

# Strategic Environmental Assessment of Supplementary Guidance Natural Environment (2016)

## Appendix B – Environmental Baseline Report

To enable the current state of environment features of Orkney to be assessed, a search has been carried out of a range of baseline data which are relevant to the SEA issues considered in this Environmental Report. A summary is produced in this section which provides a brief description of the key environmental characteristics of Orkney. This allows existing problems to be identified and provides the benchmark against which the forecast and monitored levels of environmental effects will be evaluated. The following features of the environment are examined:

1. Climatic effects
2. Biodiversity, fauna and flora
3. Water
4. Soil
5. Geology

This report provides a baseline under each of these features, together with the relevant Strategic Environmental Assessment objectives which have been identified as criteria against which to assess the possible environmental effects of the Supplementary Guidance Natural Environment.

### Baseline Overview of Orkney

Number of islands:	70+
Number of inhabited islands:	19
Total (land) area of the Orkney Islands:	990 km <sup>2</sup>
Total length of coastline:	over 980 km
Dimensions:	Approximately 85 km north to south and 37 km east to west
Outlying Island with highest population:	Westray
Smallest permanently inhabited island:	Papa Stronsay
Longitude: (Kirkwall)	3° W
Latitude: (Kirkwall)	59°N
Population of Orkney <sup>1</sup>	21,585 (mid-year estimate 30 June 2014)

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<sup>1</sup> General Register Office for Scotland

## Environmental Baseline, Issues and Objectives by Topic

### 1 Climatic factors

SEA Objectives
Promote a precautionary approach to flood risk from all sources.
Address vulnerability in the County to the likely effects of climate change.

#### 1.1 The Enhanced Greenhouse Effect

It is widely accepted that the increasing levels of certain gases in the atmosphere are causing significant changes to global climates by reducing the rate of radiative heat loss from the atmosphere, in turn allowing average temperatures around the world to rise. This is generally described as the enhanced greenhouse effect.

The United Nations Convention on Climate Change was established in 1992 as an international framework to agree strategies to reduce emissions of greenhouse gases. The Kyoto Protocol agreement subsequently established a timetable for reducing emissions as well as a framework for the sequestration of carbon by vegetation.

The Climate Change (Scotland) Act 2009 sets a long-term target to reduce Scotland's emissions of greenhouse gas emissions by at least 80% by 2050, as well as an interim target of at least 42% by 2020 and a framework of annual targets intended to drive the policies necessary for achieving the long-term target. Part four of the Act requires public bodies, including local authorities, to submit annual Climate Change Declaration Reports, indicating how they have contributed towards national targets to:

- contribute to the delivery of emission reduction targets;
- help deliver Scotland's climate change adaptation programme; and
- to do this in a way they consider is most sustainable.

#### 1.2 Future Climatic Trends

Recorded weather data confirms that temperatures have indeed increased in the UK over recent decades, but not at the same rate in all regions. Information on climate trends published by the Scotland and Northern Ireland Forum for Environmental Research (SNIFFER)<sup>23</sup> shows that, between 1961 and 2004, the average annual temperature in the north of Scotland increased by 0.92 °C.

The UK Climate Impacts Programme develops future scenarios for climate change; The UKCIP09 climate change scenarios have been developed for a range of different levels of emissions. The following scenarios have been developed for the North of Scotland by 2080 under medium emissions:<sup>4</sup>

- the central estimate of increase in winter mean temperature is +2.2°C;
- the central estimate of increase in summer mean temperature is +3°C;

<sup>2</sup> <http://www.scotlandscensus.gov.uk/documents/censusresults/release2a/rel2asbfigure21.pdf>

<sup>3</sup> SNIFFER, 'A handbook of climate trends across Scotland', 2006 [www.sniffer.org.uk](http://www.sniffer.org.uk)

<sup>4</sup> UK Climate Impacts Programme [www.ukcip.org.uk](http://www.ukcip.org.uk)

- the central estimate of change in winter mean precipitation is +18%;
- the central estimate of change in summer mean precipitation is –12%;

Overall, these predictions indicate that we can generally expect our summers to become warmer and drier and our winters to become milder and wetter. Other predicted changes to our climate include more frequent extreme weather events such as heavy and prolonged rainfall events. In addition, there is strong evidence that global sea level is rising and will continue to rise during the 21<sup>st</sup> century.<sup>5</sup> While studies show that sea levels changed little from AD 0 until 1900, sea levels began to climb in the 20th century. The two major causes of global sea-level rise are thermal expansion caused by the warming of the oceans and the loss of land-based ice (such as glaciers and polar ice caps) due to increased melting. Records and research show that sea level has been steadily rising at a rate of 0.04 to 0.1 inches per year since 1900 and this is likely to put many coastal settlements in Orkney at increased risk of coastal inundation.

### 1.3 Flooding

Orkney's average annual rainfall ranges from 861 mm to 1250 mm with the west of the county generally experiencing rather higher rainfall than the east.<sup>6</sup> Records dating from 1961 indicate that, overall, the winter months in Orkney have become wetter and the summer months a little drier.

A number of coastal areas of Orkney are susceptible to inundation by the sea, generally as a result of storm surges combined with high spring tides. During January 2005, when a deep area of low pressure crossed Orkney, bringing strong south-easterly gales which coincided with high spring tides, the villages of St Mary's, Burray and St. Margaret's Hope were severely impacted by coastal flooding. The most recent major flood event occurred in October 2006 when heavy and sustained rain caused widespread flooding throughout Orkney causing damage to many homes and major disruptions to the County's road network.

One of the North Isles, Sanday, is mainly low-lying and therefore susceptible to coastal erosion and flooding. Much of the island's coastline is designated on account of its natural heritage interest. Habitats and geomorphological features (sand dunes, sand flats, kelp beds ayres and tombolos) provide protection from the combined forces of wind and waves.

### 1.4 Environmental Issues

The Local Development Plan Proposed Plan includes policies which protect designated sites and the wider biodiversity and geodiversity, however there is scope for Supplementary Guidance Natural Environment to explain how certain habitats and geomorphological features help protect against coastal erosion and flood risk (from coastal, fluvial and drainage sources). It should point out the ongoing role these habitats/features will play in helping communities to adapt to future changes to the climate. It should also highlight the vulnerability of these habitats and features to disturbance and development.

