GOLF COURSE 2030
GREAT BRITAIN & IRELAND

ACTION PLAN

COASTAL CHANGE AND ITS IMPACT ON GOLF COURSES

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# COASTAL CHANGE AND ITS IMPACT ON GOLF COURSES

## TABLE OF CONTENTS

1. INTRODUCTION  
2. COASTAL CHANGE  
3. THE CHALLENGES POSED BY COASTAL CHANGE  
4. THE OPPORTUNITIES PRESENTED BY COASTAL CHANGE  
5. EXISTING KNOWLEDGE ABOUT COASTAL CHANGE  
   - 5.1 Land ownership  
   - 5.2 Climate change predictions  
   - 5.3 Information resources by country  
   - 5.4 Coastal management strategies  
6. GAPS IN KNOWLEDGE RELATED TO COASTAL CHANGE  
7. PROPOSED ACTIONS TO ADDRESS THE CHALLENGES POSED BY COASTAL CHANGE  
8. PROPOSED ACTIONS TO TAKE ADVANTAGE OF THE OPPORTUNITIES POSED BY COASTAL CHANGE  
9. RAISING AWARENESS OF THE CHALLENGES AND OPPORTUNITIES  
10. POTENTIAL FUNDING SOURCES FOR PROPOSED ACTIONS  
11. RECOMMENDATIONS FOR ACTION  
12. SUCCESSFUL OUTCOMES FOR THIS ACTION PLAN  
13. ACKNOWLEDGEMENTS  
14. REFERENCES  
   - UK  
   - England  
   - Northern Ireland  
   - Republic of Ireland  
   - Scotland  
   - Wales  
**APPENDIX 1.** Golf Course 2030 Scenarios  
**APPENDIX 2.** Links and cliff top courses of GB&I  
   - England  
   - Ireland  
   - Scotland  
   - Wales  


1. INTRODUCTION

Golf Course 2030 seeks to bring the golf industry together to clearly identify the challenges and opportunities facing those developing, designing, building and managing golf courses with regards to the changing climate, increasing resource constraints, and the regulations agenda.

Golf Course 2030 centres on a range of realistic scenarios (see Appendix 1), from business as usual to, effectively, a doomsday prediction of disruption from extreme weather, water scarcity, high resource costs and limited chemical availability. In this challenging environment it is impossible to see how we can maintain the playing conditions we enjoy today without technological breakthroughs, and changes in attitudes and behaviours amongst many of the sport’s stakeholders, including golf club owners, golfers, managers and greenstaff.

Golf Course 2030 aims to prepare the sport for what may be difficult times ahead; to help ensure that current strategies and solutions are effective; to uncover new solutions which can mitigate some of the challenges; and to make the most of opportunities that arise to enhance course condition and playability.

Coastal change and its impact on golf courses was identified by industry stakeholders as a priority issue for investigation. This Action Plan has been prepared to deliver a roadmap to secure a better understanding of the issue and possible outcomes to mitigate its challenges and take advantage of its opportunities.

2. COASTAL CHANGE

Coastal communities, infrastructure and landscapes already face threats from flooding and coastal erosion. These threats will increase in the future, with some coastal communities and infrastructure likely to be unviable in their current form.

Sustainable coastal adaptation for golf facilities will require:

1. Awareness of the situation facing them and an understanding of uncertainty in relation to coastal change predictions
2. Awareness of the process they need to go through, and the agencies they need to work with, to devise a plan for the future of the facility
3. Long-term commitment and proactive steps from a range of stakeholders, including government, to inform change in social attitudes.

