List (CD-F6) and SNH Species Conservation Framework (CD-F7).

5.64 One species of higher plant is of uncertain taxonomic status. Early Marsh-orchid, *Dactylorhiza incarnata*, was recorded in sample records for Menie vegetation. Its identification was based on flowers which were largely spent and it is possible that it is another orchid species. Two subspecies of *D. incarnata* are regarded as nationally important. The areas where the records were made will be searched again to determine the species, and the subspecies if necessary.

5.65 The plant species information is probably incomplete for bryophytes (mosses and liverworts). A survey has been commissioned and will probably take place in mid-June. Information from this will treated in the same way as other species information. A report is not expected before the end of June 2008. This survey follows 2007 advice from Aberdeenshire Council based on SNH opinion. The bryophyte survey was not included initially because it was not in the original scoping response from Aberdeenshire Council.

6.0 The valuation of habitats and species

6.1 This section considers the nature conservation value of habitats and species. It updates information provided in the applicant's environmental statement (Section 7.3.10 in CD-G3).

6.2 Habitat interest is estimated here using types which are covered under Annex 1 of the EU Habitats Directive (CD-F2). This requires NVC types to be placed into the correct Annex 1 type.

6.3 I make the following groupings for NVC sand dune communities: 2120 White dunes (mobile dunes = SD5, SD6, SD10 plus bare mobile sand); 2130 Grey dunes (*Priority = SD7, SD8, SD9, SD11, SD12); 2140/2150 Decalcified fixed dunes (*Priority) (dune heath = H11); 2190 Humid dune slacks (SD13, SD14, SD15, SD16, SD17).

6.4 I have calculated the following extents for these habitats in the development area (rounded here to hectares), using GIS data for NVC mapping: 2120 White dunes 68 ha; 2130 Grey dunes (*Priority) 76 ha; 2140/2150 Decalcified fixed dunes (*Priority) 16 ha; 2190 Humid dune slacks 13 ha.

6.5 I have calculated the following extents for these habitats in the development area outwith the SSSI and SINS sector (rounded here to hectares), using GIS data for NVC mapping: 2120 White dunes 33 ha; 2130 Grey dunes (*Priority) 57 ha; 2140/2150 Decalcified fixed dunes (*Priority) 15 ha; 2190 Humid dune slacks 3 ha.

6.6 I have calculated the following extents for these habitats in the Foveran Links SINS area (rounded here to hectares), using GIS data for NVC mapping: 2120 White dunes 28 ha; 2130 Grey dunes (*Priority) 26 ha; 2140/2150 Decalcified fixed dunes (*Priority) 1 ha; 2190 Humid dune slacks 11 ha.

6.7 I have calculated the following extents for these habitats in the Menie sector of Foveran Links SSSI (rounded here to hectares), using GIS data for NVC mapping: 2120 White dunes 26 ha; 2130 Grey dunes (*Priority) 18 ha; 2140/2150 Decalcified fixed dunes (*Priority) trace only ha; 2190 Humid dune slacks 9 ha.

6.8 I have calculated the following extents for these habitats in Foveran Links SSSI (rounded here to hectares), using GIS data for 1990 NVC mapping: 2120 White dunes 74 ha; 2130 Grey dunes (*Priority) 32 ha; 2140/2150 Decalcified fixed dunes (*Priority) 4 ha; 2190 Humid dune slacks 1 ha.

6.9 I have calculated the extents for these habitats (rounded to hectares) in the SDVSS site Newburgh to Bridge of Don based on data in document T33: 2120 White dunes 181 ha; 2130 Grey dunes (*Priority) 328 ha; 2140/2150 Decalcified fixed dunes (*Priority) 33 ha; 2190 Humid dune slacks 14 ha.

6.10 I have calculated the extents for these habitats (rounded to hectares) in the SNH Natural Heritage Zone North East Coastal Plain, to represent regional extent (based on data in document T29, Appendix 5): 2120 White dunes 405 ha; 2130 Grey dunes (*Priority) 1180 ha; 2140/2150 Decalcified fixed dunes (*Priority) 272 ha; 2190 Humid dune slacks 64 ha.