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<sup>5</sup> <http://oceanservice.noaa.gov/facts/sealevel.html>

<sup>6</sup> SNIFFER, 'A handbook of climate trends across Scotland', 2006 [www.sniffer.org.uk](http://www.sniffer.org.uk)

## 2. Biodiversity, fauna and flora

SEA Objectives
Conserve protected sites and species.
Safeguard valuable habitat from loss and fragmentation through development.
Protect biodiversity, enabling and encouraging habitat enhancement or restoration where appropriate, and contribute towards achievement of Orkney LBAP actions and targets.
Maintain healthy ecosystems and work with the natural processes which provide important services to communities.

### 2.1 Designated Sites

The Orkney Islands are particularly valued for their wildlife, and a number of sites are designated for conservation under European and/or national legislation. The following paragraphs provide a brief description of the protected area designations which are in place in Orkney:

- **Natura 2000** is a European network of protected sites which represent areas of the highest value for natural habitats and species of plants and animals which are rare, endangered or vulnerable in the European Community. The term Natura 2000 comes from the 1992 EC Habitats Directive; it symbolises the conservation of precious natural resources for the year 2000 and beyond into the 21st century. Scotland's Natura 2000 sites will help to protect these important areas now and for generations to come. The Natura 2000 network includes two types of protected area:
  - **Special Areas for Conservation (SAC)** are classified under the Habitats Directive for the protection of rare, endangered or vulnerable natural habitats and species of plants or animals (other than birds). These are the 189 habitats listed in Annex I and the 788 species listed in Annex II of the Habitats Directive. Species occurring in Orkney for which the UK has special responsibility include otter, grey seal and common seal. Six areas in Orkney are designated as SACs.
  - **Special Protection Areas (SPA)** are classified under the Birds Directive and are areas which support rare, vulnerable and regularly occurring migratory bird species which are listed in Annex I of the Birds Directive. SPAs are intended to safeguard the habitats of the species for which they are selected and to protect the birds from significant disturbance. Thirteen areas in Orkney are designated as SPAs. Two marine areas have been identified as proposed SPAs and a further area is identified as a draft SPA.
- **Ramsar Sites** are internationally important wetland sites, protecting wildfowl habitat. There is only one Ramsar site in Orkney and it overlaps the East Sanday Coast SSSI/SPA.
- **Sites of Special Scientific Interest (SSSI)** represent the best of Scotland's natural heritage and are special for their plants, animals or habitats, their rocks or landforms, or a combination of such natural features. They form a network of the best examples of terrestrial natural features throughout Scotland, and support a wider network across Great Britain and the European Union. Designation of an SSSI is a legal process and

sites are protected under the Nature Conservation (Scotland) Act 2004. Thirty-six areas in Orkney are designated as SSSIs.

- **Local Nature Conservation Sites (LNCS)**

These are sites which have been designated by Orkney Islands Council and were originally listed as Sites of Local Nature Conservation Importance (SLNCI) in the Orkney Local Plan 2004. They have no legal protection; however they are regarded as being worthy of policy protection on account of their ornithological, botanical and/or geological / geomorphological interest. Over 200 local sites were identified in the 2004 Plan and, as part of the Local Development Plan 2014 review process, these were surveyed and re-assessed for their natural heritage value. A number of further sites were proposed for inclusion and these were also surveyed and assessed. A boundary review of the LNCS is nearing completion, focusing on areas which are identified as improved grassland or semi-improved grassland. The current review also includes an increased level of consultation with landowners.

- **Local Nature Reserves (LNR)**

These are places with special local natural interest, set up to protect nature and for people to enjoy and appreciate; Orkney has one LNR at Mull Head in the parish of Deerness and a further LNR is proposed at Happy Valley in Stenness.

### **2.1.1 Internationally and nationally designated sites**

**Appendix F Orkney's Nationally Designated Natural Heritage Sites** indicates the locations of areas in the Orkney Islands which are designated as SSSI, SPA, SAC or Ramsar sites

As the map shows, there is a significant level of overlap in these designations, e.g. many of Orkney's SSSIs are also designated as SPAs, SACs and/or Ramsar sites. In Hoy the SPA and SAC designations fully overlap the SSSI designation.

International and national sites undergo a rolling programme whereby the qualifying interests of each site are assessed for their condition – this is known as Site Condition Monitoring. **Table 2.2** which is presented as **Appendix B.1** to this baseline provides a summary of Orkney's international and national sites and lists their qualifying features, as well as their current condition status.

### **2.1.2 Locally designated sites**

Outwith the statutorily designated sites the Local Nature Conservation Sites are areas of land and water that are recognised as having high biodiversity value and therefore worthy of protection, albeit at a lower level than that afforded to national and international sites. They contain valuable natural habitats which support a wide range of Orkney's wildlife and include areas of wetland, heath, coast, unimproved grassland, native woodland, freshwater lochs and burns. Many of these habitat types are identified in the UK Biodiversity Action Plan (UKBAP) as priorities for conservation.

**Table 2.3** sets out the habitat types which are found in the LNCS and highlights those which are recognised nationally as priorities for conservation.

**Table 2.3: Habitat types for conservation in the Orkney Local Development Plan Local Nature Conservation Sites<sup>7</sup>**

Aeolianite	Lichen heath	<b>Purple moorgrass and rush pastures</b>
Basin bog	Links	<b>Reedbeds</b>
<b>Blanket bog</b>	<b>Lowland calcareous grassland</b>	<b>Saline lagoons</b>
Burns and canalised burns	<b>Lowland dry acid grassland</b>	Species-rich heath
<b>Coastal saltmarsh</b>	<b>Lowland fens</b>	Treeless woods and dales
<b>Coastal sand dunes</b>	<b>Lowland meadows</b>	<b>Upland birchwoods</b>
Coastal strandline	<b>Machair</b>	<b>Upland calcareous grassland</b>
<b>Coastal vegetated shingle</b>	<b>Maritime cliff and slopes</b>	<b>Upland fens, flushes and swamps</b>
Conifer plantation	Maritime grassland	<b>Upland heathland</b>
Empetrum heath	Maritime heath	Upland willow scrub
<b>Eutrophic standing waters</b>	<b>Mesotrophic lakes</b>	<b>Wet woodland</b>
<b>Inland outcrops and scree habitats</b>	<b>Oligotrophic and dystrophic lakes</b>	
<b>Intertidal mudflats</b>	<b>Ponds</b>	

Note: Habitat types emphasized in **bold** are UK Priority Habitats. The remaining habitats are locally important habitats as identified in the Orkney Local Biodiversity Action Plan.