These requirements apply to links, since it is these which are most vulnerable to both sea level rise and to increased erosion as a result of increased storminess, and cliff top golf courses, especially on the east and south coasts of England, which are vulnerable to increased erosion of the soft cliffs below them. An incomplete list of links and cliff top courses in GB&I is provided in Appendix 2.
Parts of GB&I will have to adapt to sea level rise at some point in the future. Some model projections indicate that this will happen over the next 80 years, though it is already evident in parts of Wales and the east coast of England. Coastal structures need to be ready to cope with these rates of sea level rise or risk large-scale damage from extreme storm events. Rising sea levels will make the most damaging coastal floods more frequent, as well as increasing rates of coastal erosion. Many existing coastal defences are likely to be at risk of failure as sea levels rise. It is estimated that 32% of the Northern Ireland coast (including its sea loughs) is armoured, compared to 44% in England and Wales and 6% in Scotland. For Scotland, such defences tend to be limited to soft, low lying land. It is believed that 19.5% of the Northern Ireland coastline is suffering from erosion, compared to 29.8% in England. A sea level rise of 0.5 m is projected to make 20% of England’s coastal defences vulnerable to failure. Some are at the end of their life having been built more than 50 years ago, post the severe floods of 1953, and there is always the prospect of failure if a storm is powerful enough. This risk will be even higher if the current rates of deterioration of protective natural environments (e.g. saltmarshes, shingle beaches and sand dunes) continue.

Golf courses on the coastal fringe have been impacted by flooding and erosion throughout their history. This situation does seem to have become more acute in recent times, e.g. the well-publicised examples of Royal North Devon and Montrose Golf Links. Climate change predictions for more storms and rising sea levels will increase the likelihood of these impacts causing major damage. There will be an impact not only on golf facilities but also on local communities and local economies.

Today, coastal management is covered by a complex patchwork of legislation and is carried out by a variety of organisations with different responsibilities. Current shoreline management tends to be reactive and poorly structured in some areas and continuation of current practice will lead to coastal degradation and loss of amenity value. Shoreline Management Plans (SMPs) have the ambition to provide a structured and consistent framework and this may be better achieved when they are refreshed in coming years. A brief explanation of SMPs would include the fact that they:

- are not statutory, but agreed between all stakeholders
- consider flood and erosion risk, but take all other functions into account
- set policies with consideration of fundability, but this is not a guarantee (and indications are often unrealistic)
- set policies which have status, and any change needs to be agreed through a set process
- require additional information on what happens next, including how are schemes to be developed, who is responsible for maintenance, and who will pay?

The strategy of ‘holding the line’ to maintain and protect some courses is already expensive and time-consuming, so the costs and benefits of protection or surrender of the land or hole, will become even more acute in a changing climate.

3. THE CHALLENGES POSED BY COASTAL CHANGE

Rising sea level will cause more flooding of low-lying coastal areas. It will also cause issues with the water table reflected in the quality of borehole supply and the ability of land drainage schemes to outlet into estuaries and the sea.
More storms will increase the risk of erosion and the impact of tides. Storm damage will also cause debris to be deposited on the land, which can cause direct damage but also requires time and labour to clear.

In addition, predictions for higher levels of precipitation will increase waterlogging and destabilisation of coastal areas with increased downhill flow from rivers. The challenge for golf courses will be to mitigate the effects of flooding and erosion.

Flooding:

- Turf damage through waterlogging and salt contamination
- Salt contamination of bore holes, with increased risk of plant stress and soil damage
- Loss of playing days and associated revenue
- The cost of mitigation, e.g. the need for increased use of pumps and pipes improving the infrastructure to handle stronger water flow
- Cost of repairs.

Erosion:

- Loss of holes or parts of holes
- Greater likelihood of flooding
- Sand blow/accretion
- The cost of mitigation, e.g. investment in defences or change in land use as part of a managed retreat.

Although the land user, in this case the golf facility, may feel the impact, the cause may originate from land owned by another entity. There will be a need to work with the other landowners since climate change problems will be shared. This requirement for cooperation between organisations will lead to the need to have the time and resources to form partnerships and groups.