6.11 I have calculated the extents for these habitats (rounded to hectares) for all of Scotland, to represent national extent (based on data in document T29, Appendix 5): 2120 White dunes 1844 ha; 2130 Grey dunes (*Priority) 12065 ha; 2140/2150 Decalcified fixed dunes (*Priority) 1093 ha; 2190 Humid dune slacks 1203 ha.

6.12 I have determined the level of nature conservation interest for each Annex 1 habitat in each of the following areas: Foveran Links SSSI (based on 1990 mapping); Menie sector of SSSI; Foveran Links SINS; Menie Development Area outwith SSSI-SINS; and Menie Development Area.

6.13 I have assessed the level of interest to be one of the following: local, site level, regional level, national level. I have used a threshold value to determine which class of interest is appropriate. That threshold is a value of 1% or more, dividing extent in the area (e.g. Foveran Links SSSI) by extent in the SDVSS site (Newburgh to Bridge of Don), extent in SNH Natural Heritage Zone and extent in Scotland. Each of these calculations is therefore a 'test' to assess if an important proportion is present.

6.14 The 1% value is an analogue to the 1% of national breeding or wintering bird population used to determine Special Protection Area status under the EC Birds Directive. This seems appropriate, given that sand dunes are highly rated (it is the subject of local and national Coasatl Sand Dune Habitat Action Plans which are identical) and the importance of an individual area can be calculated accurately using SDVSS data for sites, regions and all of Scotland.

6.15 If the result of these calculations is a value of 1% or more for each of the site, regional and national 'tests', the level of interest is considered national. If the result is a value of 1% or more at site and regional levels, but <1% at national, the level of interest is considered regional. If the result is only >1% at SDVSS site level, interest is site-level. A result <1% in all 'tests' indicates only local interest.

6.16 My findings are as follows.

6.17 2120 White dunes: This type has National level of interest for all areas tested, including all of Foveran Links SSSI.

6.18 2130 Grey dunes (*Priority): This type has Regional level of interest for all areas tested, including all of Foveran Links SSSI.

6.19 2140/2150 Decalcified fixed dunes (*Priority): this type has highly varied findings. Foveran Links SSSI in 1990 held Regional interest. The Menie SSSI sector held only local interest on the basis of 2006/2008 data and that is the likely result for the complete SSSI in 2008 too. This is due to the loss of dune heath to a combination of inundation by mobile dunes and transformation to dune slack as a result of excessive winter grazing and supplementary feeding of livestock. The SINS is of Site-level interest. The development area outwith SSSI – SINS ground is of National interest. The development area as a whole is of National interest.

6.20 2190 Humid dune slacks: this type has highly varied findings. There was little dune slack mapped in 1990, producing only Site-level interest for all of Foveran Links SSSI. Interest is Regional for the Menie sector of the SSSI (and hence the full SSSI) using 2006/2008 data. It is also Regional for the SINS and the development area outwith SSSI and SINS. However, National level interest applies to the entire development area.

6.21 I consider these results important. They identify 2120 White dunes of National importance in all tests. 2130 Grey dunes are of Regional importance in all tests. 2140/2150 Decalcified fixed dunes and 2190 Humid dune slacks show more varied interest, and are weakest within Foveran Links SSSI. The best overall rankings of importance apply to the development area, either as a whole or south of the SSSI/SINS sector. This agrees with the judgement of the author expressed following survey in 1999 (document T33), as well as the finding in the 2007 environmental statement (CD-G3) that ground south of the SSSI was also of SSSI quality on biological grounds.

Distribution of ground of nature conservation interest

6.22 Habitat tables produced for Hole-by-Hole Analysis (T4) aggregate habitat types into three groups: Key dune habitats (major dune interest, high nature conservation interest), other habitats of moderate interest and other habitats of low interest. The high interest category contains NVC types which all fall within Annex 1 categories of the Habitats Directive.

6.23 These three different categories are mapped in Figure 5 of Production T50. The result shows that ground of high nature conservation interest is very extensive and forms a near-continuous block on the seaward side of the Menie development area.

