An Evaluation of Coastal Risk Decision Making in England, Wales and Northern Ireland

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Thesis submitted for the degree of PhD.

DECLARATION

This work has not previously been accepted in substance for any degree and is not concurrently submitted in candidature for any degree.

Signed......W. J. Dodds..........(candidate) Date...16-7-09....

STATEMENT 1

This thesis is being submitted in partial fulfilment of the requirements for the degree of PhD.

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STATEMENT 2

This thesis is the result of my own independent work/investigation, except where otherwise stated. Other sources are acknowledged by explicit references.

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Abstract

Coastal hazards and their associated risks are not new to coastal managers, engineers and planners. As an island nation the coast of the United Kingdom (UK) has been an attractive area for settlement for centuries. Consequently, a substantial proportion of urban development in the UK is at risk of flooding or coastal erosion. Traditional responses to coastal hazards across Europe have been based upon reactive, parochial hard engineering structural solutions in order to protect assets at risk. These practices have been predominantly sectoral due to fragmented institutional arrangements, with limited integration between the sectors of shoreline management and the land-use planning system. Additionally, historic coastal risk decision making has shown little understanding of the complexities of coastal systems. Whilst within contemporary coastal risk decision making, there is limited transparency as to the role of natural coastal change. Levels of uncertainty exacerbate the complex task of managing coastal risk, in particular in relation to the natural coastal change evidence base.

Using a multiple-case study approach, decision making practices in relation to coastal risk in England, Wales and Northern Ireland were evaluated. Concomitantly, the role of the natural coastal change evidence base within these decision making processes was scrutinised. Research investigations were facilitated *via* the development of two distinct and innovative methodological approaches that framed and guided two semi-structured interview schedules and a number of documentary reviews. This deductive process included a case study selection hypothesis and a Research Strategy Model (with Empirical Indicators). Case study results established the complexities associated with coastal risk decision making, including historic, contemporary and likely future decision making practices. In particular, the range of decision makers involved and the hierarchical and framed nature of decision making were identified. Importantly, traceable coastal risk decision making relationships that exist temporally, spatially and sectorally were ascertained. Forcing factors or 'context issues' that influence these decision making practices were highlighted. It was further determined that the role of natural coastal change science, as part of the coastal risk decision making evidence is constrained. This was found to be due to a number of issues, including the perpetuation of the science-practice disconnect, aggravated by natural coastal change scientific uncertainty.

Through analysis of empirical findings and consideration of the underlying case study hypothesis and previous construction of decision making, a conceptualisation of coastal risk decision making was developed. This seeks to convey hypothetical stages of coastal risk decision making pathways and convey the wider complex decision context, including intricate pathway connections. A revised suite of supporting Empirical Indicators allows for a structured and comprehensive assessment of decision making, and importantly, a mechanism by which to explore the role of science within coastal risk decision making.

Acknowledgements

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Special thanks go the Greeks (Lia, Elpida and Aggie), the Glasgow girls (Lynne, Irenee and Carol) and to Dr Anna "Hey" Haworth for all the lovely cups of Yorkshire tea. Also, to those who provided me with a roof over my head in times of need (Anna, Jen and Graham...), I will always be grateful. Lastly, thank you to friends (Dr Paivi, Dr Lizzie, Dr Cathal, Dr Mostyn, Dr "French" Cat, Dr Paivi & Dr Cat Burgess) and housemates (Holly, Anna Scott, Amy). All have joined me along various parts of the journey that has been the PhD- it would have been a rockier ride without them.

Dedication

I would like to dedicate this to my parents, sadly no longer with us, for my upbringing in the Western Isles of Scotland. It can be no coincidence that I have been drawn towards coastal research and have such a strong passion for the coastal and marine environment. I hope I will always be inspired by the beauty of the coast and in awe of the sea.