The predictions are credible so business as usual might be an option for a few decades if defences were raised and improved, though the duration of this position will depend on an assessment of costs vs benefits. Adequate defences could hold the line, but this will not be acceptable everywhere, e.g. in locations where they are not realistic, sustainable or affordable. The most likely impact is the alteration of existing layouts, possibly losing links character as holes are introduced inland to more fertile land with less sandy soil, and worse-case scenario is the loss of courses altogether.

References used to justify this response can be found in the ‘References’ section to the foot of this document.

4. THE OPPORTUNITIES PRESENTED BY COASTAL CHANGE

Enhancing natural defences can enhance nature and landscape values, providing greater diversity of habitat and wildlife. Examples of this would include the saltmarsh renovation at Dornoch and St Andrews in Scotland. This approach can result in stretches of the coastline that complement and add protection to important protected natural areas and landscapes which are situated adjacent to the area under threat.
Natural adjustment to cope with erosion and land loss could provide the opportunity to improve the layout or make it feasible to alter the purpose of the facility, e.g. a reduction in holes could result in an existing 18-hole facility becoming an academy and/or feeder venue.

Improving drainage of main in play areas and the need to redesign could contribute towards favouring traditional links turf, which will be more resilient to salt contamination whilst providing the opportunity to adjust the balance of habitat types to increase dune slack and wetland. Such management practices would also offer positive opportunities for the enhancement of coastal Blue Carbon habitats, which not only offer protective vegetated coastal buffer zones capable of keeping pace with sea level rise, but which also enhance natural carbon sequestration into the underlying soils.

Helping and enhancing biodiversity can also help to deliver a range of ecosystem services. The increase in dune slack and wetlands could result in greater biodiversity. They can act as a sponge for overflow, help with drainage, SUDS (if cleverly incorporated) and contribute to a situation of being better prepared for an increase in precipitation with regards to climate change predictions.

References used to justify this response can be found in the ‘References’ section to the foot of this document.

5. EXISTING KNOWLEDGE ABOUT COASTAL CHANGE

5.1 Land ownership

Confirmation of boundaries is essential in order to define responsibilities and duties regarding the management/maintenance of the coast. This can be done by consulting deeds and the land registry. In the UK, the coastline above the low water mark is owned by various land owners. The coastline below the low water mark is owned by the Crown. In the Republic of Ireland, the Irish State is in effect a feudal landlord and owns all of the land, including the coastline. This issue of coastline ownership may impact on policy on coastal management and also on the provision of funding from government.

5.2 Climate change predictions

Information on climate change impacts in relation to coastal change, storm and tide forecasts, predictions for future coastal change and information of flooding are available for all countries in GB&I. The main conclusions and recommendations tend to be the same, though for some there is more detail, notably for England and Scotland. The sources used to put this Action Plan together are listed in the ‘References’ section.

UKCP18 is the fourth generation of national climate projections for the United Kingdom and provides users with the most recent scientific evidence on projected climate changes with which to plan for the future. National golf organisations and individual golf facilities need to keep up to date with this kind of information, so they can prepare for future challenges. The United Kingdom Marine Climate Change Impacts Partnership (MCCIP) produces easy to read report cards about the impacts of climate change on natural habitats, and reference to the information it provides is a way for golf to be informed of the way coastal habitats may change in the future.

The pattern of sea level rise is not uniform across the UK, with notable regional differences, and greater impacts on soft rather than hard coasts. Relative sea level rise is less in the
north and more in the south, mainly due to the residual, post-glacial movement. The UK land mass is tilting. England experienced continuous rise in sea level over the last 10,000 years whilst, at least over the last 5,000 years, Scotland has experienced continuous fall in sea level. The scientific community consensus is that this isostatic readjustment has slowed, if not stopped altogether, so Scotland’s sea level rise may be about to accelerate and catch up with the rest of the UK. Mean sea level around the UK has risen by about 1.6 cm since the start of the 20th century (when corrected for land movement).

