What Chance Adaptive Coastal Management For Climate Change? A Legal Dysfunction in Vertical Governance

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"Conventional attempts at conquering the climatic future all rely, implicitly or explicitly, upon ideas of control and mastery, whether of the planet, of global governance or of individual and collective behaviour."[2]

"Curtailing climate change must … become the project we put before all others. If we fail in this task, we fail in everything else."[3]

Abstract: Mitigation has been the dominant approach to dealing with climate change to date. Perceived limitations of this approach, however, led Parties to the United Nations Framework Convention on Climate Change (UNFCC) to agree in Bali, 2007 that the alternative approach of adaptation should play a significantly greater role in the future global response, and this is now embedded as one of the post 2012 pillars. There is evidence of adaptation already taking place but this is currently piecemeal in manner. A more strategic approach is therefore needed to ensure that timely and effective adaptation measures are taken, ensuring coherence across different sectors and levels of governance. To this end the European Union produced a White Paper in April 2009, aimed at reducing vulnerability. Similarly, on a national basis many countries are consulting on a range of adaptive instruments, with the UK being no exception and issuing a consultation document on the implementation of the Marine Strategy Framework Directive in October 2009. A major problem, however, is the disconnect between the vertical structure of legal instruments from international conventions, through European Community law, state legislation, and what happens within the coastal communities through local government and agencies. Adaptive management shows up in coastal management plans, regional development plans, and agency guidance documents; yet it appears almost nowhere within codified statutory and regulatory text. The research presented in this article is geographically concerned with exploring the capacity of coastal areas to adapt to change and what legal impediments might hinder such responses. In order to further the research, a case study approach is used with a particular focus on Christchurch Bay, UK, the conclusions from which may be transferred horizontally to other vulnerable areas of the UK coast and beyond.

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[2] Mike Hulme, *The Conquering of Climate: Discourse of Fear and their Dissolution*, THE GEOGRAPHICAL J. 174(1): 5, 5 (2008).

[3] GEORGE MONBIOT, HEAT: HOW TO STOP THE PLANET BURNING 15 (2006).

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I. Introduction

There is now irrevocable evidence that our climate is changing. Temperatures have increased globally and observational evidence from all continents and most oceans show that these human-induced temperature changes are having a significant impact on physical and biological systems.[4] However, the problem of uncertainty is one of the major challenges facing those involved in the construction of institutions of international governance. Our knowledge of the social and natural systems that we seek to govern is less dependable than is commonly acknowledged, and our ability to predict the consequences of our interventions into them is more limited than we like to believe.[5] Given that the High Contracting Parties of the United Nations Framework Convention on Climate Change (Framework Convention) agreed at their meeting in Bali to embrace the concept of adaptive management,[6] in this

[4] *See*, Cynthia Rosenzweig et al., *Attributing Physical and Biological Impacts to Anthropocentric Climate Change*, 453 NATURE 353-358 (2008).

[5] Rosie Cooney and Andrew T.F. Lang, *Taking Uncertainty Seriously; Adaptive Governance and International Trade*, 18 EUR. J. INT'L L. 523, 524 (2007).

[6] "The **overall purpose** of the Adaptation, Technology and Science programme (ATS) is to support Parties in developing adaptation strategies and actions to meet their specific needs and concerns relating to adaptation to the adverse effects of climate change and to the impacts of the implementation of response measures. ATS further supports the UNFCCC process in enhancing the development and transfer of technologies, and in improving the methodological and scientific bases for international climate policy and action by Parties, including actions to reduce emissions from deforestation and forest degradation in developing countries (REDD). The programme is responsible for coordinating support for the Subsidiary Body for Scientific and Technological Advice (SBSTA). The basic **mandates** for this programme are contained in several Articles of the Convention, including Article 4 (on commitments), Article 5 (on research and systematic observation), Article 9 (on the SBSTA) and Article 12 (on the communication of information related to implementation). Further basic mandates are contained in Articles of the Kyoto Protocol, including Article 2, paragraph 3, (on implementing policies and measures in such a way as to minimize adverse effects) and Article 3, paragraph 14, (on implementing commitments in such a ways as to minimize adverse impacts). Additional mandates given in decisions and conclusions of the Convention and Kyoto Protocol bodies. Key decisions are stipulated under each programme objective in table 7." UNFCCC,

paper we consider the disconnect between adaptive management in practice and adaptive management in law.

The management theory, known as adaptive management, traces its origins to C.S. Holling's influential book from the late 1970s, *Adaptive Environmental Assessment and Management*.[7] Holling and his fellow researchers found conventional environmental management methods, particularly the environmental impact assessment process under the United States' National Environmental Policy Act, at odds with the emerging model of ecosystem dynamics. They posited that the connections within ecosystems are themselves selective and variable. The outcome of the theory was that because ecosystems are dynamic and can change; anything can happen. Efforts to suppress change are thus not only futile, but also counter-productive. The theory itself has developed further over the years until it came of age in 2007 when the High Contracting Parties to the Framework Convention met at Bali.

Taking at face value the decision at Bali that ecosystem management is the appropriate strategy for climate change, and that adaptive management is the appropriate implementation method for climate change management,[8] the question is how to translate the practice model of adaptive management into law and policy. The idea of "learning by doing" may capture the essence of adaptive management, but does not convey much legal content. Bali laid down a policy statement and this paper will consider whether regional and national legal instruments lend any more precision to the content of adaptive management, and if not, then what barriers this may raise to the actual practice of adaptive management at the local level.

II. The Road to Bali

Climate change emerged onto the international political agenda in 1988, when the UN General Assembly took up the issue for the first time and adopted Resolution 43/53, declaring climate change to be "a common concern of mankind." The debate in the General Assembly came in the wake of the establishment of the Intergovernmental Panel on Climate Change (IPCC) by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) who jointly set up the panel with a mandate to assess the emerging science of climate change and subject it to intergovernmental scrutiny. The latest set of principles governing its work state that it is to:

WORK PROGRAMME FOR THE SECRETARIAT FOR THE BIENNIUM 2010-2011, FCCC/SBI/2009/2/Add.1, 19 (May 20, 2009) *available at* http://unfccc.int/resource/docs/2009/sbi/eng/02a01.pdf .

[7] ADAPTIVE ENVIRONMENTAL ASSESSMENT AND MANAGEMENT (C.S. Holling ed., 1978). *See, e.g.*, Kai N. Lee and Jody Lawrence, *Restoration under the Northwest Power Act: Adaptive Management: Learning from the Columbia River Basin Fish and Wildlife Program*, 16 ENVTL. L. 431, 442 n.45 (1986) (tracing the term "adaptive management" to Holling's book).

[8] For further discussions, see Kai N. Lee, *Appraising Adaptive Management*, CONSERVATION ECOLOGY 3(2): 3 (1999), *available at* http://www.ecologyandsociety.org/vol3/iss2/art3/; J.B. Ruhl and Robert Fischman, *Adaptive Management and the Courts*, forthcoming in the Minnesota Law Review, Vol. 95, no. 2, pre-print version available at http://ssrn.com/absratct=1542632.

> assess on a comprehensive, objective, open and transparent basis the scientific, technical and socio-economic information relevant to understanding the risk of human-induced climate change, its potential impacts and options for adaptation and mitigation.[9]

Although the IPPC does not carry out the scientific research itself it does conduct a massive review of climate change research which has been published in peer reviewed journals by government bodies, universities, intergovernmental organisations and individual researchers from around the world. Therefore, what the IPCC provides is an objective analysis of all the scientific research in order that policy-makers can make informed decisions.

Although the need for a Framework Convention on Climate Change was agreed in 1990 at the World Summit in Rio de Janeiro it was not until the third Conference of the Parties (COP) when they met in Kyoto that a new regulatory structure was devised which included a number of flexible market mechanisms. The objective of the Convention itself, was the "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system."[10] This objective is framed in terms of an environmental quality standard inasmuch as it establishes an environmental threshold which Parties must not exceed. However, the threshold that is established (dangerous anthropogenic interference with the climate system) does allow activities which cause such interference up to this point. Article 2 of the Convention goes on to provide additional guidance concerning the timing of any actions to stay within the threshold.[11]

The objective, therefore, has a precautionary emphasis. This preventative focus of the objective also applies to the Kyoto Protocol as the Convention states that "any related instrument" shall share the ultimate objective set out in Article 2. This is also affirmed in paragraph 2 of the Preamble of the Protocol.[12]

A. The Kyoto Protocol 1997

On December 10, 1997, the Parties to the Framework Convention adopted the Kyoto Protocol.[13] The Protocol "sets forth quantitative emission reduction targets for developed (Annex I) countries through 2012, and establishes market-based mechanisms (including emissions trading) for achieving those targets."[14] The principle theme of the new market based mechanisms, as provided for under the Protocol, is the refocusing away from bureaucratic decision-making to basic economic incentives to coordinate more efficient decisions by private actors about how, when, and whether to emit their pollutants.

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[9] Intergovernmental Panel on Climate Change, Principles Governing IPPC Work, para. 2 (1998).
[10] United Nations Framework Convention on Climate Change, art. 2, 31 I.L.M. 849 (July 1992).
[11] *Id.* ("Such a level should be achieved within a timeframe sufficient to allow ecosystems to adapt naturally to climate change…").
[12] Conference of the Parties to the Framework Convention on Climate Change: Kyoto Protocol, 37 I.L.M. 22 (1998).
[13] *Id.*
[14] Daniel Bodansky, *The Copenhagen Climate Change Conference: A Postmortem*, 104 AM. J. INT'L L. 230, 231 (2010).

However, it was not until the High Contracting Parties met in Bali that an enhanced action plan on adaptation was envisaged as part of the Bali Action Plan by the Ad-Hoc Working Group on Long Term Co-operative Action under the Convention (AWG-LCA).

B. The Bali Action Plan

The Bali Action Plan was adopted at COP 13 in Bali, Indonesia in December 2007. It identifies adaptation as one of the key building blocks required for a strengthened future response to climate change to enable the full, effective, and sustained implementation of the Convention through long-term cooperative action, now, up to, and beyond 2012.

At the ill-fated meeting of the High Contracting Parties in Copenhagen in 2009, it was decided to extend the mandate of the AWG-LCA[15] and requested the group to present the outcome of its work to COP 16 when they next meet in Mexico. In addition, the COP took note of the Copenhagen Accord, in which Heads of State, Heads of Government, Ministers, and other Heads of Delegations stressed the need to establish a comprehensive adaptation programme.[16] The signatories agreed that enhanced action and international cooperation on adaptation was urgently required and that developed countries should provide adequate, predictable, and sustainable financial resources, technology, and capacity-building to support the implementation of adaptation action in developing countries, such as Least Developed Countries (LDCs), SIDS, and Africa.[17]

Part IV of the Copenhagen Accord established a Framework for Action on Adaptation (FAA) to climate change, which includes the following elements intended to enhance implementation of effective adaptation action: the development and integration of adaptation actions into national and sectoral planning processes; support for capacity building and risk management approaches; co-operation with international, regional and other organisations and the private sector; enhancing technologies for adaptation; provision of adequate and predictable financial flows, and follow-up on the effectiveness of adaptation actions. The FAA, however, consists entirely of policy proclamations rather than permissory or mandatory requirements.[18]

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[15] UNFCCC, Outcome of the Work of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention, Draft decision -/CP.15: Enhanced Action on Adaptation, FCCC/AWGLCA/2009/L.7/Add.1 (Dec. 15, 2009).