6.24 The near-continuous block is broken only by tracks and small patches of moderate interest.

6.25 The blown sand interior contains land of low interest in large blocks, including a notable proportion of the Menie sector of Foveran Links SSSI. This area is covered in weedy, ruderal vegetation and results from excessive winter grazing and supplementary feeding of cattle.

6.26 This distribution of interests has implications for mitigation proposals and I refer to this matter later.

Species interest

6.27 The importance levels in Table 7.9 of the 2007 environmental statement (CD-G3) are confirmed for lichens, lichenicolous fungi and fungi.

6.28 I have updated the status and importance ranking of higher plant records Table 5 of Document 50.

6.29 Changes are required to higher plants to bring species into line with the most recent information on status, as given by the Scottish Biodeversity List (CD-F6) and JNCC Taxon Designations (20080415). All four species of higher plant listed in CD-G3 should now be given a national ranking. All are nationally scarce (present in 16 – 100 hectads in Great Britain). Curved sedge *Carex maritima* was also placed on the UK Biodiversity Action Plan list as a Priority Species in 2007 and has been on the Great Britain Red List since 2001 due to its decline in distribution in recent decades. Intermediate Wintergreen *Pyrola media* was made a Species for Conservation Action in 2008.

7.0 Direct and indirect impacts of the development

Direct impacts of the golf development on habitats

7.1 The golf development plan is incomplete. A first course is nearly finalised in terms of all detail and locations for a clubhouse, driving range and putting practice area have been decided (document T2).

7.2 I can only report accurately to the Inquiry on the likely effects on habitats and species of this footprint. Importantly, the T2 footprint, as applied in Foveran Links SSSI, is probably near final. It still requires some small measures to reduce potential impacts on plant species and I have agreed these in outline with staff of Dr. Hawtree.

7.3 Additional golf development will involve a second course, roads, parking, maintenance buildings and the likely stabilisation of a southern sand dome at Blairton, north of Balmedie Country Park. All of this will be outside the SSSI. I have done no detailed analysis for this additional development. However, I estimate that it will be a shorter course with impacts smaller in scale. Overall effects will therefore be smaller than the first course.

7.4 The Inquiry should bear in mind that overall direct effects of the complete scheme within the development area will be less than double the figures I indicate. That doubling applies to all of the development area. However, my figures for Foveran Links SSSI are accurate and no additional development will occur within the SSSI.

7.5 The direct effects of golf development will involve mainly removal of existing dune habitat, followed by its replacement with course components and other infrastructure. The transition rough around fairways is an important course component which will modify existing habitats. Removal of habitat will usually not occur here. Instead, vegetation height will be controlled to provide a playable lie and additional techniques such as patchy scarification applied to maintain or increase plant species diversity.

7.6 Habitat removed from the course will be used for mitigation and I discuss this later.

Direct impacts arising from first course changes

7.7 The original golf course layout (Tom Fazio II layout, T1) was used to assess direct impacts for the initial application in 2007. Total direct impacts of 6.5 ha within Foveran Links SSSI and 15.3 ha outwith the SSSI are recorded in Tables 6.1 and 6.2 of the applicants Response to Aberdeenshire Council and Statutory Consultations (July 2007). The Tom Fazio II layout does not include all detail for a final Masterplan. Paths, semi-rough and transition rough were not included.

7.8 The Hawtree Layout submitted by the applicant to the Inquiry (T2) is a near-final Masterplan. It includes more information than the Tom Fazio II layout and its overall impact will therefore be larger. Direct impact values are given in T4.

7.9 Given the difference in type of detail between T1 and T2, it is important to compare the two course designs on a like-for-like basis. Table 7 in T4 does this by calculating direct habitat loss for 18 fairways and greens, plus the driving range for each design. The Hawtree Layout (17.8 ha) has slightly less effect than the Tom Fazio II design (18.6 ha). The difference, applied to key dune habitats, is slightly larger still. I suggest

that this difference is regarded as slight, with the Hawtree course affecting less habitat..