For London and Edinburgh, predictions for sea level rise by the end of the century (when compared to 1981-2000), for the low and high emission scenarios are summarised in the following table:

<table>
<thead>
<tr>
<th>Place</th>
<th>Sea level rise (m)</th>
<th>Low emission</th>
<th>High emission</th>
</tr>
</thead>
<tbody>
<tr>
<td>London</td>
<td></td>
<td>0.29-0.70</td>
<td>0.53-1.15</td>
</tr>
<tr>
<td>Edinburgh</td>
<td></td>
<td>0.08-0.49</td>
<td>0.30-0.90</td>
</tr>
</tbody>
</table>

These predictions could lead to a fivefold increase in the risk of a particular high tide event.

An increase in storm activity will increase the chance of sand blow and dune erosion, particularly when combined with rises in sea level.

The physical impacts of sea level rise will include:

- potential loss and/or change of coastal habitats
- migration along the coast of dune systems
- increased erosion of cliffs
- landward recession of the beach/dune system
- a rise in water tables
- an increase in soil-water salinity.

5.3 Information resources by country

**England and Wales**

The Environment Agency’s National Coastal Erosion Risk Map provides detail on the predicted erosion rates for 20, 50 and 100 years, along with the Shoreline Management Plan for each epoch. Stretches of coast are divided into ‘management units’, and for each of these one of the following four different management policies are agreed:

- no active intervention – there is no planned investment in defending against flooding or erosion, whether or not an artificial defence has existed previously
- hold the (existing defence) line – an aspiration to build or maintain artificial defences so that the position of the shoreline remains. Sometimes, the type or method of defence may change to achieve this result
- managed realignment – allowing the shoreline to move naturally but managing the process to direct it in certain areas. This is usually done in low-lying areas, but may occasionally apply to cliffs
- advance the line – new defences are built on the seaward side.

The work of the Marine Management Organisation is also relevant for England, as is Natural England.
Wales has its own Climate Change\textsuperscript{12} and Flooding and Coastal Erosion Risk Management\textsuperscript{11} strategies.

Scotland

The Climate Change (Scotland) Act 2009\textsuperscript{12} requires the development of an Adaptation Programme to take forward the risks identified within the UK's Climate Change Risk Assessment (UK-CCRA)\textsuperscript{13}. The UK-CCRA anticipates increases in sea level, coastal erosion and coastal flooding to increasingly affect Scotland's soft coastlines and the assets found on these coasts. Shoreline Management Plans have only been produced for short sections of the Scottish coast, e.g. in Fife, Angus and Ayrshire, which limits the information available to coastal managers. Consequently, a National Coastal Change Assessment (NCCA) has been commissioned by the Scottish Government and is supported by a number of agencies, including Scottish Golf.

The NCCA, through the Dynamic Coast\textsuperscript{14}, Scotland's Coastal Change Assessment website, provides a record of historic coastal change from maps produced between 1892 and 1905), compared to both the 1970's and current coastal position to estimate past erosion/accretion rates. Using the historic coastal change rates the coastline position can then be projected into the future, albeit mediated by a Coastal Erosion Susceptibility Model (CESM) whose function is to limit erosion to areas where the hinterland is susceptible to erosion. This will identify key assets at risk from future coastal erosion.

![Screenshot from Dynamic Coast website.](image)

The NCCA aims to inform existing strategic planning (Shoreline Management Plans, Flood Risk Management Planning, Strategic and Local Plans, National and Regional Marine Planning etc.) and to also identify those areas which may remain susceptible in the coming decades and require supplementary support. The identification of susceptible assets will enable the development of future management policies and adaptation plans robustly based on a strategic and objective evidence base.

The Marine Scotland – National Marine Plan Interactive mapping tool has been devised to assist in the development and implementation of Scotland’s National Marine Plan (NMP)\textsuperscript{15} by Marine Scotland.