## 2.2 Marine Protected Areas

The Marine (Scotland) Act 2010 established a new power for Marine Protected Areas (MPAs) in the seas around Scotland, to recognise natural features of national importance and to meet international commitments for developing a network of MPAs. SNH has undertaken reviews of a large number of marine habitats and species in order to identify those it considers to be of greatest marine nature conservation importance in Scottish territorial waters – these are termed Priority Marine Features (PMFs). A number of PMFs are known to occur locally; these include benthic habitats such as horse mussel beds, maerl beds, seagrass beds as well as mobile species such as common and grey seal, sea trout and a number of cetacean species. The list of Priority Marine Features is available on the SNH website and may be accessed at <http://www.snh.gov.uk/docs/A1327320.pdf>.

A subset of the PMFs has been used to underpin the selection of Nature Conservation (NC MPAs). Three NC MPAs have been designated in Orkney waters – these are listed in **Table 2.4** along with a description of their protected features.

<sup>7</sup> Orkney Local Biodiversity Action Plan

**Table 2.4 Nature Conservation Marine Protected Areas in Orkney**

NC MPA	Protected features
<b>Wyre &amp; Rousay Sounds</b>	Kelp and seaweed communities on sublittoral sediment; maerl beds; Marine Geomorphology of the Scottish Shelf Seabed (calcium carbonate sediments from the eroded shells and skeletons of plants and small animals, such as maerl and bivalve molluscs supply the sandy beaches around Orkney).
<b>Papa Westray</b>	Black guillemot; Marine Geomorphology of the Scottish Shelf Seabed (the action of tides and currents has formed a sand wave field).
<b>North-west Orkney</b>	Sandeels; Marine Geomorphology of the Scottish Shelf Seabed (the action of tides and currents has formed sand banks, sand wave fields & sediment wave fields).

In addition, two proposed SPAs and one draft SPA have been identified in the marine environment surrounding Orkney; these cover areas in the Pentland Firth and Scapa Flow as well as an area of inshore waters in the North Isles. Further information on these sites is available from the SNH and JNCC websites at <http://www.snh.gov.uk/protecting-scotlands-nature/protected-areas/proposed-marine-spas/> and <http://jncc.defra.gov.uk/page-7017>

### 2.3 Protected Species

A number of species are listed on Annex IV of the Habitats Directive as species of European Community interest and in need of strict protection. The protective measures required are outlined in Article 12 of the Directive. The species listed on Annex IV whose natural range includes any area in Great Britain are also listed on Schedules 2 (animals) and 4 (plants) of the Habitats Regulations and are specifically protected under Regulations 38-46 and Regulations 10-13 of the Amendment Regulations.<sup>8</sup>

All European Protected Species (EPS) are also fully protected under the Wildlife and Countryside Act 1981; however the Regulations provide a greater level of protection, primarily through licensing procedures. For any European Protected Species of animal, the legislation makes it an offence to deliberately or recklessly capture, kill, injure or disturb any such animal. It is also an offence to damage or destroy their 'breeding sites' or 'resting places' (this does not have to be deliberate, reckless or intentional for an offence to have been committed).

For any European Protected Species of plant, the legislation makes it an offence to deliberately or recklessly pick, collect, cut, uproot or destroy any such plant. This applies to all stages of their biological cycle.

European Protected Species include European otter *Lutra lutra*, which is known to be widespread in the Orkney Islands particularly in the vicinity of aquatic environments, as the animals routinely move between marine and freshwater environments. All species of bats are also recognised as EPS and, although not commonly seen, records of bat sightings indicate that the presence in Orkney of a number of species is increasing and it is probable that small

<sup>8</sup> SNH website: [www.snh.gov.uk](http://www.snh.gov.uk)

numbers breed in the county.<sup>9</sup> Additionally, all species of cetacea are EPS; the Harbour porpoise is frequently seen, particularly in south Scapa Flow<sup>10</sup> and regular sightings are reported of a number of whale and dolphin species passing through Orkney's marine environment. Marine turtles are also designated as EPS and rare sightings have been made in Orkney waters, although more often dead or injured animals are found washed up on the shoreline.

Other protected species that are found in Orkney include many bird species as well as harbour and grey seal.

When originally enacted, the Wildlife and Countryside Act 1981 provided a relatively straightforward source of wildlife law in Great Britain. However, the legal picture is now more complicated. Firstly, the introduction of the Habitats Regulations 1994 created a separate set of rules for those species (and habitats) protected under the Habitats Directive. Secondly, devolution has meant that changes to the 1981 Act (through the Nature Conservation (Scotland) Act 2004 and the Habitats Regulations have been made differently in Scotland. Information on protected species known to occur naturally in Scotland may be accessed from the SNH website at <http://www.snh.gov.uk/protecting-scotlands-nature/protected-species/which-and-how/> This indicates how each species is protected; however it is important to note that not all of the species listed occur in Orkney.

The Marine (Scotland) Act 2010 introduced further protection for seals and on the 1st February 2011 it became an offence to kill, injure or take a seal at any time of year, except to alleviate suffering or where a licence has been issued to do so. The Act also provides for Scottish Ministers to designate "seal conservation areas". The areas previously covered by the Conservation of Seal (Scotland) Orders namely Shetland, Orkney, the Moray Firth and the East Coast of Scotland have been transcribed into seal conservation areas and in addition the Outer Hebrides has also been scheduled as a seal conservation area under the Marine (Scotland) Act 2010. Marine Scotland must not grant a seal licence authorising the killing or taking of seals in a seal conservation area unless they are satisfied that there is no satisfactory alternative way of achieving the purpose for which the licence is granted, and that the killing or taking authorised by the licence will not be detrimental to the maintenance of the population of any species of seal at a favourable conservation status in their natural range (within the meaning of Article 1(e) of the Habitats Directive).

The Act also provides for additional protection for seals at designated haul out sites where it will become an offence to intentionally or recklessly harass seals. Details of designated haul-out sites in the Orkney Seal Management Area may be accessed from the Scottish Government website at <http://www.scotland.gov.uk/Resource/0045/00454617.pdf>.

The basking shark *Cetorhinus maximus* is known to inhabit the waters around Orkney<sup>11</sup>. This species is listed as a UKBAP and OSPAR species and is protected under the Wildlife and Countryside Act 1981 (as amended in 1985) and CITES27.