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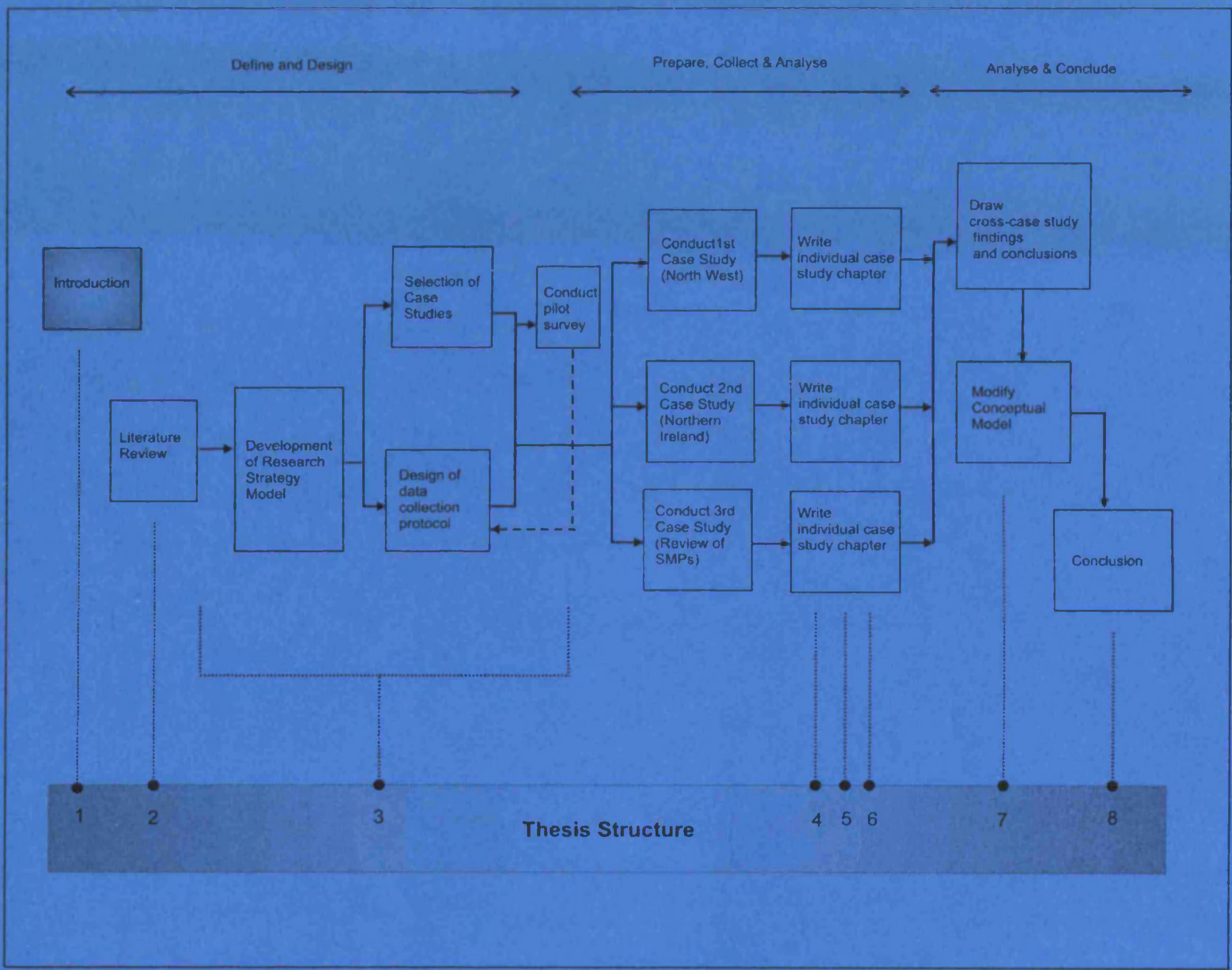
Abbreviations

AONB	Area of Outstanding Natural Beauty
ASSI	Areas of Special Scientific Interest
CPA	Countryside Protection Area
Defra	Department for Environment, Food and Rural Affairs
DRD	Department for Regional Development
DARD	Department of Agriculture and Rural Development
BERR	Department of Business, Enterprise and Regulatory Reform
DCLG	Department of Communities and Local Government
DETI	Department of Enterprise, Trade and Investment
DoE	Department of Environment
DSD	Department of Social Development
DofE	Department of the Environment
EIs	Empirical Indicators
EHS	Environment and Heritage Service
EHS	Environment Heritage Service
GBA	Greater Belfast Area
km	Kilometre
LNR	Local Nature Reserve
LNR	Local Nature Reserve
MNR	Marine Nature Reserve
MAFF	Ministry of Agriculture, Fisheries and Food
NNR	National Nature Reserve
NGO	Non-governmental Organisation
NI	Northern Ireland
NIEA	Northern Ireland Environment Agency
PPG	Planning Policy Guidance
PPS	Planning Policy Statement
PSRNI	Planning Strategy for Rural Northern Ireland
QUANGO	Quasi-Autonomous Non-Governmental Organisation
RFRA	Regional Flood Risk Assessment
RPG	Regional Planning Guidance
RSS	Regional Spatial Strategies
RSM	Research Strategy Model
RSPB	Royal Society for the Protection of Birds
SMP	Shoreline Management Plan
SSSI	Site of Special Scientific Interest
SAC	Special Area of Conservation
SCDO	Strategic Coastal Defence Option
SPA	Special Protection Area
SFCA	Strategic Flood Consequence Assessment
SFRA	Strategic Flood Risk Assessment
TAN(W)	Technical Advice Note Wales
UDP	Unitary Development Plan
UK	United Kingdom
WAG	Welsh Assembly Government
WO	Welsh Office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1 Chapter One Introduction