7.10 The environmental differences between the two courses are covered in the Hole-by-Hole Geomorphological Assessment (T4). There is less geomorphological impact from the Hawtree course, allowing dynamic processes and habitats to be retained in the north of the development, east of Hole 15. The most important habitat difference between the two courses arises from the new position for this hole. It results in an increased loss of 0.7 ha of young slack. The affected area is very dry and rare dune slack species are absent. This increased loss is balanced by notable reductions in loss elsewhere involving mobile, semi-fixed and fixed acidic dunes. The change enables geomorphological dynamics to be maintained in the north of the Menie sector of Foveran Links SSSI.

7.11 I now consider the direct impacts of the Hawtree Layout (T2) on habitats. I start with impacts calculated for all of the development area (Table 3 in T4). These calculations include the effect of stabilising the northern dome. I have assumed that all bare sand on this dome will be vegetated. Total direct impact is 41.7 ha, 15.8% of all habitat on blown sand in the Menie development area. The golf course largely avoids habitats of moderate and low interest.

7.12 This rounded 16% loss underestimates the proportion of key dune habitats affected (35.1 ha), which is 19.2% of all key dune habitats (182.8 ha).

7.13 As I have shown above, the NVC categories recorded at Menie can be allocated to Natura habitats, as listed in Annex 1 of the EC Habitats Directive (CD-F2). Losses per Annex 1 habitat are: 2120 White dunes (mobile dunes) 13.3 ha (22% of the habitat in the development site - this includes bare mobile sand); 2130 Grey dunes (*Priority) 14.8 ha (18%); 2140/2150 Decalcified fixed dunes (dune heath) (*Priority) 3.4 ha (21.5%); 2190 Humid dune slacks 3.6 ha (27%).

7.14 I point out that these loss figures are exaggerations. About 25% of the loss figures is made up of transition rough habitat around fairways (Table 3, T4). This represents a habitat modification effect, not habitat loss.

7.15 I have calculated the percentage proportion of loss of each Habitats Directive Annex 1 habitat, measuring it against the totals for these Annex 1 types, at four scales: the development site; the SDVSS site, Newburgh to Bridge of Don (document T33); the region, SNH Natural Heritage Zone North East Coastal Plain (Appendix 5, document T29); and, all-Scotland (Appendix 5, document T29).

7.16 I have taken any loss equal to or greater than 1% to be significant and to represent a significant adverse effect, when applied to the spatial scale at which it is calculated.

7.17 Development of the Hawtree Course would result in all four Annex 1 habitat types experiencing >1% habitat loss at the development site, SDVSS site and regional scales. The range in loss percentages are as follows: development site (18-27%); SDVSS site (4-26%); Natural Heritage Zone (1-6%). Losses are <1% at the national scale (0.3-0.7%).

7.18 I suggest these results show a significant adverse effect at the regional scale for habitats of European importance.

7.19 It is important to note that Annex 1 2120 White Dune habitat (mobile dunes) shows 0.7% loss at the national scale. This result is based on loss figures which include bare sand within the mobile dune areas of the site. Development of the second golf course would probably double that figure to around 1.5% loss, including stabilising the southern sand dome at Blairton. This would produce a significant adverse effect at the national scale. Relatively small amounts of mobile dune would remain, along the coastal edge of the Menie site and in the north, east of Hole 15.

7.20 Doubling the loss figures for the remaining three Annex 1 habitat types will not result in a significant adverse result at the national scale.

Direct impacts on the habitats of Foveran Links SSSI

7.21 It is important to establish the proportion of Foveran Links SSSI which will be affected by direct impacts on habitat receptors. The proportion, as a percentage, varies according to the definition of the divisor (the size representing the SSSI or SSSI subsector). These variations are now explored. I refer to direct habitat loss figures given in Table 4 of document T4, the agreed planimetric area of the SSSI (202.8 ha) and the 1990 NVC habitat map in document T21.