[16] UNFCCC, Report of the Conference of the Parties on its fifteenth session, held in Copenhagen from 7 to 19 December 2009, Addendum, Part Two: Action taken by the Conference of the Parties at its fifteenth session, 4 (Mar. 30, 2010).

[17] *Id.* at 6.

[18] Newcomers to the climate regime find tracking adaptation rule development both difficult, because the rules are interspersed in various COP decisions, and perplexing, because an issue as widely supported as adaptation seems to be embroiled in procedural disputes about which Convention article is the relevant basis for action. Although the consideration of Articles 4.8 and 4.9 of the Convention by the COP as a separate agenda item only commenced at COP-4, many fundamental issues relating to adaptation were being addressed by earlier COPs on the basis of other Convention provisions. This is because rule development concerning the adverse impacts of climate change has revolved around making good commitment *already agreed* in the Convention under Articles 4.3 and 4.4. Thus, adaptation issues are discussed as part of the negotiations giving guidance to the Global Environmental Facility (GEF) or other agenda items relating to technology. Adoption of Decision 3/CP.3 by COP-3 added a new dynamic because this Decision mandates the COP to consider actions

III. Theoretical Principles of Adaptive Management

Traditional environmental regulation was based on "command and control," which served to regulate emissions from chimneys and discharge pipes; the disposal of waste in landfill, the transportation of hazardous chemicals, and similar easily-identifiable sources of environmental harm. This system enjoyed a remarkable degree of success with cleaner air and water, less polluted land, and safer roads. However, the future that lies ahead in environmental law is filled with problems of unwieldy dimensions due to intractable causes. Because ecosystems themselves adapt to nature, this confounds the prescriptive regulatory model.

Problems that are foremost to many observers include the invasion of non-native species into ecosystems, the depletion of estuarine resources by fertilizer runoff from countless agricultural operations many miles inland, and climate change, which is irrefutable. Because ecosystems themselves adapt to nature this confounds the prescriptive regulatory model. For these problems there are no available targets for the prescriptions of "command and control," and we have no idea what response the system would have to a particular "command." Problems such as these exhibit the hallmark characteristics of complex adaptive systems and their behaviour emanates from a multitude of diverse, dispersed sources responding to co-evolving interactions, and non-linear cause-and-effect properties.[19]

> These aspects of uncertainty limit the usefulness of forecasting methods for the scientific study and management of regions in transition. Given these limits of understanding, we must focus on learning to live within systems, rather than "control" them. One might argue that it is impossible to deal with such fundamental limits of understanding, and our only reasonable choice is to struggle blindly onward.[20]

Given that the ten scientists who authored the above quote find research in this area so hard to understand, what chance is there for law to bring such aspects under control?[21] Even if legislators provided the regulatory agencies with unlimited powers, those agencies could not "command" away invasive species, or global climate change, and so legislators and regulatory agencies have experimented with many alternatives to the traditional

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related to Articles 4.8 and 4.9 at future sessions as a separate agenda item. An agenda item explicitly addressing developing countries' adaptation-related needs and circumstances has the potential advantage of highlighting a broader range of issues that might not have fitted well into other agenda items. But in the case of adaptation it also brought complications because Decisions 3/CP.3 was critical to getting OPEC countries to withdraw their veto on the adoption of the Kyoto Protocol. This means, however, that progress on adaptation issues has become conditional upon equivalent progress on response measures.

[19] *See generally,* BRIAN GOODWIN, HOW THE LEOPARD CHANGED ITS SPOTS: THE EVOLUTION OF COMPLEXITY (1996).

[20] Brian Walker et al., *Resilience Management in Social-ecological Systems: a Working Hypothesis for a Participatory Approach*, CONSERVATION ECOLOGY 6(1): 14 (2002), *available at* http://www.consecol.org/vol6/iss1/art14/ .

[21] *See, e.g.,* J.B. Ruhl, *Regulation by Adaptive Management – is it Possible?* 7 MINN. J. L. SCI. & TECH. 21 (2005).

prescriptive regulation, including market-based programmes, information-based programmes, and multiparty collaborative planning efforts.[22]

Information based programmes release information about any regulated activities into the hands of the public who may use such information to persuade companies to do what is right and so alter environmentally damaging behaviour. Any multiparty collaborative planning decision-making puts a more diverse set of interests at the negotiating table and so increases the chances of creative, multifaceted regulatory responses. Such negotiated project-specific permits allow for conditions to be tailored to the project rather than a one-size-fits-all approach.

For this "new wave" of regulatory instruments to work well, advantage must be taken of their adaptive qualities and the programmes must themselves be managed adaptively. Such programmes cannot be administered through central decision-making nor implemented through reductionist, linear models of how ecosystems function.[23]

Although it is thirty years since the seminal work of Professor C.S. Holling's and his colleagues' book, *Adaptive Environmental Assessment and Management,*[24] first described the adaptive management methodology, it is still regarded as the "blue-print" and no work on the topic has improved on the core theory. Essentially it is an iterative, incremental decision-making process built around a continuous process of monitoring the effects of decisions and adjusting those decisions accordingly.[25] This is, therefore, a responsive form of decision-making rather than a "front-end" prescriptive decision-making process when the effects of those decisions and other changing conditions are not known; as such adaptive management is more fitting to the needs of future regulatory challenges than is the traditional prescriptive regulation.

The Framework Convention and the Protocol do not contain definitions of adaptation nor related terms such as "adaptive capacity" and "vulnerability." However, various definitions have been refined over time to reflect improved understanding.[26] The IPCC defines adaptation as "adjustments in practices, processes, or structures [which] can moderate or offset the potential for damage or take advantage of opportunities created by a given change in climate."[27]

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[22] *See*, Richard B. Stewart, *Administrative Law in the Twenty-first Century,* 78 N.Y.U. L. REV. 437, 448-453 (2003); *See also*, Patricia Park, *Towards a New Regulatory System for the Atmospheric Environment, in* MOUNTBATTEN YEARBOOK OF LEGAL STUDIES 20-56 (2008).

[23] Ruhl, *supra* note 21, at 27-28.

[24] Hollings, *supra* note 7.

[25] Simon Levin, *Towards a Science of Ecological Management,* CONSERVATION ECOLOGY 3(2):6 (1999), *available at* http://www.ecologyandsociety.org/vol3/iss2/art6/ .

[26] UNFCCC, TECHNICAL PAPER, ADAPTATION TECHNOLOGIES, FCCC/TP/1997/3 (1997).

[27] IPCC, THIRD ASSESSMENT REPORT, CLIMATE CHANGE 2001: WORKING GROUP II: IMPACTS, ADAPTATION AND VULNERABILITY 89 (2001). The definition of adaptation used in previous reports by IPCC did not highlight opportunities created by a changing climate because adaptability was taken to refer "to the degree to which adjustments are possible in practices, processes or structures of systems to projected or actual changes on climate. Adaptation can be spontaneous or planned, and can be carried out in response to or in anticipation of changes in conditions." IPCC, SECOND ASSESSMENT REPORT: CLIMATE CHANGE 1995, WORKING GROUP II:

Because adaptation covers a very broad range of human activities and natural processes, many different typologies have been devised to conceptualise the different types and forms of adaptation. Good examples of planned adaptation concerning human societies include increasing the robustness of infrastructure designs and long-term investments, such as increasing the range of temperature and levels of precipitation that roads and buildings can withstand without failure, as well as devising financial, administrative or legal techniques to transfer risks away from vulnerable communities and/or to provide for collective loss-sharing mechanisms. Planned adaptation concerning ecosystems includes enhancing the adaptability of vulnerable natural systems, such as by the creation of eco-corridors, as well as reversal of trends that increase vulnerability through, for example, the introduction of set-backs for developments in vulnerable areas such as flood plains and coastal zones.

IV. A European Union Adaptation Strategy

Protecting the environment was historically seen as conflicting with other policy priorities, particularly economic development, and it was not until 1981 under the Single European Act that it has been treated as a core competence of the European Union (EU). There are signs of a greater emphasis on the environment, along-side economic and social development, as agreed in the Lisbon Strategy in 2000.[28] Nevertheless, the majority of the EU budget remains focused on sectors such as agriculture and regional development.

Adaptation is being progressed through the European Climate Change Programme II under a dedicated "Impacts and Adaption" working group. Given that the EU has a supranational focus, adaptation implementation is likely in areas that require collaborative action; that is cross-border river basins or cross-sectoral issues. Other areas may require Member States (MS) to develop their own national strategies under the principle of subsidiarity. Finally, there will be areas where neither the EU Commission nor Member States have a lead role but where the promotion of "enabling" conditions could potentially be of value to local adaptation activity.

Whatever the basis it is essential that adaptation is mainstreamed throughout the vertical structure of EU/MS policy and Directives. Such a chance was missed when drafting the European Marine Strategy Framework Directive.[29] This Directive is mandatory and is concerned with the protection and clean-up of marine ecosystems and addresses all human activities that may have an impact on the marine environment. It establishes marine protected areas including areas already identified under the Wild Birds Directive, the Habitats Directive, and NATURA 2000. What this mandatory piece of legislation does not do is mention adaptation nor coastal erosion. However, the EU White Paper "Putting

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IMPACTS, ADAPTATIONS AND MITIGATION OF CLIMATE CHANGE: SCIENTIFIC-TECHNICAL ANALYSES, Preface (1995).

[28]European Parliament, Lisbon European Council 23 and 24 March 2000: Presidency Conclusions (known as the "Lisbon Strategy"), *available at* http://www.europarl.europa.eu/summits/lis1_en.htm .

[29] Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive), *available at* http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:164:0019:0040:EN:PDF .

Adaptation & Mitigation into Perspective" has a two-part strategy (1) to reduce GHGs by swift transition to a low carbon economy, which is mitigation, (2) with climate change already happening, societies must adapt to its impacts as a certain amount of climate change is inevitable.[30] Under the White Paper, adaptation measures are to be developed and applied in a cross-cutting approach and include social, economic, and environmental aspects. This is a step in the right direction but a new Directive which may implement these aspirational policies may well be a long way in the future.

V. Adaptive Management: the UK experience

There is nothing new about adaptive decision-making; businesses do it all the time. The question is, however, can administration agencies behave adaptively and survive? Deterrents would include, inter alia, such issues as lack of legal authority. Although the Climate Change Act (2008) in the UK establishes a power enabling the Secretary of State to require public bodies and statutory undertakers[31] to produce reports on the impacts of climate change on them, their policies for adaptation and any progress made; this power is for the requirement of the production of reports on *policies* for adaptation.

These administration agencies operate in an atmosphere in which each decision involves preparation in anticipation of public participation and second-guessing by the judiciary. When decisions on adaptation are made, interest groups and local politicians must let the agency carry that decision out, and the courts must resist the temptation to second-guess the agency decision. Such deterrents create a cultural resistance among many regulatory bodies towards alternative approaches. Given the lack of explicit language authorizing the use of innovative environmental approaches and the uncertainty and complexity of institutional arrangements,[32] it would seem perverse to expect the agencies to embrace adaptive management of their rulemaking and other decisions without first changing the rules.

Under the Aarhus Convention[33] the public not only have a right to environmental information, but one of participation in decision-making. Under Article 2 of the convention the "public" includes one or more natural or legal persons, and "the public concerned" means the "public affected or likely to be affected by, or have an interest in, the environmental decision-making…" This definition is interpreted very widely which provides

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[30] Commission of the European Communities, Green Paper from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions – Adapting to climate change in Europe – options for EU action {SEC(2007) 849}, COM/2007/0354 final (June 29, 2007), *available at* http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2007:0354:FIN:EN:PDF .