1.1 Introduction

This thesis investigates decision making practices associated with coastal risk in England, Wales and Northern Ireland, and the role of natural coastal change scientific information within the associated decision making processes.

The purpose of this introductory chapter is to establish the rationale, focus and methods used within the thesis. It commences with an introduction to the field of research – coastal risk – and defines some important terms used in the thesis. Section 1.2 then outlines the associated rationale and justification for the study. The research aim and objectives are then presented. An outline of the methodological approach of thesis, particularly the thesis Research Strategy Pathway and its associated stages, are then discussed. Finally, the thesis structure is presented.

1.2 Rationale

Coastlines exhibit great diversity in their landscapes, habitats and natural processes. McInnes (2003, pg. 43) states that, "the geology and topography of the European Union coastline presents an enormous variety of coastal conditions, natural hazards and problems…". Across the United Kingdom (UK) coastline, approximately 4400km in length, are a vast number of coastal environments, ranging from low-lying expansive bays and estuaries, to hard and soft rock cliffs and extensive dune systems (DoE, 1995; Haslett, 2000; French, 2004; Burgess *et al.,* 2007). Human settlement has given rise to many urban areas being situated at or close to the coast (Haslett, 2000). A characteristic of the UK coast is its vulnerability in many areas to coastal flooding and coastal erosion (Lee, 1993). Flooding whilst, "…mild by global standards…" is considered a, "…major natural hazard in the UK" (Tunstall *et al.*, 2004, pg. 1). England and Wales, in particular, has a serious coastal flood risk due to the potential for North Sea and Irish Sea storm surges and sea level rise (Pottier *et al.*, 2005). In Europe, coastal erosion has had a major impact upon coastlines, with 25% of it's coastline experiencing erosion (European Environment Agency, 2004). Coastal erosion is part of the ever changing coastal processes occurring at the coast and as such, is considered by Burgess *et al.* (2007, pg. 271) as only being, "... considered a problem because of man's presence on the coast".

Although the terms hazard and risk are taken as being synonymous, a clear distinction between them is vital. Hazards are defined by Smith (1992) as, 'a potential threat to humans and their welfare', whilst risk is considered to be 'the probability of hazard occurrence'. Coastal hazards are defined by LGACSIG (2004) as, "a naturally occurring or human-induced coastal process of event, with the potential to create loss. Natural coastal hazards include coastal erosion, instability and flooding". Defra and the Environment Agency define risk as a combination of probabilities and consequences (Defra and EA, 2005). A definition of coastal risk developed by New Zealand's Ministry for the Environment is, "The chance of an 'event' being induced or significantly exacerbated by climate change, which will have an impact on something of value to the present and/or future community. It is measured in terms of consequence and likelihood" (Ministry for the Environment, 2008, pg. 46). It should be noted that climate change will not introduce new risks, but instead, compound existing hazards (Ministry for the Environment, 2008). Increasing tidal and fluvial flooding incidents in the UK have duly garnered attention on aspects of coastal risk (Wheater *et al.*, 2002; Evans *et al.*, 2007).

Coastal hazards and their associated risks are not new to coastal resources managers, coastal engineers and planners. Traditional responses to coastal hazards across Europe have been based upon short-term, reactive, parochial, hard engineering solutions; in order to protect assets at risk (NICMMN, 2004). Consequently, many stretches of coastal defence works seek to provide protection to a significant proportion of coastal settlement (including infrastructure) (French, 2001). In the UK in particular, management responses have been based upon fragmented sectoral divisions and responsibilities between coast protection, flood defence and land-use planning (Ballinger *et al.*, 2002; Evans *et al.*, 2007). Residential and commercial properties at risk from tidal / sea flooding and coastal flooding in England and Wales in 2001 were put at just over 1.2 million; with the capital value of assets at risk estimated to equate to £139.9 billion and annual investment estimated at £240 million (including capital schemes and maintenance) (Halcrow *et al.*, 2001). This type of situation is similar across Europe; for example, according to a European study (EUROSION), estimated annual public expenditure for coastal defence for the period 1990-2020 is expected to average 5.4 billion Euro's (European Commission, 2006).