![Screenshot from the Marine Scotland National Marine Plan website.](image)
The creation of a National Marine Plan will ensure increasing demands for the use of our marine environment are managed, economic development of marine industries is encouraged, and environmental protection is incorporated into marine decision making. It will also have a role to play in managing adaptation to climate change. The Plan will relate to the viability of coastal communities and terrestrial planning, because of the relationship between the Statutory Land Use Planning System and Marine Planning and Licensing, which could affect how golf courses are managed.

**Northern Ireland and the Republic of Ireland**

Reports on coastal change and planning and information on shoreline management, flooding and climate predictions are available from a number of sources for Northern Ireland and the Republic of Ireland and these are listed in the ‘References’ section.

The CHERISH (Climate, Heritage and Environments of Reefs, Islands and Headlands) project is a 5 year European-funded Ireland-Wales project between the Royal Commission on the Ancient and Historical Monuments of Wales, the Discovery Programme: Centre for Archaeology and Innovation Ireland, Aberystwyth University: Department of Geography and Earth Sciences and Geological Survey, Ireland. CHERISH aims to raise awareness and understanding of the past, present and near future impacts of climate change, storminess and extreme weather events on the rich cultural heritage of the Irish and Welsh regional seas and coast. CHERISH will work with communities and will widely disseminate the results and best practice for future climate change adaptation.

**5.4 Coastal management strategies**

Generally, strategies for all countries are in line with the UK Environment Agency’s management policies, and include:

1. monitoring erosion and change in dune systems
2. managed retreat – adaptive management which can be passive (where sediment released from erosion often helps to feed other beaches, but at the expense of infrastructure and property) or active (moving buildings back from the shoreline)
3. soft defences – beach nourishment and associated dune and habitat renovation. Examples would include dune grass planting, dune thatching, dune fencing, beach recycling, sandbag structures and beach nourishment, the sand engine/motor technique
4. hard defences – building sea walls/embankments to protect infrastructure and property. Examples would include gabion revetments, artificial headlands and reefs, nearshore breakwaters, groynes, beach drainage, rock or timber revetments and impermeable revetments.

Bio-engineering is a term used to describe a whole new industry that has sprung up in the last decade which produces products such as coir biorolls for soft coasts, or more environmentally friendly concrete for seawalls and gabions. Using these types of ‘defences’ goes some way to overcoming the negative connotations of this term and they are increasingly being favoured by planners and government authorities.

There are also plans for managing flooding from increased precipitation and river flow, which will affect the stabilisation of coastal areas from waterlogging. Increasingly, a multi-functional approach is being taken to coastal management – using a combination of techniques and approaches.
Building ever bigger defences to protect all coastal communities in the future would be prohibitively expensive, detract from the evolving coastal landscapes that people value and further interfere with the coast's natural adaptation to sea level rise.

The beach-dune system relationship is considered vital as a beach can dissipate wave energy, with coastal mudflats, salt marshes and wetlands serving the same function. These provide natural protection against flooding, whilst also being some of Britain's most important natural habitats. On much of our shoreline, however, the coast's natural protective mechanisms are being squeezed between rising sea levels and human development. There is growing global recognition of the role of these coastal ecosystems in the long-term, sustainable management of our coastlines.

The ability of land managers to undertake coastal protection work will be regulated by government, their agencies such as Natural England, Scottish Natural Heritage, Natural Resources Wales, the Northern Ireland Environment Agency and the Environmental Protection Agency (Ireland), and designations of protection for species and habitats such as SSSI and Natura 2000.

So, there is a great deal of information, including some planning, in relation to the challenges land owners are facing in relation to coastal change. There is a need for greater understanding of climate, coastal change and coastal geomorphology. These aspects should be the responsibility of government and their environment and coastal management agencies.