[31] Statutory undertakers are bodies with a statutory responsibility for delivering services such as energy and water.

[32] *See*, THE ROYAL COMMISSION ON ENVIRONMENTAL POLLUTION, ADAPTING INSTITUTIONS TO CLIMATE CHANGE (2010), *available at* http://www.rcep.org.uk/reports/28-adaptation/documents/adaptation_final_report.pdf .

[33] Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (Aarhus Convention), June 25, 1998, 38 I.L.M. 517 (1999). Both the UK and the EU are signatories to the Aarhus Convention.

an opportunity for anyone to comment prior to a final decision or challenge the decision once it has been made.

In the UK, this has led to not only locals with an interest, but "flying interest groups"[34] challenging planning decisions in particular. However, equity would suggest the importance to involve stakeholders, particularly local communities, in developing adaptation responses and ensuring that issues of equity (distributional and governance) are taken into consideration. The difficulties of ensuring equitable responses to climate change adaptation arise because the impacts of climate change are not likely to be felt evenly across society as some people are likely to be more vulnerable than others.[35]

The full effects of climate change are likely to be felt most intensely by future generations with the possibility of decisions made now creating problems or costs for future generations. This raises difficult questions about intergenerational equity. Policy decisions are usually based on an analysis of their cost-effectiveness, or cost-benefit analysis, but it can be hard to quantify benefits in the case of adaptation to climate change, due to uncertainties about the nature and extent of future change.

The key issue facing all stakeholders is that of decision-making under conditions of such uncertainty. Precise predictions of the future are not possible; therefore, grappling with adaptation to climate change requires decision-makers to work out ways to make sense of a dynamic and uncertain system, which is influenced by many variables. Such uncertainty can relate to insufficient knowledge, difficulty of measurement, or lack of understanding. There is also evidence of cases where competition with other goals will hamper adaptation.[36]

Different values and interests can lead to very different ways of framing a problem. For instance, the protected areas of tomorrow for nature conservation will look very different from the protected areas of today, and society will have to make difficult decisions about how we manage such protected areas. Such decisions are likely to be shaped by personal values and interests, and a willingness, or otherwise, to accept change. This would lead some organizations and individuals to focus on short-term decisions and outcomes which may be in conflict with what is required for building long-term adaptive capacity.

The main constraint on decision-making in adaptation is the absence of, not only legal authority, but also enabling mechanisms. The planning system in the UK has limited scope

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[34] "Flying Interest Groups" are, sometimes large, organised groups of people who come from outside the area in question, but make it their job to support any local group who are against decisions made by a local Agency/authority.

[35] As part of its study, the Royal Commission, *supra* note 32, made an evidence-gathering visit to Happisburgh on the Norfolk coast, where they heard that the community felt they did not have sufficient opportunity to take part in framing issues or solutions. The Royal Commission was concerned that questions of equity, including the loss of property values when coastlines are no longer protected from erosion, remain unaddressed. Similar issues arose when considering resources available to compensate for loss of habitat when contrasted with those available to compensate vulnerable human communities.

[36] For example, the proposal to create floodplain woodland in the Lever catchment to help manage flood risk in Ripon did not proceed in the end because financial incentives proved insufficient and a greater return could be achieved by using the land in ways other than as floodplain woodland.

to promote new schemes or to enable adaptation of the existing built environment, although it can encourage particular forms of development through development planning. Although many people are aware that climate change exists and could be a problem, they are not likely to take action in the near future to do anything about it unless they feel imminently threatened by the consequences. Clearly, public engagement in areas such as coastal erosion, flood protection, and nature conservation is very important. This is because a decision-making process which is perceived to be open and fair by those potentially affected can go a long way to enhancing tolerance, or even acceptance, of the outcomes. It is this input of local knowledge and understanding which can contribute to the mitigating problems of taking decisions under conditions of uncertainty and complexity.

Effective decision-making on adaptation will require the participation of the right number of people with the right skills and training, and sufficient financial resources, in conjunction with a range of stakeholders sharing responsibility for ensuring that, for example, flood defences work properly. Inevitably the burdens of climate change will be unevenly distributed, with people living in flood or coastal zones likely to feel the most dire effects of climate change. Although the provision of flood and coastal defences in the UK is a discretionary power rather than a duty and is determined by cost-benefit analysis, Treasury rules do allow for consideration of social well-being.

VI. Coastal Protection and Flood Defence in the UK: A Case for Adaptive Management?

A. The Legislative Framework

In England, the laws governing the defence of coastal land against the sea have a long history, which has profoundly influenced their content, and has resulted in the creation of two separate statutory regimes. One deals with flood defence,[37] and is concerned with the protection of low-lying land against temporary inundation, and applies to inland as well as tidal waters. The other deals with coast protection and involves the prevention of permanent erosion and encroachment by the sea.[38] Because flood defence is closely related to land drainage, it is historically associated with agricultural land.[39] In contrast, coast protection is more concerned with the urban coast, and was introduced as an emergency measure to repair defences of coastal towns that had been neglected during the Second World War. The common factor between both regimes is that they were designed to keep the sea at bay by artificial means, and they did not originally contemplate the possibility of managed realignment. The United Kingdom is also required to adopt legislation to implement the EC Floods Directive.[40]

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[37] The flood defence is administered by the Environment Agency under the Environment Act 1995 and the Water Resources Act 1991.

[38] Coastal protection is carried out by district or unitary councils under the Coast Protection Act 1949.

[39] The origins of this body of law may be traced back to the appointment of commissioners of sewers in the thirteenth century.

[40] Directive 2007/60/EC of the European Parliament and Council of 23 October 2007 on the assessment and management of flood risks (Floods Directive), *available at* http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:288:0027:0034:EN:PDF .

Although most of the legal rules governing flood defence and coast protection in the UK are now contained in legislation, there are also some relevant principles of common law, which have been applied by judges in decided cases, and reflect established custom. The majority of these principles have arisen in England because of the particular vulnerability of low-lying coastal land to the effects of flooding and erosion there. However, the common law is equally applicable to Wales and Northern Ireland, and has also influenced the development of Scottish Law.

In 1609, Lord Chief Justice Coke stated that the Crown had a common law duty, as part of the Royal Prerogative, to defend the coast against the inroads of the sea. This was described as analogous to the Crown's responsibility to protect the borders of the realm against military invasion:

> by the common law … the King ought of right to save and defend his realm, as well against the sea, as against the enemies, that it should not be drowned or wasted…[41]

Nevertheless, this obligation cannot be enforced in the courts, since the Crown is not legally accountable for the exercise of its prerogative unless legislation declares it to be so.[42] On the other hand, the Crown's theoretical responsibility can be invoked to prevent others from behaving in ways that would increase the risk of flooding erosion. Thus, a landowner normally must not act so as to expose another's property to invasion by the sea, since this would cause a breach of the Crown's duty.[43] Furthermore, a statutory body which assumes that duty may take action to prevent such interference.[44] However, if a person builds sea defences to protect his own property, he will not be liable if they increase the risk to neighboring land, provided that he acts reasonably.[45]

As a general rule, private owners of coastal land are not required to keep the sea at bay, and those who erect defences for their own protection have no obligation to maintain them for the benefit of others.[46] However, in 2000 the Court of Appeal held in the case of *Holbeck Hall Hotel Ltd v Scarborough Borough Council*[47] that an occupier owes a measured duty of care under the English common law of nuisance, to take reasonable steps to prevent a risk of damage to neighboring property due to the collapse of his own land through a cliff fall.

B. Statutory Compensation

Under the Water Resources Act 1991, the Environment Agency would be liable to compensate coastal landowners if they take *active,* as opposed to *passive,* measures to implement managed realignment. However, the amount of damages will be the difference

[41] Isle of Ely Case, (1609) 77 Eng. Rep. 1139.
[42] Although a statutory body to which the Crown expressly delegates its duty may be required to discharge it, this will depend on the wording of the grant. *See,* Lyme Regis Corporation v Henley (1834), 6 Eng. Rep. 1180.
[43] Attorney General v Tomline, [1880] 14 Chancery Division 58.
[44] Canvey Island Commissioners v Preedy, [1922] 1 Chancery 179.
[45] R v Commissioners of Sewers for Pagham, (1828) 108 Eng. Rep. 1075.
[46] Hudson v Taybor, (1877) 2 Queens Bench Division 290.
[47] Holbeck Hall Hotel Ltd v Scarborough Borough Council, [2000] Queen's Bench 836.

between the value of the land before and after the works,[48] and will be assessed by the Lands Tribunal in the event of a dispute.

C. Human Rights and Coastal Erosion

Where coastal land is owned or occupied by private individuals, the risk of flooding or erosion may also raise questions under the Human Rights Act 1998, which transposed the European Convention for the Protection of Human Rights and Fundamental Freedoms (1950) into UK domestic law. All the statutory bodies and local councils that are involved with flood defence or coast protection are public authorities for the purposes of the Human Rights Act, and if they unlawfully interfere with Convention rights when performing their public functions, the victims may seek redress in a national court or tribunal.

The Convention itself does not expressly refer to flooding or erosion but Article 8 declares the right to respect for private family life, which includes a person's home; and Article 1 of the First Protocol expresses an entitlement to the peaceful enjoyment of possessions, which can include land and buildings.[49] Notwithstanding these two provisions they are both subject to qualifications and the public interest may justify the deprivation of property or restrictions on its use.

D. Nature Conservation and Human Rights

Recent appeals concerning private sea defences in an English site of specific scientific interest (SSSI) illustrate the complex considerations that must be balanced when coast protection, nature conservation, and human rights issues are involved. In 2005, Natural England[50] extended the Pakfield to Easton Bavents SSSI in Suffolk to include an area on the landward side of a cliff, upon which there were private houses. The scientific interest of the site arose from the prehistoric fossils that were progressively exposed by erosion of the cliff face. The listed operations that required Natural England's consent included the "erection, maintenance, and repair of sea defences or coast protection works."

A landowner was subsequently refused permission by Natural England to construct a sea defence by depositing material on the beach in front of the cliff in order to slow the process of erosion. However, his appeal under the Wildlife and Countryside Act 1981 was allowed in March 2008 by the Secretary of State who agreed with an inspector that preventing the appellant from protecting his home would constitute an unnecessary and disproportionate interference with human rights.[51]

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[48] Farmer Giles v Wessex Water Authority, [1990] Estates Gazette 102.

[49] The text of the Convention and Convention protocols is available at http://conventions.coe.int/Treaty/Commun/ListeTraites.asp?MA=3&CM=7&CL=ENG .

[50] Natural England is an independent public body whose purpose is to protect and improve England's natural environment and encourage people to enjoy and get involved in their surroundings. Natural England, About Us, http://www.naturalengland.org.uk/about_us/default.aspx (last visited July 23, 2010).

[51] *See*, Refusal of Natural England to permit maintenance of sacrificed sea defences: North Sea, Easton Lane, Easton Bavents, Suffolk: Packfield to Easton Bavents Site of Special Scientific Interest: Report to the Secretary of State for Environment, Food and Rural Affairs, Report NSAP37, Planning Inspectorate, Bristol, 19 February 2008.

However, another landowner challenged the designation of the same SSSI in the High Court.[52] He claimed that promoting erosion was not a legitimate purpose for declaring an SSSI, since it involved destruction rather than conservation. The High Court ruled that conservation was a dynamic concept which may include allowing natural processes to take their course.