In light of factors including *inter alia,* climate change pressures, urban development projections and soaring financial costs associated with coastal engineering works, there is increasing realisation of the limitations of the historic sectoral and technocractic approach to coastal defence, based upon a limited understanding of the underlying natural coastal change (Ballinger *et al.*, 2002). In contrast, coastal risk management involves the integrated management of coastal hazards using a risk-based framework; its broad holistic approach encompasses the activities of all those involved for example, planners and engineers, with a view to developing shared responsibility for managing coastal risk (LGACSIG, 2004). This form of risk-based management is reliant upon a clear understanding of the risks of coastal erosion, instability and flooding. Within this, risk analysis techniques and hazard assessment methodologies deal with uncertainty in the natural and human systems *via* a probabilistic approach using scenario-based outputs to support coastal risk decision making (Evans *et al.*, 2007).

In this thesis, science refers to the natural coastal change information needed to understand and explain changes occurring on the coast, central to the sustainable management of the coast and its resources (Woodroffe, 2002). Natural coastal change researchers vie to construct a precise understanding of coastal and climate processes to characterise the physical risks that may threaten coastal areas (Tribbia and Moser, 2008). This natural coastal change information should percolate from scientists to the decision makers who need it most. Coastal decision makers are at the forefront of decisions that are integral to the safety and security of coastal communities. In recent years, UK government departments have stressed the need for evidence-based policy (Cabinet Office, 1999a & b). While there appears to be consensus that science is needed to support coastal decision making (for example: National Research Council, 1995; GESAMP, 1996; Cicin-Sain, 1998; Taussik and Carter, 2000; Allio *et al.*, 2006), there is also recognition of the observed science-practice disconnect in the context of coastal decision making, with many management decisions continuing to be made with limited scientific input (National Research Council, 1995; GESAMP, 1996; Havard *et al.,* 1996; Ballantine, 2005; Tribbia and Moser, 2008). Exacerbating the situation with respect to the science-practice disconnect are noted inherent characteristics of natural coastal change science, specifically issues of uncertainty (Woodroffe, 2002). Burgess *et al.* (2007, pg. 273) research into UK coastal erosion processes report that, "Little reliable information or confidence exists with regards to long-term future changes in waves, storminess or surge conditions...". Similarly, the modelling of coastal processes on greater time scales, such as decades to centuries, remains largely unknown (Hinton *et al.*, 2007).

The communication of uncertainty receives considerable attention in the literature, for example, Functowicz and Ravetz (1990); Jasanoff and Wynne (1998); von Bodungen and Turner (1999); O'Riordan (2000) and Wardekker *et al.* (2008). The problem of scientific uncertainty, particularly within the natural sciences, appears to be a problem of communication, often non-communication or efforts to constrain the communication of uncertainty (von Bodungen and Turner, 1999); a problem of perception, *i.e.* uncertainty being associated with low quality in scientific information within the policy context, (Functowicz and Ravetz, 1990; von Bodungen and Turner, 1999) and a problem of uncertainty in aggravating controversy within environmental decision making (Policansky, 1998). Green (2004) in his paper on flood management grapples with defining uncertainty. In this discussion he highlights the close connection between the terms uncertainty and risk, with some authors treating uncertainty as a variation of risk. He then goes on to adopt the following definition of uncertainty "...an inability to differentiate..." (Green, 2004, pg. 5).

The decision making process succinctly put by Jabes (1982, pg. 53), is that it, "starts with a problem identification and ends with a choice". Interestingly, a definition of what makes a good decision is provided by Gilligan *et al.* (1983, pg. 1), "...achieves an objective that has been set out in advance". Policy making is less clearly defined in the literature. Jordan and O'Riordan (2000, pg. 80) describe the term policy as, "slippery", in light of various models and theories that can be found in the literature that attempt to define it. Within the thesis the term 'decision making' encompasses both decision making and policy making, and is considered as being a chosen course of action, or inaction, to address a problem with a desired outcome. The traditional view that in order to improve decision making more information is merely required (Tribbia and Moser, 2008), does not recognise other inputs, factors and considerations associated with the decision making context. In particular, the highly fragmented and complex frameworks within which coastal decision makers operate. Within the environmental management literature, it is has been explicitly recognised that environmental policy making is the product of interactions amongst the following domains: bureaucratic (government), civic (public), economic (business) and academic (Jasanoff and Wynne, 1998; Lekakis, 2000; Steel *et al.*, 2004). Similar coastal-specific research is extremely limited. An exception is Fabbri (1998; 2002); this author asserts that coastal decision making exhibits a number of environmental decision making traits and characteristics. These include, complexity with regard to the range of temporal and spatial scales, and interactions and inter-linkages with numerous stakeholders from multi-disciplinary fields.