7.22 The simplest proportion is to divide the golf course footprint in the SSSI (21.7 ha, which includes ground stabilised between holes) by the area of the SSSI (202.8 ha). This represents 10.7% of the SSSI and it will not change as a result of additional golf infrastructure. Rounding up as 11%, the overwhelming majority (89%) of the SSSI will be completely unaffected by the golf course. The condition of SSSI habitats outside the Menie sector will still be subject to change, but in a manner entirely determined by their local geomorphological dynamics, soil evolution on stable surfaces and the effects of management.

7.23 The SSSI extends to Mean Low Water Springs for most of its length except in the north. It is therefore necessary to consider if the SSSI area between MHWS and MLWS markedly affects the proportion of SSSI dune habitats affected by golf. This calculation requires the extent of dune habitats above Mean High Water Springs (so-called supratidal habitat, 154.7 ha in T4). The proportion is calculated as golf course SSSI footprint (21.7 ha) divided by the area of habitats above Mean High Water Springs (154.7 ha). The result represents 14.0% of SSSI dune habitat, with 86% of SSSI habitats unaffected directly by golf development. These two figures are probably more representative figures to use in relation to habitats.

7.24 The differences arising from the two sets of different calculations can be considered moderate.

7.25 This analysis can be applied to the Menie sector of the SSSI. Habitat extent south of the Sandend Burn totals 67.3 ha (43.5% of SSSI dune habitat area). The golf course footprint (21.7 ha, which includes ground stabilised between holes) is divided by 67.3 ha, equivalent to 32.2% of the Menie SSSI sector. Golf development will therefore make up about a third of the Menie sector (including stabilising the dome). Two thirds of this sector will be unaffected by direct impacts on habitats.

7.26 All calculations of percentage loss for the SSSI and the Menie sector of the SSSI represent a significant adverse effect, before taking account of mitigation.

7.27 The direct effects should also be seen as component of cumulative adverse effects, applied to an SSSI area which is probably in unfavourable declining condition due to the effects of winter grazing and feeding of stock. This poor land management has already contributed markedly to near-total loss of dune heath from the SSSI, a habitat which is an Annex 1 Priority type. Unfavourable condition is present on at least 11% of the Menie SSSI sector. About a third of ground in unfavourable condition will be developed for golf. This would leave about 7% of the Menie SSSI sector to be added to golf impacts to calculate cumulative impact. This gives a result of around 40% of the Menie SSSI affected by cumulative impact.

7.28 This represents a significant adverse cumulative effect, before taking account of mitigation.

Direct impacts on the habitats of Foveran Links SINS

7.29 Effects within the SINS will be similar to that for Foveran Links SSSI due to the high degree of overlap between SSSI and SINS extents. The details of impacts are given in Table 5 in document T4.

7.30 Losses due to golf development amount to 24.1 ha, 28.2% of SINS habitat area (85.4 ha).

7.31 This habitat loss from the Menie sector of the SINS represents a significant adverse effect, before taking account of mitigation.

7.32 The SINS is also affected by the same areas of SSSI ground in unfavourable condition and golf development will represent a cumulative effect, giving a total area of around 31 ha affected by loss and adverse habitat change due to poor land management. This represents a 36% cumulative impact.

7.33 This represents a significant adverse cumulative effect, before taking account of mitigation.

Direct impacts on rare species and areas of lichen interest

7.34 I refer here to maps of the distribution of rare higher plants, one lichen and two areas of lichen interest which are given in Figure 7 and Figure 8 of Document T50.

7.35 Most rare higher plants known for the Menie area are found in dune slacks. The exception is Rush-leaved Fescue *Festuca arenaria* which occurs on mobile and semi-fixed dunes. Revisions to first golf course have increased potential effects on dune slacks and this also affects rare species.

7.36 I have not attempted any detailed analysis of impacts on fungi. The development site was shown in the 2007 environmental statement to have a diverse species list (108 total), including many Wax Caps (*Hygrocybe* spp.). The site Wax Cap total to date, 16, is just below a threshold of 17 which some specialists regard as a national level of interest. However, a total of 17 has to be achieved in a single site visit and that does not apply to Menie records.