E. The Policy of Managed Realignment

The task of implementing managed realignment is complicated by the traditional approach of current legislation, which assumes that flood defence and coast protection are concerned with the exclusion rather than the admission of the sea. However, the discretionary character of the powers of flood defence and coast protection authorities means that they generally have no legal obligation to preserve particular areas of coastal lane, and consequently they should be able to abandon existing structures. On the other hand, since mere abandonment leading to uncontrolled failure may have unpredictable consequences, managed realignment is more likely to involve active intervention, which also needs to be compatible with statutory functions.

Public bodies operating under statute are only entitled to do what their legislation either expressly or impliedly authorizes, and they may be subject to judicial review if they exceed their powers. Their conduct must also not be wholly unreasonable, in the sense that no reasonable authority would have behaved in the same way, and this test will apply not only to positive actions but also to omissions. Thus, an unjustifiable decision to abandon sea defences may still be challenged in the courts as an abuse of discretion.

Managed realignment is a pragmatic policy to address a serious consequence of rising sea levels by adaptive management. Whether it is capable of achieving its objectives will depend not only on its practicability, but also on the legality of the procedures and techniques employed. The case studies below highlight some of the problems and possible solutions.

VII. Climate Change and Coastal Management in the UK

In the UK, management of the coast, at least indirectly, has been in evolution since engineers first started to build "hard" physical structures such as sea walls, harbours, ports, and coastal resorts, thereby interfering with natural coastal processes.[53] Such interference with the coast, particularly during the nineteenth century and a large part of the twentieth was considered the norm, since the environment was viewed as a resource to be exploited and over which control could be exercised. The implications, however, of this "control" were not fully understood at the time. Since then, greater scientific knowledge has resulted in a deeper understanding of the dynamic nature of the environment and with respect to the coast, shed light on a number of serious issues such as coastal erosion,

[52] R (on the application of Boggis) v Natural England, [2008] EWHC 2954 (Admin).

[53] *See generally*, Peter W. French, *The Changing Nature of, and Approaches to, UK Coastal Management at the Start of the Twenty-First Century*, THE GEOGRAPHICAL JOURNAL, 170(3): 116-125 (2004).

pollution, and habitat loss. All of these, to varying degrees, have resulted from this intervention; and, all are part of the complex set of hazards associated with climate change.

Understanding the nature of climate change is of course fundamental to effective management, with predictions based on the development of climate change scenarios; where such scenarios are defined as coherent, internally consistent, and plausible descriptions of a possible future state of the climate. It is not a forecast; rather, it is one alternative image of how the future can unfold. In this regard, a set of scenarios is often adopted to reflect the range of uncertainty involved in the projections. As a result there is an accumulating body of evidence pointing to the continued rise in average near-surface sea temperatures, increasing sea level, and both greater surface run-off and multiplicity of storm events. Despite an evident uncertainty at the confidence that can be placed in downscaled predictions, there is a consensus that the UK's coastline is at increasing risk from one of a number of associated complex hazards. For example, Figure 1 shows the vulnerability of coastal areas to flooding in England and Wales.

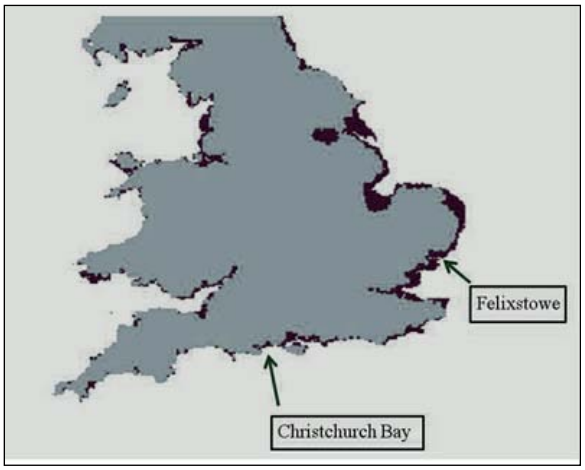

Fig. 1. Coastal vulnerability to flooding in England and Wales.

The UK Climate Impact Programme predicts that over half a million people directly employed in marine activities and more than £150 billion of assets are estimated to be at risk from coastal flooding.[54] This is of particular significance to the South and East coasts of England, which are subject to a sinking coastline due to isostatic compensation as a result of the retreat of ice from the northern part of the British Isles at the end of the last ice age; as well as the effects of climate change, with its predicted rising tides and winter storms.

Historically, coastal flooding and erosion have been the subject of a piecemeal approach to shoreline management with individual "hard engineering" schemes built with a view to protecting defined and often short stretches of coastline. There are currently over 2000 km of such measures, built up over the centuries, but particularly during the time between the

[54] UK Climate Projections, Online Marine & Coastal Projections Report (June 2009), Introduction & Overview, http://ukclimateprojections.defra.gov.uk/content/view/1833/500/ (last visited July 26, 2010).

two World Wars, and the period immediately thereafter. Indeed, following 1945, with the UK involved in rationing food supplies, attitudes were very much focused both on land reclamation for agricultural purposes and on a "hold the line" approach whereby coastal areas were to be protected against another "enemy" – the Sea. As such, the Coast Protection Act 1949 was passed as a means of entrusting "coastal protection authorities," i.e. local Maritime District Councils, with the power and ability to access central government funding to carry out protection measures seen as being appropriate. The Act was the spur for a host of coastal engineering works, with many funded with little concern for viability and cost; and with many ending abruptly at administrative boundaries. In 1985, an element of control was introduced with the requirement for decisions to be based on the application of a traditional cost-benefit analysis approach, though still this was without reference to the effects of measures upon adjacent coastal areas.

Enshrined in the Coast Protection Act 1949 is also a distinction between schemes designed to avoid the threat of coastal flood (sea defence) and those designed to eliminate or control coastal erosion (coastal protection). Whilst the latter is still under the auspices of the Maritime District Councils, since the Water Resources Act 1991 the responsibility for flood defence now belongs to the Environment Agency. The "Regulator," as the agency is known, has a duty to reduce flood hazards through the development of protection measures, the introduction of flood warning systems, and the ability to enable bylaws for flood defence purposes. These functions are carried out by regional flood defence committees who are charged with acting against seawater or tidal water inundation in their area. In addition, with some private landlords, including the Ministry of Defence, also developing coastal defences and protection, this resulted in a complex, site specific and fragmented approach to shoreline management, which did not view the coastal environment as the dynamic and interdependent zone of land and sea that science was proving it to be. Instead the different organizations considered their own particular issues, with generally poor communication links between them. This approach did not therefore reflect the greater understanding of the coastal environment and hence led overall to ineffective management solutions.[55]

The continued existence of fixed physical defences in a situation whereby sea levels are rising has lead to loss of coastal habitats, and in particular intertidal saltmarsh and mudflat areas as a result of a condition known as "coastal squeeze." However, many of these defences are now coming to the end of their effective lives, and the sustainability of maintaining such structures is being questioned.[56]

Part of the greater scientific understanding of the coastal environment came in the form of advances in coastal processes, and the interrelationship between sediment dynamics and coastal geomorphology. For example, it was seen that the best form of coastal defence was in fact a beach since the availability and transportation of sediment would use the energy of tides and waves, and hence reduce the likelihood of coastal erosion. Hard physical

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[55] *See generally*, RHODA BALLINGER, JANE TAUSSIK, AND JONATHAN POTTS, MANAGING COASTAL RISK: MAKING THE SHARED COASTAL RESPONSIBILITY WORK, COASTAL PLANNING AND SHORELINE MANAGEMENT: A REVIEW OF LEGISLATION AND GUIDANCE, A REPORT TO THE LOCAL GOVERNMENT ASSOCIATION'S SPECIAL INTEREST GROUP ON COASTAL ISSUES (2002).

[56] *See*, R.K. TURNER, ET AL., COASTAL MANAGEMENT IN THE 21ST CENTURY: COPING STRATEGIES FOR VULNERABILITY REDUCTION, CSERGE Working Paper ECM 06-04 (2004).

structures such as groynes or sea walls only reduced and restricted the availability of sediment and hence enhanced certain localised erosion.

A further key discovery was that of the "sediment cell" (or littoral cell); defined as "a length of coastline … where interruption to the movement of sand or shingle should not have a significant effect on adjacent sediment cells."[57] In other words, each sediment cell could effectively be viewed as a discrete management unit in which coastal processes could be used so as to better protect the wider coastal area in question. This led to an acknowledgement that coastal processes and shoreline management should be affected through greater strategic and integrated thinking.

The need for greater strategic management and integration in coastal management more widely was acknowledged on an international level at the United Nations Conference on the Environment and Development held in Rio de Janeiro in 1992. In particular, Chapter 17 of Agenda 21 dealt specifically with oceans and coastlines and committed signatories to the "integrated management and sustainable development of coastal areas."[58] At a national UK level, the House of Commons Environment Select Committee (HOCESC) supported this, and highlighted the inadequacy of the existing UK framework in a 1992 report entitled "Coastal Zone Protection and Planning."[59] In this report, the Committee made a number of recommendations, the most salient being that the coast should be treated as one unit; in other words that coastal management should be integrated. The report further stated that in order to achieve this there should be a rationalisation of the existing legislation and organisational responsibilities to come under one strategic national coastal management plan; and that, in order to operate this plan, there should be a national coastal zone management unit established. In addition, to further this, there should also be an extension of the terrestrial planning system out to 12 nautical miles, enabling integration of spatial planning across both land and sea, thereby removing the problem of the coastal boundary.[60]

The UK Government accepted some of the recommendations made by the Committee, but not all. For example, despite acknowledging the need for greater integration along the coast, the government historically insisted that radical organisational surgery was unnecessary and that the existing framework was appropriate to deliver the desired integration.[61] In accepting the elements of integrated coastal management but rejecting a statutory framework, the Government thus paved the way for the development of the voluntary approach clearly evident today. Indeed, the last decade has seen a proliferation of non-statutory plans and voluntary networks that have emerged in order to better co-ordinate the activities of vested stakeholder interests in contested coastal environments. Table

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[57] Dorset Coast Forum, Shoreline Management Plans, http://www.dorsetforyou.com/index.jsp?articleid=21145 (last visited July 26, 2010).

[58] U.N. Conference on Environment and Development (1992), Earth Summit: Agenda 21, http://www.un.org/esa/dsd/agenda21/ (last visited July 26, 2010).

[59] HOUSE OF COMMONS ENVIRONMENT SELECT COMMITTEE, COASTAL ZONE PROTECTION AND PLANNING, SECOND REPORT (1992).

[60] *Id.*

[61] DEPARTMENT OF THE ENVIRONMENT, COASTAL ZONE PROTECTION AND PLANNING: THE GOVERNMENT'S RESPONSE TO THE SECOND REPORT FROM THE HOUSE OF COMMONS SELECT COMMITTEE ON THE ENVIRONMENT, Cm 2011 (1992).

1 identifies the variety of such voluntary coastal groups operating at different geographic scales and with different purposes in the UK.