## **2.4 Priority Habitats and Species**

Each local authority in Scotland has developed its own Local Biodiversity Action Plan (LBAP) that lists the priority habitats and species for its area. The Orkney Environment Partnership, through its Biodiversity Steering Group, produced the original Orkney Local Biodiversity Action Plan (LBAP) in 2002, a document which identified a total of 83 species and 21 distinct habitats as being of importance in the Orkney Islands. This plan was supplemented by the Orkney LBAP

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<sup>9</sup> Orkney Wildlife Information and Records Centre

<sup>10</sup> Booth, C. & J. Sillocks, Skarfies & Selkies, (2005)

<sup>11</sup> Orkney Wildlife Information and Records Centre



2008-2011 which focused on ten of these habitats, introducing new sets of targets and actions to be completed during the three year period. The current revision, also focusing on ten habitats, covers the period 2013-2016 and includes lists of habitats and species which occur in Orkney and are identified as Priorities for Conservation on the UK Biodiversity Action Plan and the Scottish Biodiversity List. All three versions of the Plan may be accessed from the Orkney Islands Council website at [www.orkney.gov.uk](http://www.orkney.gov.uk). Further information on the distribution and abundance of species and habitats throughout the county is available from The Orkney Wildlife Information and Records Centre which is located in the Orkney Library and Archive.

## **2.5 Wider Countryside Measures**

There are a few bird species, either listed on Annex I of the Birds Directive or regularly occurring migratory species, for which Special Protection Areas are not appropriate in Scotland. For some other species, a large proportion of the population is not protected within SPAs. In both these cases, special measures outwith designated areas are of particular significance.<sup>12</sup>

Article 10 of the Habitats Directive encourages national governments, through their land-use planning and development policies, to manage landscape features which are of major importance for wild fauna and flora, particularly with a view to improving the ecological coherence of the Natura 2000 site network. Features which are essential for the passage and dispersal of wild species in the countryside, such as river corridors, and features which act as 'stepping stones' between sites such as small woods and ponds, are highlighted as particularly valuable.

In Orkney the identification of Local Nature Conservation Sites is considered to be an effective means of highlighting areas of sensitive habitat out-with the nationally and internationally designated sites.

As well as having its own intrinsic value, the natural environment provides us with a wide range of services and products that support us in our day to day lives and underpin our economy. These are known collectively as ecosystem services. The Ecosystems Services Approach is all about recognising the value of these services so that they can be fully taken into account within policy preparation and decision making as well as 'on the ground' actions. The range of ecosystem services that we routinely benefit from includes:

1. Increased soil fertility through microbial biochemistry and decomposition
2. Water purification through soil processes and natural filtration
3. Flood mitigation by peatlands, wetlands, woodlands and soils
4. Coastal protection by dune systems, shingle/cobble beaches saltmarsh and mudflats
5. Carbon capture and storage in biomass, peat, soils and sediments
6. Landscape features and natural beauty provided by the diversity of vegetation cover and other wildlife
7. Pollination by invertebrate species
8. Protection and preservation of cultural heritage resources
9. The presence of biochemicals which may be used to manufacture medicines, now or in the future;
10. The health and well-being benefits people obtain from ecosystems through recreation, reflection and spiritual enrichment.

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<sup>12</sup> SNH website: [www.snh.gov.uk](http://www.snh.gov.uk)

## 2.6 RSPB Reserves and Scottish Wildlife Trust Sites

The Royal Society for the Protection of Birds (RSPB) manages over 8000 hectares in Orkney<sup>13</sup>, with most of this land designated as nature reserves. The 13 reserves are at the following locations:

Noup Cliffs, Westray  
North Hill, Papa Westray  
Trumland, Rousay  
Onziebust, Egilsay  
Mill Dam, Shapinsay  
Marwick, Birsay  
Birsay Moors  
The Loons, Birsay  
Cottasgarth and Rendall Flows  
Brodgar, Stenness  
Hobbister, Orphir  
Copinsay  
Hoy

Linga Holm, a small island off the west coast of Stronsay, is owned by the Scottish Wildlife Trust (SWT) and is operated as a sanctuary for grey seal. The SWT also owns areas of land in the parish of Harray and at East Hill, Shapinsay which are of interest for ornithological reasons. A further site owned by the Trust is the Hill of White Hamars in South Walls which features an area of lichen-rich and floristically diverse coastal maritime heath.

## 2.7 The effects of climate change on biodiversity

Climate change is considered to be the single biggest threat to Scotland's habitats<sup>14</sup>, with potential for these to be altered in a number of different ways. Some may be affected directly, for example existing coastal machair habitats may be lost due to sea-level rise and sand dune habitat may be breached or may move inland. Another consequence of rising temperatures combined with a reduction in rainfall, is that peatland soils and habitats will be damaged by drying out and eroding.

Having enough space will be another factor. Some habitats already suffer from fragmentation and it is recognised that isolated areas of habitat will be more vulnerable to irreversible damage from rapid climate change.

Species are also at risk from the effects of climate change. At the top of the marine food web, seabirds are a visible sign of the changes taking place below the surface. They are sensitive to disruptions in the food chain. Sand eels populations are declining due to dramatic changes in their plankton diet. In turn, birds are not finding enough sand eel food to sustain them and their young. Kittiwakes, arctic terns, guillemots and shags are among the seabirds that depend on sand eels for adult and chick food, and in recent years the seabird colonies in Orkney have experienced sharp declines in breeding success.

## 2.8 Invasive Non-Native Species (INNS)

The spread of invasive non-native species also poses a serious threat to biodiversity, both on land and in the water. Plant species already known to be present in Orkney include salmonberry *Rubus spectabilis*, Japanese knotweed *Fallopia japonica* and Himalayan balsam *Impatiens*

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<sup>13</sup> RSPB website: [www.rspb.org.uk](http://www.rspb.org.uk)

<sup>14</sup> Scottish Natural Heritage <http://www.snh.gov.uk/climate-change/impacts-in-scotland/effects/habitats/>

*glandulifera*. There is also potential for aquatic species such as New Zealand pygmy weed *Crassula helmsii* to be incorporated into SuDs pond planting schemes, from where they could quite easily spread to natural water bodies, e.g. through fragments attached to birds' feet. In recent years stoats *Mustela erminea* have appeared in Orkney and sightings of the animals have been reported from many parts of the Orkney mainland and linked South Isles. How the animals reached the islands is uncertain and there are considerable concerns about the effect they could have on local wildlife, e.g. its diverse birdlife. The stoat is an efficient hunter which typically feeds on birds and small mammals. Amongst its potential prey is the Orkney vole which is not only unique to Orkney but is also an important source of food for the islands' populations of hen harrier and short eared owl.

## 2.9 Environmental issues

Development can lead to loss and fragmentation of natural habitat with further impacts on protected and priority species and habitats. The SG should explain that certain habitats are identified by the UK BAP and/or the Scottish Biodiversity List as priorities for conservation and should seek to ensure that future development avoids or minimises further loss or fragmentation of natural habitat.

