Climate Proofing the Cheviot Hills

Climate change and its associated impacts are at the forefront of the Environment Agency's agenda, with a focus on identifying efficient and pragmatic adaptation techniques that will be effective with the predicted climate changes by 2050. To further develop our understanding, with respect to climate change adaptation, a project has been set up to identify and trial techniques that will aid adaptation to the impacts of climate change in the Cheviot Hills region, within Northumberland and the Scottish Borders.

The project has commenced with a Scoping Study, which is the focus of this document, working with key organisations to identify efficient and effective techniques to reduce the threat from altering weather patterns. The study area is broad due to the potential interconnectivity between geographical areas (e.g. upland to lowland) or between issues (e.g. water resources and agriculture), and covers large parts of Northumberland and the Scottish Borders and small sections of Cumbria and Dumfries & Galloway. The scoping study looked at six land-uses on which the impacts of climate change were assessed, along with suggested adaptations that informed trial techniques to be used at four demonstration sites. The land-uses assessed in this study included:

- Agriculture
- Nature Conservation
- Forestry and Woodland
- Military
- Tourism and Recreation
- Water Resources

The climate change predictions used in this report have been generated using the Environment Agency's Regional and Weather Impacts Generator (EARWIG), which allows for weather predictions to be generated on a spatial grid of 5km squares and provide daily, monthly and seasonal averages. Two locations were chosen at either end of the study area (Cell 1, in the north, and Cell 4, in the south) and the model's outputs were based on the UK Climate Impacts Programme (UKCIP) 2050's Medium High emissions scenario and compared to the 1960-91 baseline average. A summary of the main predicted climate changes is presented below.

Temperature	• An increase in the annual average can be expected of 1.7 and 1.8°C (Cells 1 and 4 respectively). • All seasons exhibit an increase ranging from 1.3 to 2.1°C, with summer showing the highest increase and winter the least. No significant difference was observed between the two Cells. • The occurrence of frost is predicted to decrease by 41.4 and 41.5% (Cells 1 and 4 respectively) with no change in the annual timing of frost events (i.e. earlier or later).
Rainfall	• A decrease in the annual average can be expected of 4.7 and 3.0% (Cells 1 and 4 respectively). • Strong seasonal fluctuations are predicted, with summer showing a large decrease (31.8 and 24.8%, Cells 1 and 4 respectively) and winter a significant increase (8.7 and 13.7%, Cells 1 and 4 respectively). A small decrease was exhibited by both Cells in autumn, whilst spring varied between Cells, with Cell 1 showing a 5.8% increase and Cell 4 a 3.5% decrease. • The seasonal soil moisture content predictions mirrored those for rainfall with large reductions in the summer and increases in winter.
Wind	• A small reduction in mean and maximum wind speed, with no significant difference between the two Cells, can be expected, although the frequency of wind events may increase.

A flood risk assessment has been conducted on the study area, incorporating the predicted climate changes, to give us an insight into how the occurrence and severity of flooding may change, and which areas and sectors will be the most affected. The assessment identifies upland areas as having the greatest flood risk due to the faster flood flows and the limited response time available from flood warnings. This is likely to increase with the increasing seasonality of rainfall, bringing higher intensity, flashy flood flows, particularly during the summer months. The increasing seasonality of rainfall, and autumn and winter wetness, will also lead to greater ground saturation again particularly in upland areas. The result will be higher volumes and rate of runoff flows, which will exacerbate associated issues.

Key Impacts and Adaptations

Agriculture

The predicted climate changes are expected to have a negative impact on agricultural yield, primarily due to an increase in stress levels on the animals and plants farmed, caused by increases in temperature, drought conditions and water logged soils, thus affecting quality and growth. Indirect effects of climate change, such as an increase in pests and diseases, will also have a negative impact. Agricultural adaptations to climate change include:

- Sourcing animals and plants from warmer climates.
- Being more water efficient and providing shade/shelter.
- Sourcing alternative water supply schemes.
- Using biofuels and renewable energy.
- Producing and implementing pest and diseases management plans.