Table 1: Typology of Voluntary Coastal Groups in the UK[62]

Type	Purpose	Example(s)
International	To network and lobby on an international level	The EU Coastal Union
National: Government	To enhance coordination at a national level	Welsh Coastal and Maritime Partnership
National: Non-governmental	National networking and training	CoastNET
Regional	Facilitate information on a regional scale	Arc Manche
Issue or Sector-based	Resource management; facilitate information sharing, problem identification; policy formulation and implementation.	Standing Conference on Problems Associated with the Coastline (SCOPAC)
Local multi sector groups (Coastal Partnerships and similar Fora)	Sustainable multiple resource management: Facilitate information sharing; problem identification; policy formulation and implementation	Dorset Coastal Forum; Exe Estuary Management Partnership; Solent Forum

With regard to the management of coastal processes, an example of a voluntary group working towards a more integrated approach is that of the Standing Conference on Problems Associated with the Coastline.[63] This stakeholder group is an example of an issue-based group which includes local authorities, members of the public, and other relevant organisations concerned with holistically managing the processes of the south coast of England, between Portland Bill, Dorset and Selsey Bill, West Sussex. A schematic of the principal organisations involved in the environmental management of coastal areas in England and Wales (at present), and the position of the voluntary coastal groups, is shown in Figure 2.

[62] Adapted from Table 2 (Voluntary Coastal Groups operating in the UK) in Stephen Fletcher, *Stakeholder Representation and the Democratic Basis of Coastal Partnerships in the UK*, MARINE POLICY 27(3): 229–240, 231 (2003).

[63] Standing Conference on Problems Associated with the Coastline, http://www.scopac.org.uk/ (last visited July 26, 2010).

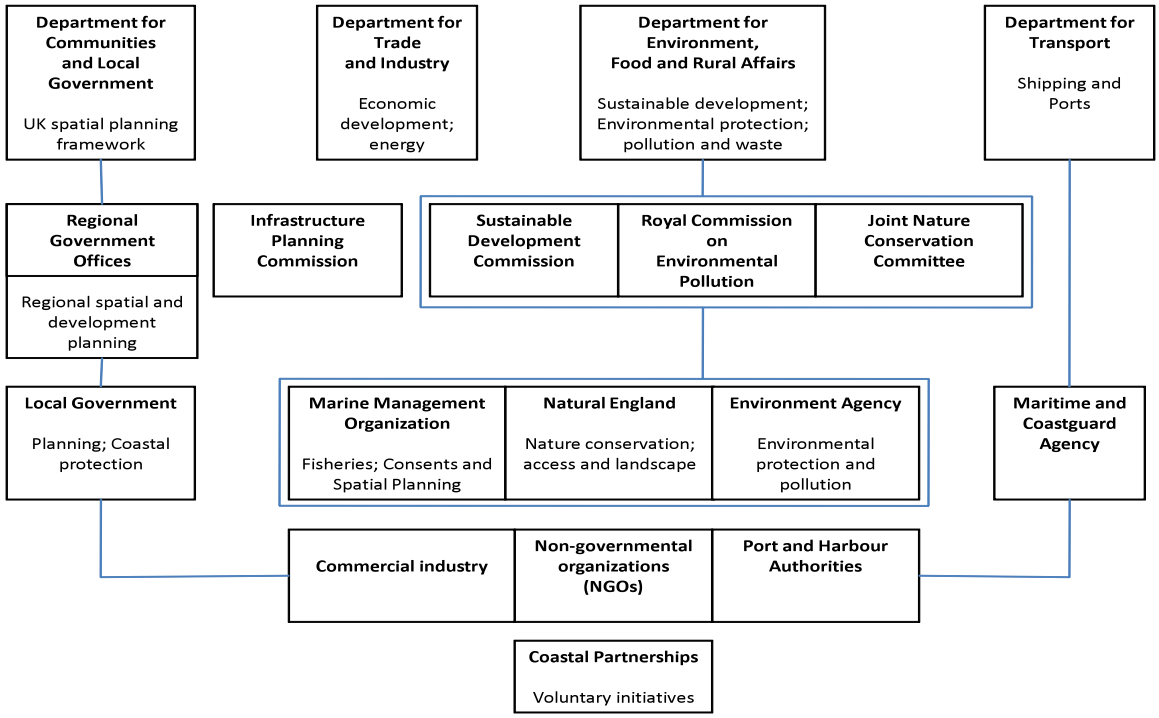

Fig. 2: The principal organisations involved in the environmental management of coastal areas in England and Wales. Graphic courtesy of Anthony Gallagher.

Evidence of the UK Government encouraging integrated initiatives can also be seen in several of its subsequent planning and policy statements. For example, the Planning Policy Guidance note on Coastal Planning (PPG20), issued in 1992, outlined the Government's commitment to encourage cooperative working, stakeholder participation, and the role of voluntary networks in coastal planning.[64] In addition, and more specifically, the Ministry for Agriculture, Fisheries and Food (MAFF) published non-statutory guidance relating to coastal defences, entitled "Shoreline Management Plans: A Guide for Coast Defence Authorities" in 1995.[65] This outlined a more strategic and co-ordinated approach by which the Maritime District Councils were "encouraged" to manage coastal processes. This new framework involved the production of Shoreline Management Plans (SMPs) aimed at developing sustainable coastal defence policies based on sediment cells and sub-cells. Table 2 identifies a typology of UK coastal plans, including SMPs, which are non-statutory documents, offering guidance strategically and for the long-term, which are delivered through "Regional Coastal Groups" with a Lead Authority in the shape of the Maritime District Councils. The development of SMPs has lead to enhanced cooperative working between engineers, planners, and other relevant organisations and stakeholders with the view to choosing one of four policy options for each coastal area. Those options are:

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[64] DEPARTMENT OF THE ENVIRONMENT, PLANNING POLICY GUIDANCE NOTE 20: COASTAL PLANNING (1992).

[65] MINISTRY OF AGRICULTURE, FISHERIES AND FOOD, SHORELINE MANAGEMENT PLANS: A GUIDE FOR COAST DEFENCE AUTHORITIES (1995).

- Hold the line
- Managed realignment
- Non-active intervention
- Advance the line

The traditional "hold the line" approach relates of course to preserving the coastline as it is, whereas "advance the line" relates to pushing it further into the sea. "Managed realignment" is a response to greater understanding with respect to coastal sediment processes and involves selecting non-high value locations, whereby breaches are made in existing defences[66] and intertidal saltmarshes and mudflats are allowed to form to create natural, "soft" sea defences against flooding and erosion.[67] This increases the availability of sediment, saves money on the maintenance costs of the respective coastal defences and also of course has the added advantage of enabling the recreation of endangered habitats.

[66] Examples include Tollesbury, Essex, Brabcaster, Norfolk, Alkborough Flats and Thorngumbald on either side of the Humber, and Abbots Hall Farm on the Blackwater estuary, near Colchester. These sites were chosen specifically by nature conservation organisations as a means of protecting shrinking saltmarshes and saline lagoons, promoting employment through nature tourism, and maintaining a form of sea defence at a lower cost than traditional hard measures. They also help the government observe its obligation to provide for lost habitats under the provisions of the Habitats Directive (Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora) and the Wild Birds Directive (Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds).

[67] Turner, *supra* note 56.

Table 2: Typology of UK Coastal Plans[68]

Management Plan	Prepared By:	Primary Purpose	Reason for Plan Production	Statutory Basis	Geographic Coverage	Degree of Integration	Characteristics
Development plans	Planning Authorities	Land use planning	Legislative requirement	Town and Country Planning Act 1990	Regional and local	Subject specific	Public participation required in plan production; and area coverage to Mean Low Water
SAC Management Schemes	Management group of relevant authorities	Habitat and species conservation	Legislative requirement	EU Habitats and Species Directive 1992	Local	Subject specific	Participatory in nature; and, comprehensive use of scientific data
Heritage Coast Management Plans	Local Authorities and Countryside Commission	Public access and recreation	Response to management problems and funding availability	Non-statutory	Regional and local	Subject specific	Focuses on practical conservation and access
Shoreline Management Plans	Coastal Defence Authorities	Coastal defence	Response to management problems and funding availability	Non-statutory	Regional and local	Subject specific	Plans inform the statutory planning process
Estuary Management Plans	Management group of relevant authorities and other stakeholders	Sustainable estuary resource management	Response to management problems and funding availability	Non-statutory	Regional and local (dependent upon estuary size)	Integration (intended)	Plans prompted by English Nature's Estuaries Initiative (1993)

Both the Environment Agency and Local Authorities have statutory discretion to decide whether or not to protect particular areas, but must act "reasonably." Their powers to carry out any engineering works must therefore have a positive benefit for the protection of coastal land, which implies that an active intervention for the purpose of managed retreat may need to be combined with some protective work in order to be lawful. Passive inaction that allows defences to be breached naturally, or through "non-active intervention," would therefore appear legitimate and whilst there is no entitlement to expose third party land to risk of flooding by active interference with sea defences, there is also no obligation to maintain the existing works. In addition, whilst there is a statutory obligation to compensate landowners for the depreciation in the value of their land, there is also no liability if damage is the result of natural processes.

Having been negotiated, consulted and introduced, SMPs are intended to be reviewed at nominal five yearly intervals so as to enable their evaluation; to incorporate any new research or changes of national policy; and hence to improve coordination, and foster better guidance and administrative mechanisms. The first tranche of SMPs have thus undergone such a period of review with one of the principal conclusions being that whilst SMPs represent a marked improvement on the previous approaches, offering both participation and integration, they are still not fully integrated into the statutory planning system. Furthermore, since decision-making is still based on cost-benefit analysis, which estimates a value for private property but which fails to calculate the value of sediment lost through

[68] Table adapted from ROBERT KAY AND JAQUELINE ALDER, COASTAL PLANNING AND MANAGEMENT (1999)

erosion or gained through accretion, it fails to fully account for the functionality and value of the environment. Other criticisms have also pointed to logistical aspects such as inappropriate SMP boundaries in relation to coastal processes and a failure to generate or use new scientific information, largely as a result of limited funding.

There are therefore a number of areas where management can be improved. With respect to adaptation, one of the key criticisms has been that there is no compensation mechanism available for the loss of buildings or land due to coastal change, or to enable the funding of transitions relating to coastal change. As such there would appear to be a failure with respect to enabling social justice and it can be concluded therefore that there is no explicit or embedded adaptation strategy in the SMP approach and hence that there is still a need for further management thinking.

VIII. Policy Developments Relating to Coastal Management and Adaptation

From a policy perspective, progress in the integration of coastal management has been made continually since 1992, both nationally and internationally. The principal driver in this has been the European Union, whose current strategy has major implications for UK coastal management. Following the EU Demonstration Programme on Integrated Management in Coastal Zones in Europe, which reviewed coastal management in 35 local and regional projects around the Member States between 1997 and 1999, the EC Communication to the European Council and Parliament stated that "an integrated, participative territorial approach is required to ensure that the management of Europe's coastal zones is environmentally and economically sustainable, as well as socially equitable and cohesive."[69] It went on to state that the integrated management of the coastal zone requires strategic, coordinated and concerted action at the local and regional level, guided and supported by an appropriate framework at the national level. To this end, a European Parliament and Council Recommendation concerning the implementation of Integrated Coastal Zone Management (ICZM) in Europe was adopted on May 30, 2002.[70] The Recommendation required individual Members to initiate a national stocktaking exercise in order to analyse the actors, laws, and institutions that influenced the planning and management of their coastal zones. The Recommendation further required that this stock-taker should form the basis from which a national ICZM implementation strategy should be produced.

For the UK, the stocktaking exercise was carried out by the Atkins Consulting Group and completed in 2004[71] and the ICZM Strategy for England was published in 2008. This strategy has as its core a series of principles of which adaptive management is one, although as a strategy this does not provide any detail as to what adaptive management might involve.