Inappropriately designed and sited projects to enhance biodiversity can lead to adverse environmental effects, e.g. through the introduction of non-native species which may have potential to be invasive. The SG should provide brief guidance on enhancement projects, e.g. by recommending the use of species of local origin. It should also provide links to other publications, e.g. on the SNH and SEPA website, which provide more in-depth guidance.

It should also highlight the provisions of the Wildlife and Natural Environment (Scotland) Act 2011 in relation to INNS.

There is potential for ecological surveys to be undertaken at inappropriate times of the year, resulting in the submission of poorly informed environmental reports to support planning applications. The SG should provide guidance on the timing of ecological surveys.

## 3. Water

SEA Objectives
Promote the protection and improvement of the water environment, including burns, lochs, estuaries, wetlands, coastal waters and groundwater.
Maintain water abstraction, run-off and recharge within carrying capacity.

### 3.1 The water environment of Orkney

Orkney has a diverse freshwater and marine water environment. Its catchment areas provide water supplies for people, community services and industry in the islands and the marine environment supports both the shellfish fishing industry and aquaculture. Freshwater watercourses in Orkney generally include freshwater lochs and lochans, streams and drainage ditches, in addition considerable areas of the islands are described as Groundwater Dependent Terrestrial Ecosystems (GWDTE) which are waterlogged with areas of standing water for much of the year these. GWDTEs are wetlands which critically depend on groundwater flows and/or

chemistries<sup>15</sup> and include dune slack, fen, wetland, peat bog, reedbed, saltmarsh, springs, flushes and seepages, swamp, wet grassland, wet heath, wet machair and wet woodland<sup>16</sup>. In the marine environment there are coastal waters and saline lagoons.

### **3.2 Water supply**

Scottish Water is responsible for the supply of potable water within the county, and operates water treatment plants at Boardhouse and Kirbister Lochs on the Orkney mainland; Saintear Loch on Westray; Bea Loch on Sanday; Sandy Loch which supplies Hoy and Graemsay and Heldale Water which supplies Walls, and Flotta. Properties in North Ronaldsay, Eday and Stronsay are also linked to public water supplies. In Rousay the school is served by a public water supply but otherwise water is sourced from bore holes. Residents of Papa Westray access water from a community water scheme.

In the remaining outlying islands water is supplied from boreholes. In addition, some households continue to rely on private, untreated water supplies and on sources that may be vulnerable to diffuse or single-source pollution.

### **3.3 Foul water treatment**

Scottish Water also has responsibility for waste water and, in recent years has upgraded sewerage treatment facilities at a number of locations including: Head of Work, which serves the town of Kirkwall; The Bu, which serves the town of Stromness; St Margaret's Hope; Burray; Holm; Stenness; Dounby; Evie; Finstown, Sanday and Westray. However, in a number of rural settlements foul water drainage facilities are at, or close to, capacity. In others there is no strategic provision for foul water drainage and properties are reliant on private systems, e.g. septic tanks and soakaways. Where a number of houses are in close proximity to each other this can lead to a proliferation of septic tank systems and a significant risk of water pollution, especially during the wetter months when percolation rates within the soil are poor. This has been a particular problem in certain areas and the Scottish Environment Protection Agency (SEPA) has designated the following Planning Consultation Areas where proliferation of private waste water systems has led to a cumulative impact on the water environment:

- Pierowall, Westray
- Whitehall, Stronsay
- Birsay
- Tingwall
- Grimeston Road, Harray
- Houton
- Hatston
- Carness
- Berstane
- Burray Village
- Herston
- Longhope

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<sup>15</sup>Water Framework Directive UK Technical Advisory Group <http://www.wfduk.org/resources/groundwater-dependent-terrestrial-ecosystem-threshold-values>

<sup>16</sup> Scotland's Environment Web

### 3.4 Water quality and overall status classification in Orkney

SEPA has primary responsibility for the water environment and, under the Water Environment (Controlled Activities Regulations) (Scotland) 2005, operates as a regulator for abstraction from and discharges to surface and ground waters. A water quality classification system allows SEPA to determine the state of the environment, highlighting areas that need particular protection, and where improvements need to be made. On an annual basis each water body is reported as high, good, moderate, poor or bad.

The **overall status** classification of surface water bodies describes by how much their condition ("status") differs from near natural conditions. Water bodies in a near natural condition are at high status while those whose quality has been severely damaged are at bad status.

The **water quality** classification looks at both biological and chemical indicators of pollution. Water bodies with low levels of pollution are classified as high or good water quality, whereas those with high levels of pollution are classified as poor or bad.

The classification system was devised following EU and UK guidance. It is underpinned by a range of biological quality elements, supported by measurements of chemistry, hydrology (changes to water levels and water flows), morphology (changes to the beds, banks and shores of water bodies) and an assessment of invasive non-native species.

The following settlements are located close to freshwater watercourses that are included in SEPA's monitoring programme:

Burnside (Burn of Netherbrough)

The Palace (Burn of Boardhouse)

Lyron (Burn of Sweenalay)

Burray Village (Burn of Sutherland)

Stenness Village (Loch of Stenness)

The water quality and overall status classification of monitored watercourses in Orkney, based on the findings of sampling undertaken during 2013 is summarised in **Appendix B.2**.

### 3.5 Environmental Issues

Inappropriately designed and/or sited development can lead to negative impact upon water quality. The SG should provide a brief explanation of River Basin Management Planning and the role of the planning authority in contributing to RBMP objectives. It should highlight ways in which new development can avoid adverse impact on the water environment, e.g. in the appropriate siting and design of septic tanks and by establishing development-free buffer zones adjacent to water bodies.

## 4. Soil

SEA Objectives
Reduce the threat of contamination and seek to protect soils from damage such as erosion or compaction.
Recognise the environmental benefits provided by soils and protect their quality and quantity.

## 4.1 Soil types

General information on the soil types of Orkney is available from Scottish Natural Heritage Review No 100, Orkney Character Assessment.<sup>17</sup> More detailed information is available from the Soil and Land Capability for Agriculture Maps (Orkney and Shetland) and accompanying handbook, both of which are produced by the Macaulay Institute<sup>18</sup>.

Data is currently not available on the quality of soils in Scotland as no monitoring is carried out on their composition. However, Scotland's Climate Change Programme<sup>19</sup> includes plans to establish a soil monitoring system, especially with regard to carbon content, and to develop a soil strategy.