6. GAPS IN KNOWLEDGE RELATED TO COASTAL CHANGE

From a golf governance perspective, there are basic gaps in our knowledge in relation to the impact of coastal change on golf facilities that need to be addressed if the sport is to plan ahead in terms of provision and participation. The key gaps to fill include:

- the need for a central database of golf courses potentially threatened by coastal change. Whilst individual facilities may have considered the impact of coastal change on their course, and whilst there is data available on coastal change, the sport in GB&I does not have this information in a collated format for managers to access and to help with strategic planning. A database of this type could consist of an overarching report with a fact sheet on each course. This could also identify coastal protection already in place

- the extent of the risk for those facilities being impacted or likely to be impacted by coastal change

- the possible options for those golf facilities threatened by coastal change, informed by existing examples of facilities that have investigated their own situation

- the process of planning to adapt to coastal change in GB&I and who golf facilities engage with, e.g. statutory consultees. This could be presented in the form of a flow chart based on regions for managers to follow

- innovative practices for protection or adaptation that are cost-effective, which could be built into a database.
7. PROPOSED ACTIONS TO ADDRESS THE CHALLENGES POSED BY COASTAL CHANGE

Given the gaps in knowledge identified above, there are a number of actions needed to provide golf facilities with the information to develop their own strategy to mitigate against coastal change.

(a) The first thing that needs to be done is for the sport to gain a better understanding of the situation for each golf facility in GB&I under threat from coastal change. A simple survey might provide the answer to this.

(b) Guidance should be prepared to assist golf facilities to prepare their own risk management plan, which should include options for coastal protection and adaptation. This could be derived from, or form part of, a shoreline management plan to be incorporated into the overall climate change risk assessment, that would also include precipitation/drought, etc. The guidance should point golf facilities towards the statutory regulators who can impact on a facilities risk management plan, and perhaps constrain them significantly.

(c) Guidance should be developed to explain the process of engaging with coastal management plans and understanding climate change predictions in relation to coastal change.

(d) Research into innovative, cost-effective solutions.

8. PROPOSED ACTIONS TO TAKE ADVANTAGE OF THE OPPORTUNITIES POSED BY COASTAL CHANGE

As part of the guidance proposed in (b) and (c) above, the potential positives in relation to changing the layout of golf facilities and the potential for biodiversity enhancement should be explained, for example:

- enhancement of nature and landscape values, providing greater diversity of habitat and wildlife
- natural adjustment to cope with erosion and land loss could provide the opportunity to improve the layout or make it feasible to alter the purpose of the facility
- improving drainage of main in-play areas and the need to redesign could contribute towards favouring traditional links turf
- draining main in-play areas could provide the opportunity to adjust the balance of habitat types to increase dune slack and wetland with the additional benefits to local biodiversity and carbon sequestration
- helping and enhancing biodiversity can also help to deliver a range of ecosystem services.

9. RAISING AWARENESS OF THE CHALLENGES AND OPPORTUNITIES

Once the level of risk associated to each golf facility is identified, they need to be made aware of their options and how they engage with coastal management planning and
sources of funding. Additionally, the survey and guidance described previously needs to be widely disseminated and supported by education. Mechanisms to raise awareness might include seminars, webinars, training, guidance materials using a combination of direct personal activities and online support.

In order to raise awareness and implement the recommendations of this Action Plan, there will be a need for engagement from industry and external stakeholders:

- leadership from golf governing bodies and decision-makers at golf facilities to ensure that there is adequate information for those impacted to make informed plans of action and mitigation
- leadership from golf governing bodies and decision-makers at golf facilities to help find a way forward, given their value to society and the role they play in land stewardship
- engagement between golf governing bodies and golf facilities, between golf governing bodies and national government agencies and between golf facilities and their local statutory agencies
- support from golf facilities with experience of addressing coastal change and their willingness to share information
- realism and pragmatism in terms of what coastal planning can offer and what coastal protection measures will be available and affordable
- forward thinking so that the outlook for golf facilities is planned for over the long-term, i.e. for at least the next 50 years
- business planning so that credible coastal management options can be budgeted for and viable golf offerings delivered by those impacted by coastal change
- political will to provide support to golf facilities which can demonstrate value to the local community and economy
- investment in innovation and research by the golfing community, with support from government and other research and capital investment funds.