The rationale for this study has two main elements:

- Firstly, whilst a considerable amount of United States-based coastal management literature concerns the development of coastal management programmes and initiatives (for example: Cicin-Sain, 1993; Olsen *et al.*, 1997; Cicin-Sain and Knecht, 1998), few studies have focussed upon the processes of coastal decision making itself, with none specific to coastal risk. In particular, there is a lack of UK-based studies into this area; this, therefore, appears to be a neglected area of research. Investigation is required to consider how coastal risk management decisions are undertaken in the UK, specifically, to explore and assess the nature and complexities of coastal risk decision making processes over both geographical and temporal scales.
- Secondly, despite its purported importance within decision making, there is a notable lack of transparency concerning the role of natural coastal change science within coastal risk decision making. Investigation is required to increase knowledge and understanding concerning the application of the natural coastal change evidence base within coastal risk decision making. Particularly in light of several of the points made above, including, the need for evidence-based policy making, the science-practice disconnect and natural coastal change uncertainty.

1.3 Research Aim and Objectives

Section 1.2 established the research rationale the thesis research. The main aim of the thesis is to:

'To examine the role of science within coastal decision making, with particular reference to decisions pertaining to coastal risk.'

This central aim translates into two thesis objectives, each with a number of associated sub-objectives, as follows:

'To identify the salient decision making characteristics particular to coastal risk'

- Investigate by what means and in what manner coastal risk management decisions are made, including identifying and tracing decision making processes and characteristics;
- Examine potential internal and external influences and forcing factors that may occur in relation to coastal risk decision making and
- Explore the interface between coastal risk decision making processes.

'To evaluate the application of natural coastal change science as evidence used within coastal risk assessment and its associated decision making procedures'

- Examine natural coastal change as a form of task information, including identifying particular information characteristics;
- Assess the natural coastal change evidence base utilised by coastal risk decision makers, including identifying mechanisms that assist this process and current limitations and
- Identify other forms of decision support utilised within coastal risk assessment and coastal risk management decision making.

The thesis objectives above can be distilled into two main areas of concern, that herein will be referred to as research questions, *viz 'how are coastal risk management decisions made?'* and *'what is the role of natural coastal change information within this process?'*. The first of these pays particular regard to the decision making processes and characteristics associated with the field of coastal risk management. This encompasses and combines policy making and decision making alike. The second question is set in the broader context of how scientific information, specifically natural coastal change science, supports the decisions of coastal risk practitioners as they plan and prepare for coastal risk. Whilst they are expressed as separate components, the thesis research exercise viewed them as being very much inter-connected.

1.4 Methodological Approach

The thesis research methodology (Chapter Three) predominantly employed qualitative data collection techniques. In summary, it comprised semi-structured interview schedules and a number of documentary audits and reviews. As highlighted in Section 1.2, the research context concerning coastal risk, *i.e.* a multi-disciplinary and multi-layered complex process, necessitated the application of qualitative research practices that allowed the in depth study of social phenomena. These techniques are aligned with the theoretical underpinning and philosophical assumptions of the thesis. Firstly, the ontological perspective of the thesis, that is the conception of the nature of reality, is the assumption that knowledge is both situated and contextual. Social theory is the lens used for the interpretation of empirical data; that is, the ability to explain and understand findings of research within a conceptual framework is constructed *via* a social theory (Mason, 2002). Secondly, the epistemological perspective of the thesis, regarded as critical to the development of the research, has exercised a deductive reasoning approach, or what Mason (2002) terms the 'hypothetico-deductive method', considered part of the Positivism school of thought.

The overall research process undertaken to deliver the thesis aim and objectives can be viewed as a Research Strategy Pathway, illustrated in Figure 1.1. This research process contained a number of key research stages:

- *Literature Review:* A review of the literature concerning decision making, policy making, coastal management and the science-practice interface. The aim of this was to develop familiarity with the research context, establishment of current thinking, stimulate research questions and enhance theory development (Struass and Corbin, 1998). Findings used to develop working definitions of key thesis terms, namely 'coastal risk', 'coastal risk management', 'science' and 'decision making'.
- *Theory Construction*: Development of a case study-selection hypothesis and associated selection of two geographical case studies. Construction and application

of the thesis Research Strategy Model and Empirical Indicators to the two geographical case studies. Generation of a divergent investigative research approach and application to a documentary review-based third case study.