## 4.2 Peat and carbon-rich soils

Layers of peat underlie large areas of Orkney, including its moorland hills and peatland basins, where they represent important sinks and storage areas for carbon. Peat forms over periods of hundreds to thousands of years in wet conditions where water saturation causes anoxic conditions and prevents bacteria and fungi from rapidly decomposing the remains of dead plants. Moorland vegetation such as sphagnum moss and heather dies back and accumulates, year on year, becoming compressed and altered and ultimately preserved as layers of peat at a very slow rate of approximately 1 cm in 10 years. Although a very slow process, peat continues to form in these areas where conditions are suitable, and represents an important means of removing carbon dioxide from the atmosphere.

Due to its capacity to absorb and store water, peat also represents a valuable resource for the regulation of water storage. Many plant species and the species which they in turn support are dependent on the chemical and physical properties of peat and cannot survive in other substrates. It is therefore important, where possible, to avoid or minimise the disturbance or loss of peat.

Scottish Natural Heritage has prepared a consolidated spatial dataset of 'carbon rich soil, deep peat and priority peatland habitats' in Scotland derived from existing soil and vegetation data. The new Carbon and Peatland (2014) map<sup>20</sup> provides greater understanding of where Scotland's peatlands are to be found and it is envisaged that the new map and data may be used to:

- Provide greater appreciation and transparency around where Scotland's peatland occur
- Support strategies and projects related to the management and restoration of Scotland's peatland habitats
- Support the implementation of the forthcoming Scotland's National Peatland Plan
- Assist in identifying peat and other carbon-rich soils for development planning and development management purposes
- Facilitate mapping of wind farm spatial frameworks in line with the new Scottish Planning Policy (SPP) (2014)

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<sup>17</sup> Scottish Natural Heritage Review No 100, Orkney Landscape Character Assessment. Land Use Consultants, Glasgow (1998)

<sup>18</sup> Soil and Land Capability for Agriculture Maps (Orkney and Shetland) [mapsales@macaulay.ac.uk](mailto:mapsales@macaulay.ac.uk)

<sup>19</sup> Changing Our Ways, Scotland's Climate Change Programme Scottish Executive (2006)

<sup>20</sup> <http://www.snh.gov.uk/planning-and-development/advice-for-planners-and-developers/soils-and-development/cpp/>

- Inform the siting of proposals that could impact on the soil resource and subsequent mitigation to avoid or reduce such impacts

### 4.3 Environmental issues

Loss of, or disturbance to, peatland can cause the release of stored carbon to the atmosphere. Inappropriate development and site drainage may lead to increased soil erosion. Clarification that planning approval is required to dispose of topsoil from development sites would be useful.

The SG should highlight the role played by peat and soils in storing carbon.

It should explain the need for all development to avoid or minimise the loss of or disturbance to peat and carbon rich soils.

It should list the range of information that the planning authority would expect to be included in a peatland or soil management plan.

## 5. Geology

SEA Objective
Protect designated and undesignated sites which are recognised and valued for their geological or geomorphological importance.

### 5.1 Summary of Orkney's geological history<sup>21,22</sup>

Most of the rocks which make up Orkney as we know it today formed around 400 million years ago during the Devonian Period when Britain was positioned approximately 10° south of the equator and was part of a supercontinent made up of the land masses which are today North America and Northern Europe. At that time there were mountains to the north-west and the open Devonian Sea covered the area that is now southwest England. Between the mountains and the sea was a vast desert plain within which a large, shallow, freshwater lake occupied the topographic lowest levels. This shallow lake, known as Lake Orcadie, extended from Shetland, through Orkney, Caithness and the Moray coast and across to western Norway. It was fed by numerous rivers which flowed down from the western mountains eroding gravel sand and mud and transporting these materials into the lake where they settled out as layers on the lake bed.

The oldest rock exposed in Orkney is the Precambrian Basement Complex, examples of which outcrop around the town of Stromness and on the neighbouring island of Graemsay. These outcrops represent the tops of island hills which were surrounded by Lake Orcadie. In the warm, tropical climate evaporation rates were high and rainfall was seasonally variable and this caused large fluctuations in the depth of the lake and the area that it covered. Mud flats on the lake margins periodically dried out before being inundated again. Evidence for this can be seen today in flagstones where mud cracks are visible which have been filled in by sand. Superimposed on this seasonal cycle were climatic patterns which varied on a much longer timescale, causing the lake to become steadily deeper and wider, at times meeting the edge of the western mountains before retreating to begin the cycle again. These cycles are easily seen

<sup>21</sup> Geology of Orkney. [www.fettes.com/Orkney/geology.htm](http://www.fettes.com/Orkney/geology.htm)

<sup>22</sup> Orkney and Shetland a Landscape Fashioned by Geology [www.snh.org.uk](http://www.snh.org.uk)

in the well exposed coastal cliffs of the West Mainland where the cycle begins with a finely laminated dark grey to black muddy flagstone representing periods of greatest water depth in Lake Orcadie and ends with shallow water lake margin sediments consisting of sands, silts and light grey muds.

At times Lake Orcadie appears to have been very productive and evidence shows that during intervening periods of drought large numbers of fish died, sinking out of the water column to the bed of the lake where they became preserved in the fine-grained muds. Remains of these fish can be seen today as fossil fragments in the flagstone strata known as the Sandwick and Rousay fish beds, which are most clearly visible at Cruaday Quarry in the parish of Sandwick. The discovery of many fossil fish during the extraction of stone for construction purposes led to designation of the quarry as a Site of Special Scientific Interest. Some of the particularly fine specimens recovered from Cruaday are now displayed at the Fossil Centre in Burray along with fossils from other locations in the Orkney and Caithness area.

This cyclicity of lake deposition continued until Upper Devonian times when the waters of Lake Orcadie retreated so far that it became broken up into many small separate lakes in a predominantly desert landscape. This dry period is characterised by sandstones derived from deposits laid down by the large braided rivers which continued to flow from the Western Mountains, and also the sand dunes which migrated across the desert plains. Great thicknesses of sand and gravel were deposited and are preserved, for example, on Orkney's best known natural feature, the Old Man of Hoy, where they rest on a basal plinth of tough lavas that resist erosion by the sea.

Changes in stress within the Earth's crust during Carboniferous to Permian times led to considerable volcanic activity in the area, leaving lavas and vents filled with agglomerate and ash. Intrusive igneous dykes dating from the Younger Permian (250 million years ago) are numerous and can be seen traversing the intertidal areas of many rocky shores. A particularly clear example is found at the Point of Buckquoy in Birsay where the black basalt dyke containing vesicles (bubbles) contrasts strongly with the surrounding paler sedimentary rock.