10. POTENTIAL FUNDING SOURCES FOR PROPOSED ACTIONS

There are a range of potential funding sources for coastal change projects, depending on their nature, e.g. research, demonstration of practical techniques. These sources may include:

- industry funding for surveys and guidance
- industry funding with support from Research Council grants for PhD projects
- government and NGO funding for coastal management projects which include the coastline on which golf facilities are situated
- community funding. Many golf courses are in rural areas, so rural development agencies share golf’s community and employment values and could be a good funding partner
• other grant funding organisations, e.g. charitable and philanthropic contributions

• in kind support from stakeholders and other experts.

11. RECOMMENDATIONS FOR ACTION

There is a need for intelligence gathering for the sport, in general, to understand the scale of the issue, in addition to investigation of existing options and innovative techniques for coastal management. The following are recommendations for pieces of work/activities which can be delivered over the next 3 years.

1. Identify the links and cliff top courses in GB&l and carry out a survey to assess their awareness of the challenge and their readiness to face it. Although any published information coming out of the survey must be designed to preserve anonymity, the survey must be able to identify individual clubs so they can be approached to share their experiences if this can add to a database of coastal management strategies. The survey should, therefore, be designed so that it can identify those golf facilities that have identified the risks and the plans they have made to mitigate them.

The survey should identify:

• if the club is aware of the challenge to their course from coastal change
• which regulatory (or other) organisations they have approached to engage with a coastal management strategy
• if they are part of a coastal management plan
• if they are aware of the coastal management strategies available to them
• if they have undertaken any coastal management and, if so, what.

The survey proposal should indicate the level of consultation and, where relevant, collaboration with key stakeholders such as national governing bodies, professional associations, research institutes, government agencies and Links Initiative organisations in its preparation and delivery. Such a survey could be completed within 6 months.

2. A study to identify the official coastal management strategies for England, Wales, Scotland and Ireland and how a golf facility would engage with it. The study should also present current options for coastal management, on both soft and hard coasts, including coastal protection measures and managed retreat. Case study examples derived from the survey outlined in (a) or known from other sources should be included to illustrate the available options. Such a study should not be restricted to GB&I as there will be many global examples of coastal management and protection which can be included.

The study proposal should indicate the level of consultation and, where relevant, collaboration with key stakeholders such as national governing bodies, professional associations, research institutes, government agencies and Links Initiative organisations in its preparation and delivery. Such a study could be completed within 6-12 months.

3. Studies to showcase potential innovations for golf courses facing coastal change, on both soft and hard coasts, including coastal protection measures and managed retreat. Innovation in coastal defences is moving apace and working with nature is moving forward. Such a study should not be restricted to GB&I as there will be many global examples, with innovations in associated land management such as river engineering.
and farming to manage flooding impacts, erosion and sediment deposition also being considered.

There is a growing global opportunity for nature-based solutions in both the mitigation of and adaptation to climate and coastal change. More could be done, for example, to assess and highlight the value of the existing natural capital of these coastal environments in order to identify and then enhance nature-based solutions linked to their effective management and protection. For example, an audit of coastal habitat types and their Blue Carbon resources would, very likely, highlight a significant (first-order) global soil carbon store associated with coastal golf courses. Such an audit would enable golf course management decisions to be taken that enhance, where appropriate, coastal management for a wide-range of ecosystem benefits, including coastal protection, biodiversity and enhanced carbon sequestration. At a time when there is increasing consumer awareness and interest in positive climate action; Blue Carbon may provide a very positive opportunity for golf and golf course management under coastal change.

A study could describe innovative approaches, undertake applied research on the implementation of such approaches or provide investment into a demonstration project which would be a proof of concept exercise.