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[69] European Commission, Communication from the Commission to the Council and the European Parliament on Integrated Coastal Zone Management: A Strategy for Europe, COM/2000/547 (2000), *available at* http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2000:0547:FIN:EN:PDF .

[70] Council of the European Union, Recommendation of the European Parliament and of the Council of 30 May 2002 concerning the implementation of Integrated Coastal Zone Management in Europe, 2002/413/EC (2002), *available at* http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2002:148:0024:0027:EN:PDF .

[71] ATKINS CONSULTING GROUP, ICZM IN THE UK: A STOCKTAKE (2004).

At the same time as the national ICZM strategies were being developed, the idea of marine spatial planning (MSP) was also being progressed both in Europe, through the development of the Integrated Maritime Policy, and in the UK, through the commitment to introduce new primary legislation in the form of the Marine and Coastal Access Act which received Royal Assent in November 2009. This Act is aimed at delivering a more holistic, ecosystem-based approach to "marine stewardship" through a package of new initiatives including the introduction of a range of measures and a new Marine Management Organization in order to implement and regulate a three-dimensional planning system for UK waters. This represents a significant development in terms of the management of the marine environment but includes no specific powers with respect to coastal adaptation.

With respect to Europe, there are two key planks of marine and maritime policy; namely the Marine Strategy Framework Directive[72] and the EC Communication on An Integrated Maritime Policy for the European Union.[73] The former is concerned with implementing an ecosystem-based approach to European waters in order to enable "good environmental status" for those waters by 2021; whereas the latter is concerned with establishing good governance and integrated coordination of the EU maritime sector in order to achieve sustainable development. This includes such diverse interests as the "quality of life" in coastal regions, tourism, shipping and ports, and energy production and states that given the interaction of coastal and maritime issues across the land-sea interface, an overall EU maritime policy would have a major stake in the success of ICZM. Consideration should therefore be given to an EU-wide mechanism for comparative analysis and an exchange of best practice. The Policy also goes on to reference the ecosystem-based approach and identifies maritime spatial planning (as opposed to marine spatial planning) as an action area. Whereas the Marine Strategy Directive makes no explicit reference to adapting to climate change, the Integrated Maritime Policy Communication does state the need for supporting research in mitigating and adapting to climate change in maritime and coastal zones. However, this represents only a broad indication of intent rather than any specific action.

A more specific EU action has been the EC Floods Directive[74] which requires Member States to carry out flood risk assessments and prepare flood hazard maps. This was transposed into UK law by the Flood Risk Regulations 2009[75] and since supported by the Planning Policy Statement 25: Development and Flood Risk[76] published in March 2010 and the Flood and Water Management Act which received Royal Assent on 8 April 2010.[77] Flood

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[72] Marine Strategy Framework Directive, *supra* note 29.

[73] Commission of the European Communities, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions of 10 October 2007 on an Integrated Maritime Policy for the European Union, COM/2007/575 (2007), *available at* http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2007:0575:FIN:EN:PDF .

[74] Floods Directive, *supra* note 40.

[75] Statutory Instruments 2009 No. 3042, *available at* http://www.opsi.gov.uk/si/si2009/uksi_20093042_en_1 .

[76] Communities and Local Government, Planning Policy Statement 25: Development and Flood Risk, http://www.communities.gov.uk/publications/planningandbuilding/pps25floodrisk (last visited July 26, 2010).

[77] The text of the Flood and Water Management Act 2010 and additional information is available at http://www.defra.gov.uk/environment/flooding/policy/fwmb/ .

risk assessment maps will of course help provide improved information for SMPs and raise awareness, thereby contributing towards a more adaptive management approach, and hence they represent an essential component of any toolkit for adaptation.

Another significant development in relation to coastal change has been the Department of Environment, Food, and Rural Affairs' publication of "Adapting to Coastal Change: Developing a Policy Framework" in March 2010,[78] which is seen as a "staging post" in supporting coastal communities adaptation to coastal change. As part of this, a Coastal Change Fund has been made available which includes the provision of a coastal erosion assistance fund to help cover some of the transition costs incurred by homeowners who experience the total loss of a home due to coastal erosion. This proposes grant aid available to local authorities to cover baseline level of assistance with the immediate demolition and moving requirements of affected homeowners, though it still does not cover the value or alter the long standing policy not to pay compensation. The basis for this policy is that no one has the statutory right to flood or erosion protection; therefore, where protection cannot be provided, the homeowner cannot claim compensation. The homeowner does however have the right to be engaged in the process of appraising whether the investment to reduce the risk is justified and can make a claim for compensation on this basis.

The Coastal Change Fund is also available to fund specific projects known as Coastal Pathfinders, of which 15 coastal pathfinders were announced in December 2009. The purpose of these being to enable partnerships to be developed which operate innovative approaches to planning and managing change; with the intention of improving the understanding of how coastal communities can adapt to coastal change, including the costs and benefits involved. These then can provide practical lessons and examples that can be shared with other practitioners, particularly on community adaptation planning and engagement and delivery of adaptive solutions. This then represents a learning programme aimed at developing and sharing best practice.

IX. Case Studies

This section will consider two examples of adaptive planning for flood control, the first covering the experiences and problems related to the Christchurch Bay area on the South coast, and the second examining the use of the UK Climate Impact Programme's (UKCIP) Adaptive Wizard as a proactive planning tool by the port of Felixstowe on the East coast. It is not within the scope of this paper, however, to consider the actual extent of the climate change outcomes as determined by UKCIP.

A. Christchurch Bay

A study of future coastal defence management in Christchurch Bay was undertaken by members of the Tyndall Centre for Climate Change in 2004.[79] It details the physical

[78] The document and additional information is available at http://www.defra.gov.uk/environment/flooding/documents/manage/coastalchange-policyframework.pdf .

[79] Roger Few, Katrina Brown, and Emma L. Tompkins, *Climate Change and Coastal Management Decisions: Insights from Christchurch Bay, UK,* COASTAL MANAGEMENT 35(2): 255-270 (2007) [hereinafter *Insights from Christchurch Bay*].

problems from weather variability, both on a historical and an anticipated basis, as well as a consideration of problems related to the planning process posed by the interaction of planning authorities, from a local to a national level.

Christchurch Bay spans some 18 km of the Dorset-Hampshire coast, stretching from the high headlands of Hengistbury Head at the western end, to the narrow spit of shingle of Hurst Spit in the East. Much of the coast and its hinterland is largely urbanised, the stretch between Barton and Christchurch forming a continuous residential belt; further eastward, the land is dedicated more to agriculture and conservation and recreational use.[80] As well as being an attractive area to live and retire, the area attracts large numbers of summer visitors, putting heavy pressure on the natural character of the coastline. The natural processes of the sea, the weather, and groundwater movements also impact upon the coast and on human activity there.[81]

The geology consists mainly of sedimentary tertiary sands and gravels, which offer little resistance to weathering. At Barton on Sea, situated approximately midway along the bay, exposed clay forms an underlay to permeable sands, where percolating rainwater results in slip plains and mass rotational land slumps. Prevailing South Westerlies produce a longshore drift from west to east, with the beaches at the more sheltered western end consisting of finer beach material than the coarser materials at the eastern end, where rock and gravel produces beaches that are predominantly shingle. Figure 3 illustrates the bay and its sedimentation transport patterns.

[80] ROGER FEW, KATRINA BROWN, AND EMMA L. TOMPKINS, TYNDALL CENTRE FOR CLIMATE CHANGE RESEARCH, SCALING ADAPTATION: CLIMATE CHANGE RESPONSE AND COASTAL MANAGEMENT IN THE UK (2004).

[81] *See generally*, NEW FOREST DISTRICT COUNCIL, NEW FOREST DISTRICT COUNCIL MANAGEMENT PLAN (2003).

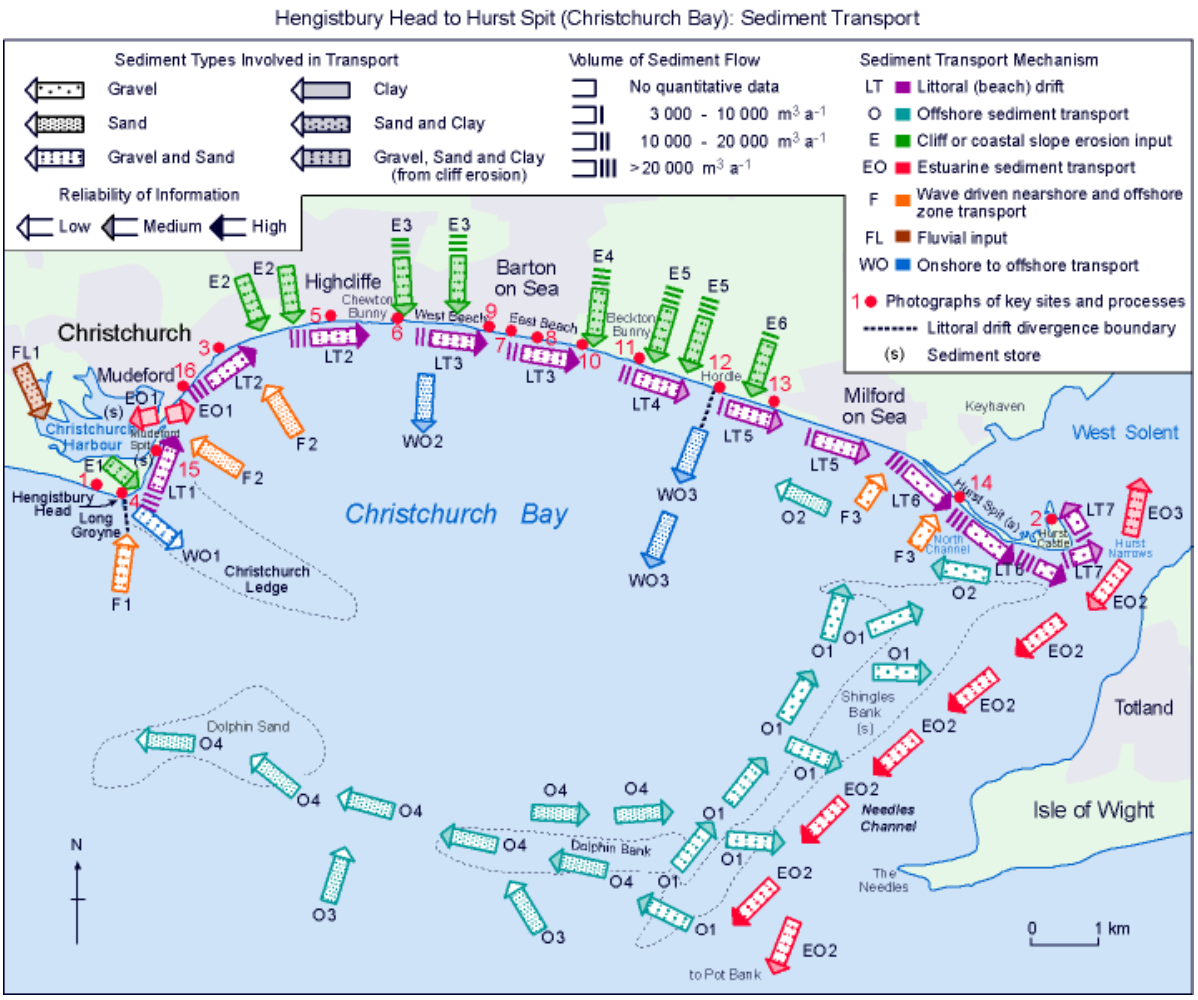

Fig. 3. Christchurch Bay. Graphic courtesy of Royal Haskoning UK Ltd.