7.37 Effects on fungi can be estimated indirectly by examining the species diversity of different habitats, as recorded by the fungal surveyor, Elizabeth Holden. A descending order of possible species-richness is shown by fixed acidic dunes (50

species), dune slacks (37), dune heath (26), lichen-rich grey dunes (24), yellow dunes (6) and trackside ruderals (4). All extensive key dune habitats at Menie inland from mobile dunes are therefore important in terms of fungi. Each of these habitats will lose notable areas and therefore this could result in loss of some fungal species. There might also be long-term indirect effects from use of fungicides in golf management via soil transmission to adjacent dune habitats. Effects on fungi, without mitigation, are therefore presumed to be significant adverse.

Rare species and lichen interest within Foveran Links SSSI

7.38 Within Foveran Links SSSI there are potentially serious effects on Curved Sedge *Carex maritima* and Small Adder's-tongue *Ophioglossum azoricum* from the fairway and rough of Hole 18. It is unlikely that these effects can be removed or reduced by further changes to golf course design.

7.39 There are potential effects to Curved Sedge *Carex maritima* and possible Early March-orchid *Dactylorhiza incarnata* from paths between holes 14 and 15. Ongoing discussions with the Course Designer suggest that the paths can be re-routed to avoid these plant populations, by moving to higher ground. The design of the path needs consideration to maintian suface seepage of dune slack moisture over a sloping surface, a feature of slack ground in this area.

7.40 A tee for Hole 17 is indicated close to the nationally-important lichen *Leptogium palmatum*. Ongoing discussions with the Course Designer indicate that the tee can be moved to another location nearby. This particular impact is unlikely to take place.

7.41 The effects on rare plants from Hole 18 should be regarded as significant adverse.

Rare species and lichen interest outside the SSSI

7.42 Outside the SSSI, two locations for Intermediate Wintergreen *Pyrola media* will be affected by the fairway of Hole 1. The largest population of Small Adder's-tongue so far found at Menie will be affected by the fairway for Hole 3.

7.43 Large extents of lichen-rich grassland and dune heath will be affected by Holes 1, 2, 3, 5, 6 and 7 within Lichen Area 2. This was indicated to be of regional importance for lichens by national specialists in the 2007 environmental statement (CD-G3). As an approximate estimate of potential loss using GIS data, 0.8 of lichen-rich acidic fixed dune grassland (total area 2.5 ha, 32% loss) and 1 ha of dry dune heath (total area 6.7 ha, 15% loss) will be affected. The areas affected are the driest dune conditions at Menie.

7.44 Changes to the course design cannot be made to avoid these impacts. The effects on rare plants and the area of lichen interest should be regarded as significant adverse.

Indirect effects of golf development

7.45 The 2007 environmental statement (CD-G3) discusses habitat loss due indirect impacts in section 7.4.1. Increased nutrient levels and changes in vegetation composition and structure due to the loss of rabbit grazing effects are emphasised.

7.46 It has not been possible to research likely indirect effects to greater depth. This is particularly important for the effects of increased nutrient levels. This requires careful

study of location-specific proposals for drainage and irrigation, matched with knowledge of habitats, plant species and dune soils. The information on drainage, irrigation and soils is not yet available.

7.47 The conclusions reached in the environmental statement are therefore retained here. Without mitigation, early slack habitats are likely to disappear quite quickly. This should be regarded as a significant adverse effect. Loss of rabbit grazing effects will also produce a significant adverse effect.

7.48 These conclusions apply to ground within the Foveran Links SSSI, Foveran Links SINS and ground outwith the SSSI-SINS area.

7.49 Indirect effects have to be added to direct effects on habitats and species. There will be a larger overall significant adverse effect within Foveran Links SSSI, Foveran Links SINS and ground outwith the SSSI-SINS area.

8.0 Mitigation of effects

8.1 I argue here that effective mitigation can be achieved for what, so far, has been a long list of significant adverse effects to habitats and plant species. This extends the account of habitat mitigation given in section 7.5.1 of the 2007 environmental statement (CD-G3).