- *Data Generation*: Generation of predominantly qualitative empirically-based data using a multiple-case study approach (two geographical case studies and a non-geographical case study).
- *Theory Vs. Practice:* Scrutiny of case study empirical findings against the underpinning case study selection hypothesis.
- *Theory Reconstruction*: Assimilation of empirical knowledge and lessons learnt from the investigative approaches of the multiple-case study approach. Generation of a Coastal Risk Decision Making conceptualisation.

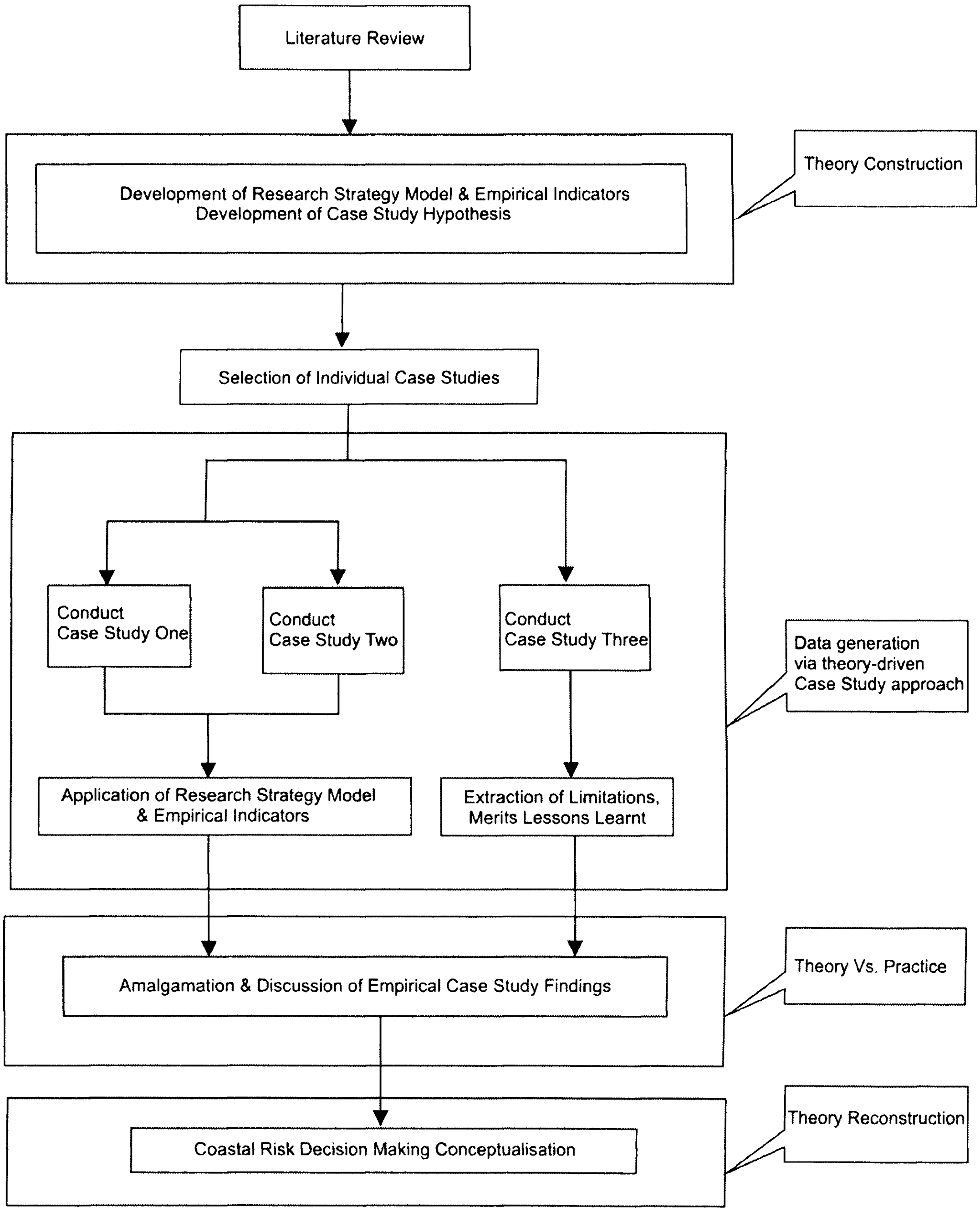


Figure 1.1: Thesis Research Strategy Pathway

Source: Original

1.4.1 Data Generation: The Multiple Case Study Approach

Each phase of the Research Strategy Pathway was undertaken with the thesis aim in mind; this kept the research process clearly aligned to thesis research questions. Whilst the stages and methods associated with the Research Strategy Pathway have been outlined above, it is worth presenting an overview of the data generation process achieved via the multiple-case study approach (Figure 1.2).