Climate change predictions indicate an increase in the rate of erosion caused by the rising sea level (as well as some possible changes to wave direction and sedimentation patterns). However, it is the expectation of higher winter rainfall and storms that is considered more likely to exacerbate coastal changes through groundwater seepage and cliff falls at Barton, whilst flooding of the harbour at Christchurch may result from higher river flow and extreme high tides. It is the potential changes in both the terrestrial and marine environments that add to the uncertainties of climate change in terms of extent of the possible success of any mitigating/adaptive action. Much of the coastline already has a mix of both hard sea defences such as sea walls, and soft sea defences, such as beach replenishment; these in turn appear to have resulted in effects on protection measures and changes to sedimentation patterns further along the coast. Whilst slowing the rate of erosion, the construction of hard coastal defences can reduce the amount of material naturally generated to replace the beaches and spits. In addition, the construction of sea walls prohibits the natural movement inland of coastal habitats of mudflats and saltmarshes which results from rises in sea level, a process known as "coastal squeeze."

These valuable inter-tidal habitats, which absorb energy and water, are consequently lost by drowning.[82]

Christchurch Harbour itself is formed by the lower valleys of the Stour and Avon rivers and is connected to the sea by a narrow channel. The harbour is largely protected from the sea by the Mudeford Sandbank, which lies in the lee of Hengistbury Head. Since the construction of the Long Groyne in 1938, the sandbank has lost much beach material, threatening a breach to the harbour and the likelihood of extensive flooding. A range of groynes to seaward was subsequently constructed by the Christchurch Borough Council to counter this threat. Along the northern shore of the harbour and in the low-lying areas around Christchurch, hundreds of properties are potentially at risk from tidal and/or riverine flooding.[83]

Erosion from the high wave energy along the bay, especially at Barton on Sea, has caused the cliffs to recede to within a very short distance from a number of cliff-top buildings. Erosion rates averaging more than 1.5 metres per year have been experienced in some of the undefended stretches of the coast. Barton is at long-term risk from coastal recession and subsequent further loss of housing, roads, etc., since funding for long-term protection is not guaranteed; meanwhile cliff erosion continues, even without the added complication of climate change. Exposure of important fossil beds by erosion of the cliffs at Barton is deemed to be of importance for geologists; it is therefore considered necessary to allow erosion to take place, albeit at a reduced rate. Over the years, a range of measures have been tried around the Barton area, beginning with wooden groynes and rock revetments. A new concept of siphoning off drainage water was introduced to reduce the rate of cliff recession.

Further east, the soft cliffs at New Milton are designated a geological SSSI and for that reason, are unprotected, but the need to reduce the rate of erosion and improve the aesthetics of the beach has been recognised. At Milford on Sea, strong coastal protection measures have been constructed to protect the suburban development, with a concrete sea wall and rock revetments offering protection from both erosion and flooding. Timber groynes control longshore movement of shingle and inhibit its transport eastwards.

At the Easternmost end of the bay lays Hurst Spit, a 2.5 km shingle bank originally formed by natural processes, with Hurst Castle at the seaward end. The Spit provides an important coastal defence for the Western Solent and a designated area of saltmarsh to the North. In the 1940s, the construction of coastal protection works further westward in the bay disrupted the natural flow of shingle; a breach in 1996 required the construction of a rock breakwater and rock revetment and regular replenishment by recycled shingle. The area contains two Special Areas of Conservation and a Ramsar site.[84] A permanent breach could lead to erosion of the marshes and mudflats behind the Spit and extensive inland flooding.

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[82] Turner, *supra* note 56.

[83] Insights from Christchurch Bay, *supra* note 79.

[84] ROYAL HASKONING UK LTD., POOLE AND CHRISTCHURCH BAY SHORELINE MANAGEMENT PLAN REVIEW SUB-CELL 5F, SECTION 4, POLICY DEVELOPMENT ZONE 1, 4.2.3 (2009).

The eastern section of the bay lies within the New Forest District Council (NFDC) in Hampshire; the western section lies mainly within the Borough of Christchurch in Dorset, with Hengistbury Head falling within the Borough of Bournemouth. Coastal defence from the effects of flooding and coastal erosion has long been a major problem in the bay and most of the defensive works have so far been carried out by the local authorities and the Environment Agency, but these defences have not always been constructed to a unified or coordinated pattern. It was only in the late 1990s that the first SMP for the area was instigated on an integrated basis for the period of some 50 years ahead.

The first generation SMP focused mainly on historical defence measures and SMP1 sought to replace earlier piecemeal plans to address a series of cliff collapses in the 1990s and 2001 with more sustainable options. A timescale of 100 years is now employed by the NFDC and modern computer technology and GIS techniques allow a much closer monitoring of events. This extended timescale, together with the uncertainties of effects on particular sites add to the difficulties of an effective programme of adaptation. As well as meeting government requirements for coastal management and coordinating proposals for activities of all the various agencies involved, the SMP also intended to promote public understanding of the special qualities and problems of the coast.[85] The proposals from SMP1 for some of the various sections of the coast are shown in Table 3. The second generation SMP, due to be completed by the end of 2010, focuses more on natural processes, which may result in some shoreline defences being abandoned. SMPs may now formally include the option of "no defence"[86] or "managed retreat" whereby expenditure on coastal defences cannot be justified or would have unacceptable impacts elsewhere.[87]

Table 3. Proposals from Shoreline Management Plan 1[88]

Unit	Location	Policy
CBY7	Hurst Spit	Hold the Line, short and long term.
CBY6	Milford-on-Sea to Hordle Cliff	Hold the Line, short and long term.
CBY5	Hordle Cliff to Barton Common	Do Nothing short term, Selective Retreat long term.
CBY4	Barton Common to Cliff House Hotel	Hold the Line, short and long term.
CBY3	Marine Drive West, Barton	Retreat short term, Hold the Line long term.
	Naish Holiday Village	Retreat short term, Do Nothing long term.
	Chewton Bunny	Retreat short term, Hold the Line long term.
CBY2	Chewton Bunny to Mudeford Bank	Selectively Hold the Line, short and long term. Undefended sections possibly retreat long term
CHB 4,5	Mudeford Quay and Town	Hold the Line, short and long term
CBY1	Hengistbury East	Retreat
	Mudeford Spit	Hold the Line

[85] New Forest District Council Management Plan, *supra* note 81.
[86] Parliamentary Office of Science and Technology, Postnote: Coastal Management, no. 342 (Oct. 2009) *available at* http://www.parliament.uk/documents/post/postpn342.pdf .
[87] New Forest District Council Management Plan, *supra* note 81.
[88] Adapted from Royal Haskoning, *supra* note 84, at 4.2.14.

SMPs, however, are non-statuary, high-level documents. A summary of the proposed preferred options for the various sections of the bay are shown in Figure 4, which highlights the local and specific nature of the plans for each section of the bay. Key values for the shoreline as contained in the second SMP include, but are not limited to:

- Protecting the economic viability and heritage values of Christchurch;
- Reducing flood risk to Christchurch and Mudeford;
- Maintaining the communities of Barton and Milford;
- Managing risk to properties due to flooding and erosion where sustainable;
- Maintaining geological exposure of cliff line;
- Maintaining the dynamic coastal zone and its capacity to change
- Reducing reliance on defences.

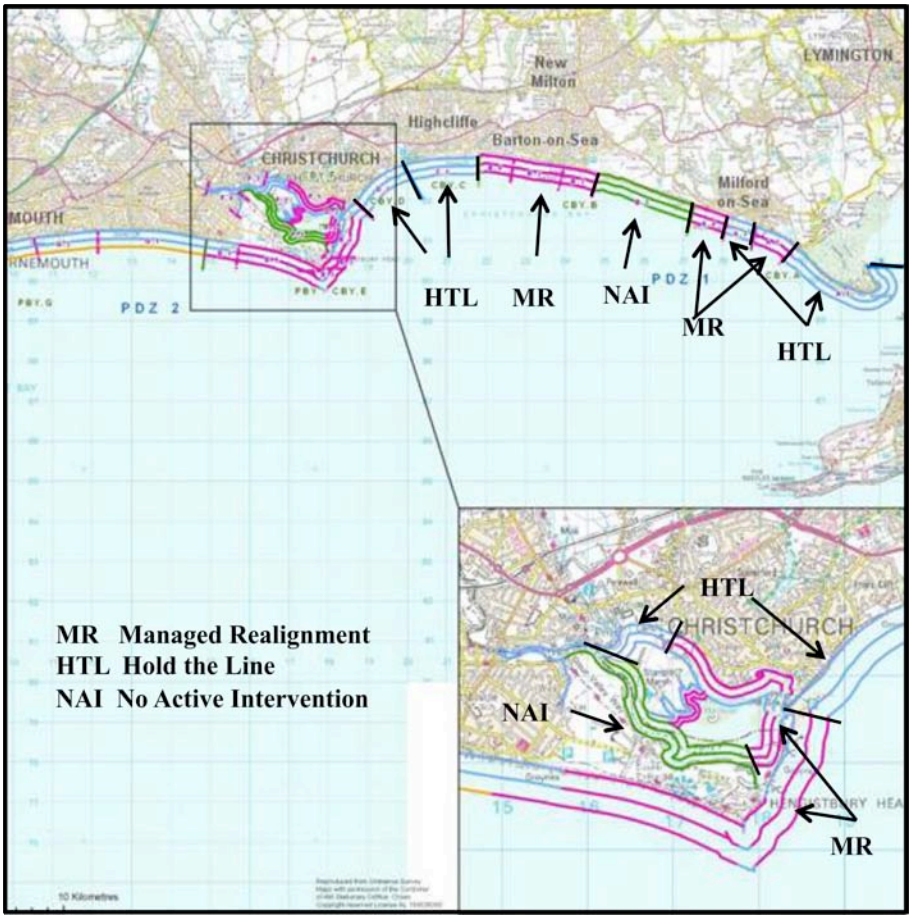

Fig. 4. Proposed Policy, Shoreline Management Plan 2. Graphic courtesy of Royal Haskoning UK Ltd.

At Christchurch Harbour, the general plan is to "Hold the Line" for important development areas around the harbour, whilst allowing natural adaptation of habitats and to maintain without enhancing the sea wall in front of Mudeford (unless longer term sea rises dictate otherwise). Natural development of the estuary habitat should be allowed.

The plan for Barton is one of long-term adjustment, protecting the eastern sea front and improving the stability of the coastal slope, whilst accepting further cliff recession. To the west of the town, adaptation would allow the loss of property whilst reducing the rate of loss through establishing some degree of control over existing defences and drainage. As well as the deliberate breaching of certain established sea defences to establish new buffer zones of marshland, managed retreat may also include a measure of long-term management of the rate of cliff erosion by soft engineering techniques such as beach recharge, slowing without stopping completely the rate of cliff toe erosion.[89]

To the east, the seafront at Milford is to be managed by retaining the beach and drawing forward the natural realignment by means of offshore structures or, should funding not be available, realigning the defence line backwards to maintain an area of beach, whilst at the same time, allowing some increased exposure of the designated geology. Hurst Spit is to be maintained by holding the line at Hurst Castle and maintaining the eastern end of the rock revetment and groyne.