The proposal for any study should indicate the level of consultation and, where relevant, collaboration with key stakeholders such as national governing bodies, professional associations, research institutes, government agencies and Links Initiative organisations in its preparation and delivery. Depending on the nature of the study, this activity could involve a project lasting between 1 and 3 years.

12. SUCCESSFUL OUTCOMES FOR THIS ACTION PLAN

3 years after implementation of this Action Plan, it is anticipated that there will be:

• greater knowledge of climate change in general and the impact of coastal change on all affected golf facilities, or those likely to be affected within the next 50 years

• guidance available to enable golf facilities to devise credible long-term plans to mitigate the impact of coastal change, which provides clarity on the process a golf facility will need to go through to realise its options

• identification of innovative, affordable solutions and their availability in a central library or information resource

• a co-ordinated communication network to support those facilities facing the implications of coastal change. This could be supported by the formation of a golf climate change committee.

13. ACKNOWLEDGEMENTS

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Sandy Veale, Golf Coordinator – Wales Golf, Wales Golf

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APPENDIX 1. Golf Course 2030 Scenarios

**Scenario 1.** Limited change from the environment that now exists as alternative technologies, management solutions and behavioural change address the challenges posed by climate, resources and regulations and optimal golf course condition and playability is secured.

**Scenario 2.** Severe restrictions in the availability and use of synthetic chemical plant protection products, together with 50% less water being available for irrigation compared with current levels. Alternative technologies, management solutions and behavioural change partially address the challenges posed by climate, resources and regulations.

**Scenario 3.** The banning of all chemical plant protection products and fertilisers, together with 75% less water being available for irrigation compared with current levels. Alternative technologies, management solutions and behavioural change fail to address the challenges posed by climate, resources and regulations.
## APPENDIX 2. Links and cliff top courses of GB&I

### England

| Berwick-upon-Tweed | Royal Cinque Ports |
| Bridport & West Dorset | Royal Cromer |
| Bude & North Cornwall | Royal Guernsey |
| Burnham & Berrow | Royal Jersey |
| Caldy | Royal Liverpool |
| Castletown | Royal Lytham & St Annes |
| Cleveland | Royal North Devon |
| East Devon | Royal St George's |
| Felixstowe Ferry | Royal West Norfolk |
| Fleetwood | Rye |
| Formby | St Annes Old Links |
| Frinton | St Enodoc |
| Great Yarmouth & Caister | Sandilands |
| Hartlepool | Saunton |
| Hayling | Seacroft |
| Hesketh | Seahouses |
| Hillside | Seascale |
| Hunstanton | Seaton Carew |
| La Moye | Sheringham |
| Leasowe | Silloth on Solway |
| Littlehampton | Southport & Ainsdale |
| Littlestone | Southport Municipal |
| Lyme Regis | Staddon Heights |
| Minehead and West Somerset | Trevose |
| Mullion | Wallasey |
| Newbiggin | Walmer & Kingsdown |
| Newquay | Warren |
| Perranporth | West Cornwall |
| Prince's | West Lancashire |
| Royal Birkdale | Weston-super-Mare |

### Ireland

<p>| Achill | Kirkistown Castle |
| Ardglass | Lahinch |
| Arklow | Laytown &amp; Bettystown |
| Ballybunion | Mulranny |
| Ballycastle | Narin &amp; Portnoo |
| Ballyliffin | North West |
| Bundoran | Old Head of Kiinsale |
| Bushfoot | Portmarnock |
| Cairndhu | Portmarnock Golf Links |
| Carne | Portsalon |
| Castlegregory | Portstewart |
| Castlerock | Rosapenna |
| Connemara | Rossclare |
| Connemara Isles | Royal County Down |
| Corballis | Royal Dublin |
| County Louth | Royal Portrush |
| County Sligo | Rush |</p>
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**Scotland**

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