The definition of a case study provided by Yin (2003, pg. 13) indicates the appropriateness of this approach for addressing the thesis' research questions, "an empirical inquiry that investigates a contemporary phenomenon within its real-life context...". The case study approach, therefore, provided a framework for examining the processes by which coastal risk decisions are made and the role of natural coastal change information within this real-life context. In total three case studies were undertaken, with the geographical coverage achieved being England, Wales and Northern Ireland. In addition to these geographical scales (and associated variety of coastal hazards and risk), three decision making tiers were included (Strategic, Tactical and Operational) (Figure 1.2). All case studies concentrated upon coastal risk decision-making within their respective contexts and the role of the natural coastal change evidence base. Multiple-case studies, as opposed to a single-case study, are noted for the ability to increase depth of study and allow greater generalisation with regard to findings (Yin, 2003). Case Studies One and Two were guided in their development and undertaking via the Research Strategy Model, whilst Case Study Three took a contrasting investigative approach.

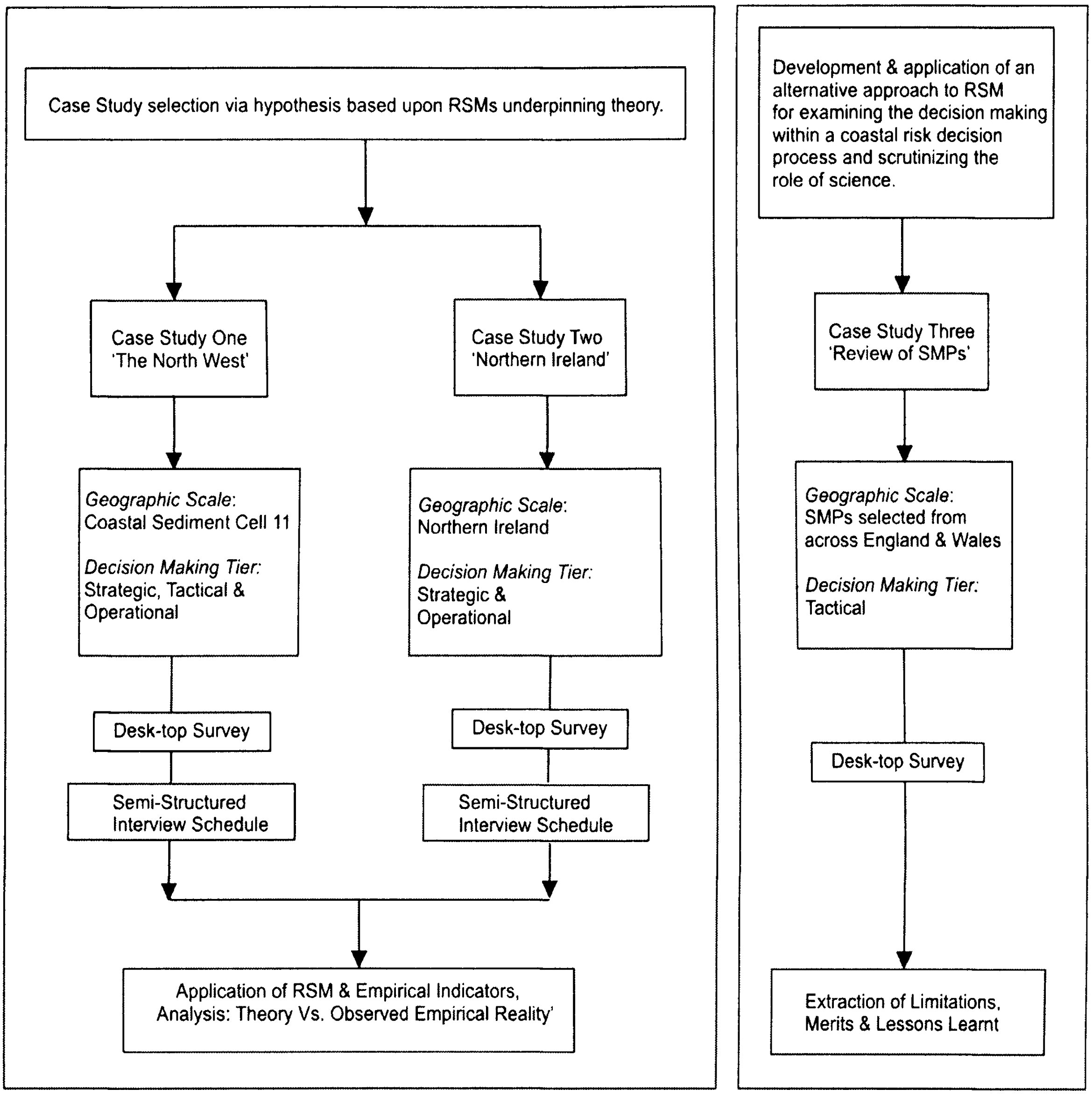


Figure 1.2: Overview of multiple-case study approach

Source: Original

The rationale behind the selection of the geographically based case studies (Case Studies One and Two) used the premise of gaining insight by considering extremes. The Literature Review (Chapter Two) identified that both the regulation and scientific underpinning of coastal risk differs within these localities. The North West case study (Case Study One, Chapter Four) covers coastal sediment cell eleven from the Great Orme in Wales northwards to the English-Scottish border of the Solway Firth. This area encompasses some of the UK's largest estuaries, numerous ports and sea-side resorts. Significant stretches of this 1100 km coastline are artificially defended from coastal hazards, such as flood and coastal erosion risk furthermore, much of the area is at risk from sea-level rise. The Dee Estuary contains a geographical divide between Wales and

England, consequently this cross-border aspect amplifies the complex and multi-layered coastal risk decision making framework in place, administered nationally, regionally and locally by numerous Operating Authorities. Case Study Two (Chapter Five) addressed coastal risk decision making throughout Northern Ireland. This coast is similar to the North West with respect to its vulnerability and pressure from substantial commercial and recreational activity. However, it exhibits different geological and geographical attributes, with large scale flooding considered rare and coastal erosion only a localised phenomena; as such, coastal risk has been perceived as only a minor concern to government.