B. The Port of Felixstowe – UKCIP Adaptive Wizard

The UK Climate Impact Programme's (UKCIP) Adaptive Wizard is a process devised to help organisations to assess their vulnerability to current climate and future climate change, identify their options for addressing their key climate risks, and helping them to develop a climate change adaptation strategy that will ultimately lead to the formulation of decisions or strategies that will facilitate the development of a climate change strategy.[90] Through a series of five steps (see Figure 5), members of an organisation, working together as a small group, can be directed to source, assemble, and analyse information and assumptions pertinent to the organisation through a series of tasks and questions[91] that can assist in the development of a plan. This, in turn, should be subject to review as further information and understanding is generated. Rather than supply data and answers, the tool is intended more to lead the user to supply data that is pertinent to his organisation and lead him to solutions relevant to his own situation. A case study illustrated by UKCIP covers the use of the Adaptation Wizard by the Port of Felixstowe; some of the basic findings are cited below.

[89] New Forest District Council Management Plan, *supra* note 81.
[90] UK Climate Impacts Programme, The UKCIP Adaptation Wizard V 2.0 (2008), www.ukcip.org.uk/wizard (last visited July 26, 2010).
[91] For a full set of tasks and questions, *see* UKCIP Adaptation Wizard, Download Notepad, http://www.ukcip.org.uk/index.php?option=com_content&task=view&id=92&Itemid=219 .

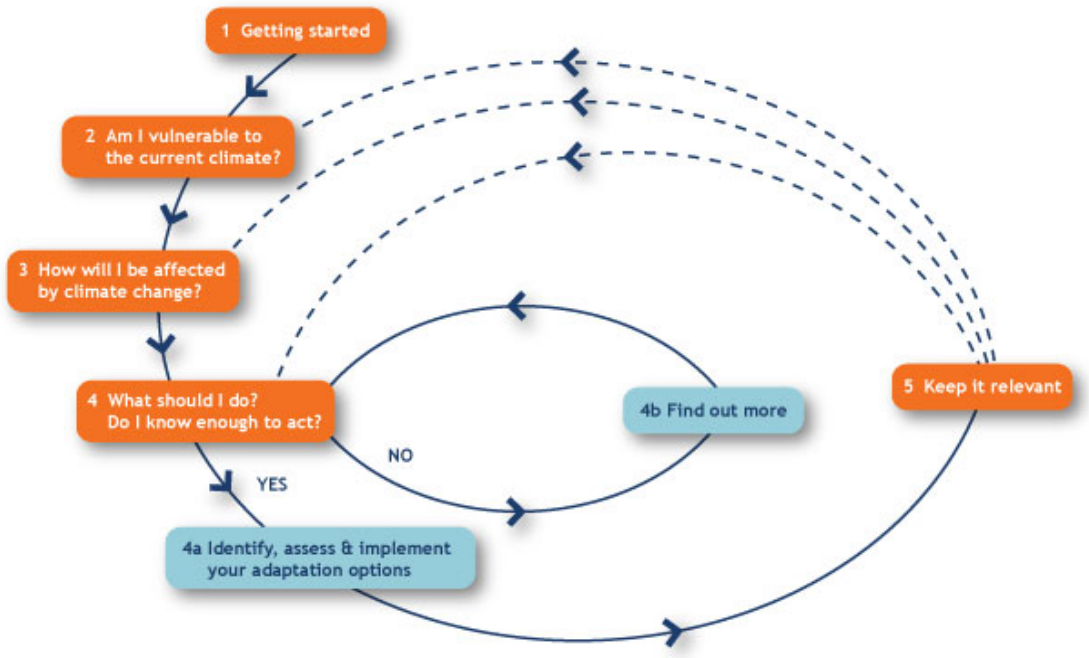

Fig. 5. *The UKCIP Adaptation Wizard* v 2.0. © UKCIP (2008). Graphic courtesy of UK Climate Impacts Programme.

The port of Felixstowe is located on the east coast of England, a coastline which is already sensitive to current risks from the vagaries of the weather. Possible new and increased risks from climate change may result in increase to both the coast's and the port's vulnerability. In 2009, the port worked with UKCIP to employ the first three steps of the Adaptation Wizard to formulate a high level assessment of the likely impacts and adaptive measures deemed necessary by the port to maintain its operational status and position as the UK's largest container port.[92] This proactive work has also enabled the port to respond promptly to the new requirements for formal reporting of their assessments and adaptation plans to the Secretary of State.[93]

As an illustration, the following are extracts from the Felixstowe exercise, which covered some of the tasks in the first three steps of the Wizard. Step 1 – Getting started – is intended to define objectives and the resources needed, and identify those who are to be involved and the management requirements necessary to achieve the outcomes.[94] Within Step 1, Task 1.5 sought to identify the actual problems that need to be assessed, namely the possible adverse climate change effects. Felixstowe listed these to include power outages resulting from damage to the distribution system; changes to sedimentation patterns,

[92] UKCIP, Adaptation Wizard: Case study, http://www.ukcip.org.uk/index.php?option=com_content&task=view&id=686&Itemid=560 (last visited July 26, 2010) [hereinafter *Felixstowe Case Study*].
[93] Climate Change Act 2008, 2008 Chapter 27, s.59, *available at* http://www.opsi.gov.uk/acts/acts2008/ukpga_20080027_en_6#pt4-pb1-l1g59 .
[94] UKCIP, Adaptation Wizard: Step 1 Getting Started, http://www.ukcip.org.uk/index.php?option=com_content&task=view&id=49&Itemid=200 (last visited July 26, 2010).

navigation routes and the potential need for dredging; losses and stoppages resulting from adverse weather; and the knock-on effect that disruption to inland distribution might have on the port.[95]

More frequent port closures could impair the port's competitiveness. On the other hand, early measures taken to address the risks might actually enhance the port's competitive advantage. The objectives of Task 1.5b involved exploring the anticipated robustness of the infrastructure in the face of climate change. These included recommendations for improving the resilience to change, objectively assessing the need for adaptation, and the raising of awareness within the organisation.[96]

Task 1.10a sought to identify anticipated barriers to adaptation and identified the need for better evidence and confidence in climate change in order to facilitate commercial arguments for investing in climate change adaptation. Issues highlighted included the incompatibility of long-term investment decisions with the normal time frame of current business decisions and the limited pressure to make such investments compared to the day-to-day investments required to meet more normal business risks.[97]

Step 3 of the process examined how the port may be affected by climate change.[98] By means of a workshop, Task 3.2 sought to define the anticipated climate impacts on the port in the six generic business areas of markets, logistics, premises, people, finance, and processes. Amongst the threats to the port that were identified were the long term nature of investment (the design-in concept usually being somewhat cheaper than retrofitting); the risk of quays being overtopped by higher sea levels, with the associated adverse impacts on equipment operation and hence productivity; the problem posed by wind, which is a factor that can have a significant effect on container handling.[99] The process also afforded an opportunity to ensure that provisions to adapt to climate change can be incorporated into developments in a way that is cost effective and establishing better processes for monitoring changes will allow better collaboration with manufacturers to produce more robust equipment. It also identified the possible need for less dredging as a result of higher sea levels.

The above allowed a listing of priorities requiring adaptation measures to be devised. These included possible disruption of power supplies from high winds and adverse weather and port closure of more than three days caused by high tides, winds, and heavy rainfall. Higher sea levels could reduce the clearance between ships and booms, affecting loading operations and increasing stoppages in crane and pilot operations whilst the possibility of high sea levels overtopping quays could also stop port activity through the loss of crane operations.

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[95] Felixstowe Case Study, *supra* note 92.
[96] *Id.*
[97] *Id.*
[98] UKCIP, Adaptation Wizard: Step 3 How will I be affected by climate change?, http://www.ukcip.org.uk/index.php?option=com_content&task=view&id=112&Itemid=237 (last visited July 26, 2010).
[99] Felixstowe Case Study, *supra* note 92.

Although the study only included part of the overall Adaptation Wizard, and although no high magnitude risks were identified as needing urgent attention, the process identified a number of issues which required attention. Two key issues were defined as being riverine flooding[100] and wind, two risks over which the port has little direct control. The study also allowed the port to identify a number of internal and proactive capacity building actions, including raising the awareness of the risks posed by climate change and the incorporation of these risks into flood risk management and business continuity plans.

Subsequent steps relating to implementation were not addressed at that time. Step 4 examines an organisation's attitude towards risk – how much risk is acceptable? – and considers the practicalities of implementation; building and installing the appropriate adaptive capacity and the timeline for completion.[101] Since the outcome of actioned plans may only be apparent in the longer term, Step 5 calls for a pre-emptive review of the proposals' relevancy to the envisage variability of climate and compared to other socio-economic goals the cost effectiveness of the proposals defined and the need for changes of strategy in the face of developing information.[102]

UKCIP has identified a number of principles for good adaption programmes, which should be followed in working through the Adaptation Wizard, including identifying, informing, and working in partnership with the community concerned to ensure that both uncertainties and risks are identified and understood by all. Risks include both climate and non-climate change risks and a balance must be maintained between them to maintain an overall approach, whilst focusing initially on current climate variability and the risks and opportunities they offer. Since there may be a large element of uncertainty involved in planning, it is essential to adopt a policy of continual monitoring and improvement, addressing likely solutions that do not restrict later action elsewhere.

X. Conclusions

This article has demonstrated how mitigation has been the dominant approach to dealing with climate change to date, and identified the perceived limitations of this approach, which led Parties to the United Nations Framework Convention on Climate Change to agree in Bali in 2007 that the alternative approach of adaptation should play a significantly greater role in the future global response. This is now embedded as one of the post 2012 pillars.

Although there is evidence of adaptation already taking place, it is currently piecemeal in manner and mainly based on the interpretation of policy documents. A more strategic approach is therefore needed to ensure that timely and effective adaptation measures are taken, ensuring coherence across different sectors and levels of governance. To this end, the European Union produced a White Paper in April 2009, aimed at reducing vulnerability.

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[100] Felixstowe is at the mouth of The Haven, where the rivers Stour and Orwell conjoin.
[101] UKCIP, Adaptation Wizard: Step 4 What Should I do?, http://www.ukcip.org.uk/index.php?option=com_content&task=view&id=122&Itemid=247 (last visited July 26, 2010).
[102] UKCIP, Adaptation Wizard: Step 5 Keeping it Relevant, http://www.ukcip.org.uk/index.php?option=com_content&task=view&id=143&Itemid=268 (last visited July 26, 2010).

Similarly, on a national basis many countries are consulting on a range of adaptive instruments, with the UK being no exception and issuing a consultation document on the implementation of the Marine Strategy Framework Directive in October 2009.

A major problem, however, is the disconnect between the vertical structure of legal instruments from international conventions, through European Community law, state legislation, and what happens within the coastal communities through local government and agencies. Adaptive management shows up in coastal management plans, regional development plans, and agency guidance documents; yet it appears almost nowhere within codified statutory and regulatory text. This creates major barriers to the implementation of adaptive management with regulatory bodies and agencies having their decisions challenged by different stakeholders. The courts can only look to legislation and the common law for legal authority within the UK; and this in turn is constrained by issues of human rights in addition to the public right to be involved with environmental decision-making. Strategy and policy documents are aspirational but agency decision makers look for a mandatory duty, or at least permissory legal authority prior to carrying out adaptive management activities. The case studies demonstrate how administrative bodies in the UK *are* carrying out adaptive management measures by looking for a broader interpretation of existing legal instruments. However, as the legal cases show such decisions are constantly open to legal challenge.