8.2 My case, in outline, is that sufficient suitable ground is available within and outwith Foveran Links SSSI to re-establish all habitats likely to be lost to development. I propose habitat translocation of habitat turf as the main technique and this will also be used for species affected by development. I also propose habitat enhancement to restore ground in unfavourable condition. I estimate likely success on the basis of professional opinion and experience.

Available ground for mitigation

8.3 I propose that mitigation is based on establishing key dune habitats lost to golf development upon ground which is of only moderate or low nature conservation interest.

8.4 I have calculated the relevant total extents of affected key dune habitats and lower interest ground. I have reported these summary in Table 4 of document T50 and I now refer to these values. They are based on totals in Table 3 and Table 4 of Document T4

8.5 It is important that ground to be used to provide mitigation is suitable. Mitigation will have to provide for wet and dry key dune habitats, with soil and vegetation details fitting as closely as possible to the acidiity and wetness conditions discussed in section 5 of this precognition.

8.6 I have mapped the distribution of potential mitigation areas in Figure 6 of document T50. This shows areas which are dry which would be suitable to receive SD12 grey dune and dry types of H11 dry dune heath. Areas which are already wet or which could be excavated slightly to towards the watertable are also indicated. These would be suitable for establishing SD13 young dune slack, SD16 mature slack and wet forms of H11 dune heath.

Foveran Links SSSI

8.7 A total of 19.4 ha of key dune habitats will be lost to development in the Menie sector of the SSSI.

8.8 This total can be reduced as a target for mitigation as follows. First, stabilisation of the sand dome would take place and it is proposed to do that by using grey dune turf imported from development-affected ground in the SSSI and outside the SSSI. My estimate of the area of mobile bare sand and some mobile dune which will be stabilised is 6.7 ha, based on GIS habitat data. This reduces the key dune habitat total requiring mitigation to 12.7 ha.

8.9 A further reduction in loss can come from assuming that transition rough around fairways (4 ha) represents modified habitat, not as habitat loss. Mitigation is then required for 8.6 ha of key dune habitats.

8.10 A total of 9.3 ha of ground of moderate and low interest is available in the SSSI, some of it ground identified already as being in unfavourable condition. This therefore more than covers the 8.6 ha of loss requiring mitigation.

Mitigation outside the SSSI

8.11 A total of 15.7 ha of key dune habitat loss requires mitigation. The total area of ground of moderate and low interest unaffected by development is 68.6 ha.

8.12 This leaves more than 50 ha of potential habitat for mitigation. This is likely to be required for mitigating other golf development, including the second course. The additional impacts are likely to be less than the first course. This 50 ha remainder is therefore sufficient to provide mitigation for those effects too.

8.13 I suggest that, overall, there is likely to be sufficient ground in the development area to provide mitigation for all golf development.

Principles of habitat and species translocation

8.14 In very simple terms, habitat and species translocation would involve stripping turf from a donor area (ground to be developed for golf), followed by transporting the turf to a receptor area which has a very similar environment to donor ground.

The acceptability of translocation

8.15 Habitat and species translocation is regarded by environmental practitioners as a technique of last resort, only to be used after exhausting all other options such as avoidance of sensitive ecological receptors, e.g. key dune habitats. However, there is very little scope for avoidance at Menie without compromising the course design.

8.16 I accept that habitat translocation within an SSSI is not an acceptable alternative to maintained conservation within SSSI boundaries, a policy of the JNCC. There is a strong presumption against this method. The applicant is aware of this. It is proposed at Menie because there is no alternative if the golf development is approved.

8.17 It is for the Reporter to decide if the method can be used in Foveran Links SSSI.

8.18 The alternative, if approval is granted, is for the stabilisation of the dome to use conventional hydroseeding methods with a low-interest grass sward based on common non-dune species. There will also be a need to dispose of much turf stripped from golf areas, probably by burial within the golf footprint.

Achieving successful translocation

8.19 I am aware that the scale of translocation required for the Menie development will be one of the largest applied to a sand dune system in Scotland since 1939-45 when a few large sites were used for airfields.