The formation of depressions in the Earth's crust, where sediments accumulated, continued around Scotland throughout Mesozoic and up to Quaternary times. Economic quantities of oil and gas accumulated in some of these depressions or basins. By the late Permian period, stresses in the Earth's crust created the Viking Graben, a rift valley located in what was to become the North Sea. This event marked the partial break-up of the supercontinent. The rift valley filled with sediments eroded from adjacent areas, including the Orkney-Shetland region, and by early Jurassic times a link with the open sea was established.

Thick sequences of marine sediments accumulated in basins around Britain during Jurassic and Cretaceous times at this time. Tensional stresses were creating a new ocean, the Atlantic, as the supercontinent split apart. North America separated from Africa in the Jurassic (around 165 million years ago) and from Europe in the Late Cretaceous. Europe and North America gradually moved apart as volcanic eruptions added new material along the central spine of the widening ocean – the Mid-Atlantic Ridge.

The earliest stages of stretching and thinning of the Earth's crust near the margin of the emergent ocean allowed molten lava to break through the crust to form a line of volcanoes, for example those running from Skye to Arran. To the present day, we continue to move farther and farther away from America as volcanic eruptions along the Mid-Atlantic Ridge adds new ocean floor, thus forcing the continents apart.

The land mass containing Orkney continued to move northward and during the Quaternary (2.6 millions years ago) its geology became heavily modified by glaciation which smoothed and



rounded hills and ridges on land and excavated the major firths of Hoy Sound, Eynhallow Sound and Westray Firth. Local glaciers developed at intervals on the island of Hoy where they carved out striking corries and valleys. As the last ice sheet thinned and retreated, considerable thicknesses of glacial deposits were laid down in hollows. A coastal section at Den Wick in Deerness contains two superimposed depositions of glacial till. Likewise, cliff sections at Scara Taing in Rousay are important for the exposure of three superimposed tills and the adjacent striated (scratched) bedrock surfaces which provide evidence of fluctuating patterns of ice flow.

Although ice has covered Orkney and Shetland many times during the last two million years and sculpted the landscape, the broad outline of the islands owes much to the action of the wind, rain and sea over the last 150 million years. The sea has cut 'geos', which are long narrow slots following faults and joints, into the cliffed coastline and also eroded 'gloups' (blow-holes), caves and natural arches. The Gloup in Deerness is probably the finest example of a blow hole to be seen in Orkney and in the island of Stronsay a natural arch remains intact at the Vat of Kirbister. As erosion continues, the rock spanning arches protruding from the retreating cliff line often collapses, leaving vertical rock pillars as sea stacks; the most famous of these are the Old Man of Hoy and the Castle of Yesnaby, both formed of sandstone.

The power of the sea during westerly gales is vividly illustrated by the high-level storm beaches formed of large blocks of rock, which have been torn from the cliff by the waves and piled up in crescent-shaped ridges behind the cliff top. An excellent example can be seen at Sacquoy Head on Rousay, where boulders lie as much as 80 metres inland at the top of 18 metre high sea cliffs.

A rise in sea level following the melting of the glaciers about 10,000 years ago was responsible for the drowned landscape of the inner coasts of Orkney. Flooding of the gently undulating Orkney landscape has formed broad open bays, often backed by sand dunes. Layers of peat, some containing tree trunks and roots, occur beneath the sand and shingle of some modern beaches.

The combined forces of wave action and tidal currents are responsible for the constant reworking of seabed sediments which surround the coasts of Orkney, for example the process of long-shore drift causes sand and gravel to be transported laterally along the shoreline often forming distinctive geomorphological features including narrow spits of shingle or sand. These coastal features are known as 'ayres' in Orkney, and are commonly found cutting across the seaward ends of shallow bays. In some cases spits may partly, or completely, cut off a sheltered stretch of water from the sea to form a shallow lagoon or 'oyce', which eventually may silt up to become a stretch of fertile land. Spits can also form tombolos, joining islands to offshore isles. The island of Sanday is one of the best locations in Orkney where these and other coastal sand features can be seen.

## **5.2 Sites designated for their geological / geomorphological importance.**

Orkney's geological history is most clearly visible and interpreted along its coastlines where the rock has been subject to sea level change, deformation, erosion and localised deposition; and also in quarries where rock extraction has exposed a sequence of rock strata. A number of sites are designated, either nationally as Sites of Special Scientific Interest and/or Geological Conservation Review Sites; or locally as Local Nature Conservation Sites on account of their geological/geomorphological importance in an Orkney context. A full list of these sites is included in **Table 5.1**.

**Table 5.1: Sites in Orkney, that are designated for their geological/geomorphological importance<sup>23</sup>**

<b>SITE</b>	<b>DESIGNATION</b>	<b>GEOLOGICAL/GEOMORPHOLOGICAL INTEREST</b>
<b>Birsay</b>		
Point of Buckquoy	LNCS	Unique exposure demonstrates consequences of oscillation in the level of Lake Orcadie during the Devonian
Whitaloo Point	LNCS	A typical monoclinal fold in Upper Stromness Flags
<b>Deerness</b>		
Denwick	SSSI/GCR	Best example in Orkney of a multiple till section
Point of Ayre	GCR	Area of basaltic lava flow
Taracliff Bay – Newark Bay	GCR	Section showing transition from Rousay Flag series to Lower Eday Flag series
Mirkady Point	LNCS	Shingle spit
<b>Eday</b>		
Greenan Nev Coast,	GCR	Exposure of Eday marls of interest in the study of Palaeo environments
Newbiggin to Neven Point,	LNCS	Good section of the western limb of the Eday Syncline
South Fersness Bay,	GCR	Good section of the western limb of the Eday Syncline
<b>Evie &amp; Rendall</b>		
Links of Aikerness	LNCS	Outcrops of Aeolianite unique in Scotland
<b>Hoy &amp; Graemsay</b>		
Hoy	SSSI / GCR	geology, geomorphology, petrifying tufa springs, (Ward Hill, Enegars Corrie & Dwarfie Hamars) Exposures of the Hoy Volcanics and the Hoy Sandstone in their type area (Old Man of Hoy Coast) Silurian and Devonian volcanic ricks (Too of the Head)
Melsetter Coast section, Hoy	LNCS	Outcrops of the Hoy Lavas
Muckle Head and Selwick	SSSI/ GCR	Geological site due to locally important raised beach deposits
North Coast of Graemsay	LNCS	Exposure of the lower section of the Stromness Flags and crystalline basement
<b>Sanday</b>		
Central Sanday	SSSI/ GCR	Machair and other blown sand and shingle landforms unique in North Scotland.
Doun Helzie,	LNCS	Beach Dune and Machair association
Hegglie Ber,	LNCS	Coarse pebbly and conglomeratic facies of Lower Eday Sandstone
Scar	LNCS	Glacial erratic
<b>Sandwick</b>		
Bay of Skail	SSSI/GCR	Middle Devonian Fish Beds with fossil plant community