Nature Conservation

Species and habitats occupy areas of climate space which is suitable for their existence. Climate change is altering the location of this 'suitable space', resulting in a general northern shift in species distribution; however the fragmentation of the countryside can impede this. Species will find it increasingly difficult to survive in their current locations, whereas some habitats can be lost altogether. Aquatic systems are especially sensitive to changes in temperature, and peatlands (important for their role in carbon storage) are at increasing risk of drying out. Changes in phenology alter predator/prey interactions and competition, whilst climate reduces species' resilience and increases the chance of being over-competed by harmful invasive species. Nature conservation adaptations include:

- Using models to predict how species and habitats will move.
- Better management, protection, restoration and enlargement of conservation areas; implementation of action plans; and providing buffer zones.
- Promotion of agri-environment and restoration projects, specifically peatlands.
- Identify specific climate change effects and how species will respond.
- Improve resilience of species and habitat connectivity.
- Reduce pressure from other sectors.

Forestry and Woodland

Forestry and woodland play an important role in the global carbon budget, which needs to be taken into account when assessing the associated impacts and adaptations. The impacts of climate change on forestry are similar to that for agriculture, whilst those for woodlands are synonymous to those for nature conservation. A reduction in yield is predicted for forestry, with quality of timber also being reduced; however there is the additional risk from forest fires. Woodland tree species and associated organisms would be affected as described above. Forestry and woodland adaptations include:

- Using prediction models for wind, changing climate space, and how pest and diseases may spread.
- Sourcing trees from warmer climates; altering planting times and locations.
- Promote sustainable practices.
- Producing and implementing pest and diseases management plans.
- Investigate wildfires.
- For protection of woodlands, see nature conservation adaptations.

Military

The Otterburn Training Area makes for an excellent training ground because of the variety of habitats that it contains. As such the impacts of climate change on military in this area reflects the impacts on these habitats, specifically the rampant growth of bracken, increased water shortages and increased risk of flooding and fires. Military adaptations include:

- New fire fighting and control burning techniques.
- Increased water storage and natural drainage systems.
- Produce invasive species management plans.
- Use biofuels and renewable energy.

Tourism and Recreation

Climate change is predicted to have a beneficial effect on this sector through an increase in domestic and international visitors. However, this will put extra pressures on existing services (such as hotels, transport, and parking) and resources (such as water and nature conservation). Tourism is also a major contributor of carbon emissions, through transport, mainly flights, and related activities. Tourism and recreation adaptations include:

- Promoting sustainable tourism, eco-tourism and green tourism schemes.
- Educated visitors to conserve resources whilst also developing their experience.
- Investigate increased tourism demand and tourism participation in carbon offsetting schemes.

Water resources

Climate variations can have a significant influence on water resources regarding the supply and demand for water and the physical, chemical and biological components of the water resource environment. Water resource adaptations include:

- Investigating the use of vegetation for shading and reducing flood risk.
- Promote the wise use of water and water harvesting.
- Provide incentives for reducing water use and recreating floodplains / wetlands.

Demonstration Sites

A key aim of this scoping study was to recommend a range of trial demonstration sites that cover the predicted climate change impacts and adaptation techniques on the various land uses of the study. Four trial demonstration sites were identified - Millfield Plain, Wooler Water, Breamish Valley and Otterburn Camp. Although, Otterburn Camp does not form part of the sub-catchment which contains the other sites, it has been included as a trial demonstration site in response to adaptation measures that are directly related to the Otterburn Camp. At each demonstration site adaptation measures were identified. A total of 14 specific adaptation measures / projects were identified and placed in a prioritisation framework based effectiveness, practicability, timescale and estimated cost. Key projects included those associated with fire management, water storage, wetland flood control, peatland rehabilitation, wind erosion monitoring of agricultural soils and best practise guidelines for farm management.