8.20 Translocation is known in the environmental arena to be a complex area involving logistics and the matching of donor turf with suitable receptor areas. At Menie it also requires integration into a two-course golf development design which includes the

landscaping of the receptor areas. A key aim will be to mimic and maintain, as best as possible, the existing habitat zonations in the dune interior.

8.21 Translocation work at Menie would require on-site soil analysis facilities and considerable watertable and weather (evapotranspiration) monitoring to achieve success. Vegetation analysis so far has identified the importance of soil acidity and wetness but those relationships are based on general scales developed for all-UK conditions. Work is required to adapt the general model to local conditions and formal measurements of acidity and soil moisture. This will need additional vegetation sampling and soil analysis. It will need to be integrated with further work on drainage and irrigation for the golf development.

8.22 The organisation of translocation, including all preliminary studies and subsequent monitoring, should be organised by MEMAG under procedures which are being presented elsewhere to the Inquiry. MEMAG would require best practice and would ensure all necessary research, contractual supervision and remedial measures. MEMAG would also undertake research into indirect effects, including long-term monitoring.

8.23 Considerable desktop research will be needed before any translocation can be attempted, particularly on potential indirect effects on habitats and species. There is uncertainty in the dune arena on the long-term success of golf course management. The classic location for sensitive management is often stated as Royal St. George's in Kent (document T22) and existing experience must be tapped as early as possible.

Habitat enhancement proposals

8.24 The applicant wishes to restore dune ground in unfavourable condition to favourable status. Initially this will involve just the Menie sector of Foveran Links SSSI. This will involve stopping the winter use of dunes by livestock, followed by measures to restore all badly affected ground. This might require 5 or more years to remove the worst effects of excess nutrients, based on experience in Northumberland (documents T32 and T18).

8.25 There is also ground in unfavourable condition south of the SSSI (e.g. conifer plantations) and this too would be targetted in the medium term if the ground is not used for mitigation by translocation.

8.26 It will be the responsibility of MEMAG to record ground requiring enhancement and to specify detailed remedial measures and monitoring.

Likely success

8.27 I am presuming that MEMAG will be adequately resourced to undertake its work and that funding for translocation and habitat enhancement work will be sufficient to use best practice. This will probably require the development of specialist machinery to strip, handle and place dune turf from different habitats.

8.28 On the basis of personal observation, many dune habitats are quite resilient to major disturbance. Yellow and grey dune habitats recover well from fire and re-establish quite quickly in areas of scrub clearance as long as the shrub removed is not Sea Buckthorn *Hippophae rhamnoide*s, which alters soil conditions considerably. It is not present at Menie.

8.29 Small-scale excavations in slacks to provide ponds for Natterjack Toad *Bufo calamita* are known to develop good adjacent habitats if designed carefully. Turf stripping in the Netherlands has retained early succession (young dune slack) species. Large-scale dune slack restoration has been achieved in the Netherlands on ground formerly used for waste water treatment.

8.30 Major pipelines have been installed through dunes (e.g. Cruden Bay, St. Fergus, Barry Links) and vegetation recovery in a wide variety of habitats has been fair to excellent. Turfing was used at Barry Links to restore the pipeline corridor,

8.31 Given this resilience, and the assumption that translocation work would be well-resourced, I estimate that there would be at least 66% success for habitats established in receptor areas in the short term (1 – 5 years). Following remedial measures, I estimate that near-100% would be possible in the medium to long-term (5 – 25 years).

9.0 Conclusion

9.1 I conclude by relating potential mitigation success to initial estimates of significance of effects. I consider that residual direct effects on habitats will be reduced from severe (in the absence of mitigation) to moderate in the short term. This applies both in the Foveran Links SSSI and to ground further south. In the medium to long term I consider residual effects will be slight to moderate in the same areas.

9.2 I continue to have reservations on the scale of possible long-term indirect effects resulting from golf course management. I therefore consider that these could be severe to moderate in the long term depending on the success of research and sensitive management at Menie.

9.3 It is important to stress that the result of mitigation by translocation will be a highly modified dune habitat mosaic within a two-course golf landscape. The existing habitats and important species will be retained but in changed quantities. It will be a much changed dune landscape.