<sup>23</sup> JNCC website; also The Orkney Local Development Plan 2014

SITE	DESIGNATION	GEOLOGICAL/GEOMORPHOLOGICAL INTEREST
Cruaday Quarry	SSSI/GCR	Site is of outstanding geological importance due to exposure and preservation of the Sandwich Fish Beds
Stromness Heaths & Coasts	SSSI/GCR	Coastal geomorphology (West Coast of Orkney) Non-marine Devonian (Yesnaby & Gaulton Coast Section)
<b>Shapinsay</b>		
Vasa Loch	LNCS	Complex cusped foreland
Lairo Water and The Ouse	LNCS	Complex of shingle depositional landforms
<b>South Ronaldsay</b>		
Ayre of Cara	LNCS	Provides opportunity for study of rates of accretion and erosion due to construction of Churchill Barriers
Croo Stone Vent coast section	LNCS	Largest and most complex vent to be found in Orkney
Dam of Hoxa	LNCS	Composite depositional structure
South-east Coast	LNCS	Shows relationship of coastal morphology to geological structure
The Altar	LNCS	Demonstrates the influence of jointing on the resultant coastal landforms
<b>Stromness</b>		
South Stromness Coast	SSSI/ GCR	Crystalline basement rock with overlying Stromness Flags. Lead mineralisation.
<b>Stronsay</b>		
Mill Bay, Stronsay	SSSI/ GCR	Geological: Classic shelly till with palaeo-geomorphological importance.

SSSI: Site of Special Scientific Interest

GCR: Geological Conservation Review site (nationally important Earth Science Site)

LNCS: Local Nature Conservation Site

### 5.3 Environmental issues

The policies and proposals of the Orkney Local Development Plan and the associated Supplementary Guidance Natural Environment should provide effective protection to sites which are designated for their geological or geomorphological interest and which illustrate Orkney's geological history.

### Summary of data collected in compiling the environmental baseline

DATA	SOURCE
Area and population of Orkney	General Register Office for Scotland
<b>CLIMATIC FACTORS</b>	
CO <sub>2</sub> emissions within the scope of influence of Orkney Islands Council	Ricardo-AEA May 2014 Local and Regional CO <sub>2</sub> Emissions Estimates for 2005-2012 (Ricardo-AEA/R/3374)

DATA	SOURCE
Average rainfall in Orkney	SNIFFER, 'A handbook of climate trends across Scotland', 2006 <a href="http://www.sniffer.org.uk">www.sniffer.org.uk</a>
Information on current climate trends	<a href="http://www.scotlandscensus.gov.uk/documents/censusresults/release2a/rel2asbfigure21.pdf">http://www.scotlandscensus.gov.uk/documents/censusresults/release2a/rel2asbfigure21.pdf</a>
	SNIFFER, 'A handbook of climate trends across Scotland', 2006 <a href="http://www.sniffer.org.uk">www.sniffer.org.uk</a>
Information on sea level rise	National Oceanic and Atmospheric Administration (NOAA) <a href="http://oceanservice.noaa.gov/facts/sealevel.html">http://oceanservice.noaa.gov/facts/sealevel.html</a>
North of Scotland future climate change scenarios	UK Climate Impacts Programme <a href="http://www.ukcip.org.uk">www.ukcip.org.uk</a>
<b>BIODIVERSITY, FLORA &amp; FAUNA</b>	
Legislation relating to European Protected Species	SNH website: <a href="http://www.snh.gov.uk">www.snh.gov.uk</a>
List of statutory and non-statutory designated natural heritage sites	Scottish Natural Heritage (SNH) <a href="http://www.snh.gov.uk">www.snh.gov.uk</a> Orkney Islands Council Local Plan
Lists of Priority habitats in Orkney	Orkney Islands Council Local Biodiversity Action Plan
Information on bat sightings in Orkney	Orkney Wildlife Information and Records Centre
Information on cetacean presence in Orkney	Booth, C. & J. Sillocks, Skarfies & Selkies, (2005)
Information on basking shark presence in Orkney	Orkney Wildlife Information and Records Centre
Measures to protect species outwith designated areas	SNH website: <a href="http://www.snh.gov.uk">www.snh.gov.uk</a>
Information relating to RSPB reserves in Orkney	RSPB website: <a href="http://www.rspb.org.uk">www.rspb.org.uk</a>
Climate change and natural heritage	Scottish Natural Heritage <a href="http://www.snh.gov.uk/climate-change/impacts-in-scotland/effects/habitats/">http://www.snh.gov.uk/climate-change/impacts-in-scotland/effects/habitats/</a>
<b>WATER</b>	
Water quality data ( freshwater and coastal) and Groundwater quality data	Scottish Environment Protection Agency (SEPA)

DATA	SOURCE
Definition of Groundwater Dependent Terrestrial Ecosystems	Water Framework Directive UK Technical Advisory Group <a href="http://www.wfduk.org/resources/groundwater-dependent-terrestrial-ecosystem-threshold-values">http://www.wfduk.org/resources/groundwater-dependent-terrestrial-ecosystem-threshold-values</a>
GDTEs present in Orkney	Scotland's Environment Web
<b>SOIL</b>	
Information relating to Orkney soil types	Soil and land capability for agriculture maps (Orkney and Shetland) <a href="mailto:mapsales@macaulay.ac.uk">mapsales@macaulay.ac.uk</a>
	Scottish Natural Heritage Review No 100, Orkney Landscape Character Assessment. Land Use Consultants, Glasgow (1998)
Plans to establish a soil monitoring system	Changing Our Ways, Scotland's Climate Change Programme, Scottish Executive 2006
<b>GEOLOGY</b>	
Geology of Orkney	<a href="http://www.fettes.com/orkney/geology">www.fettes.com/orkney/geology</a>
Orkney and Shetland a Landscape Fashioned by Geology	<a href="http://www.snh.org.uk">www.snh.org.uk</a>
Orkney geological sites	JNCC website The Orkney Local Development Plan 2014