The construction of the Research Strategy Model (RSM) integrates for the first time, current thinking within the literature on aspects of both decision making and policy making, into one single integrated theory. Part A of the RSM ('Decision Process Tracing') comprises two components, 'Decision Pathway' and 'Decision Making Tiers'. The first of these ('Decision Pathway') presents a theoretical rational decision making model of the idealised process or decision pathway sequence that a decision maker may undertake. The second part of the RSM (Part B 'Decision Making Aid and Context') presents hypothesised assertions regarding the role and relationship, between task information used by the decision maker ('Decision Support') and the complexity of decisions ('Decision Structure'). To strengthen the RSM and take forward the research, a series of Empirical Indicators were developed. These were directly applied to case study data. In light of this, case study results are structured and presented within their respective chapters according to the RSM's four elements. In summary, the RSM and Empirical Indicators provided a structured framework that enabled the critical study and tracing of both decision making and the role of science within these decision making process. This sought to avoid 'data dredging' and a purely discursive empirical study of coastal risk decision making.

Using a different and experimental approach, Case Study Three developed a prototype method for tracing a coastal risk decision making process and examining the role of science was devised. This case study whilst having geographic boundaries, was framed and constructed using a documentary review and the development of a unique process of survey and content analysis of Shoreline Management Plans (SMPs). These plans are heralded by government as playing a critical role within the flood and coastal erosion risk management framework for England and Wales (Defra, 2006a). Survey instruments, *i.e.* two proformas, were utilised to review the scientific basis and underpinning and decision making transparency and justification of the coastal risk management policies presented in the SMPs.

1.4.2 Towards Conceptualisation of Coastal Risk Decision Making

The case study approach produced a large amount of empirical data; the next research stage entailed a process of explaining and understanding these findings within a conceptual framework. As highlighted by Handfield and Melynk (1998, pg. 321), "Without theory, it is impossible to make meaningful sense of empirically-generated data". Central to the thesis Research Strategy Pathway has been the generation of theory including the hypothesis used for the selection of Case Studies One and Two, and the RSM. This process is regarded as being a constructive and beneficial way of conceptualising the primary themes of decision making and associated evidence base. In doing so, it facilitated the comparison of coastal risk decision making in various geographical localities with different defining characteristics, including legislative and governance arrangements.

As theoretical considerations may appear abstract, the design of the Research Strategy Pathway recognised the need to establish congruity between theory and reality. In light of this, it was decided that there was considerable scope for the modification and further development of the RSM to more accurately reflect coastal risk, based upon a combination of the Research Strategy Model's underpinning theory, empirical study and lessons learnt from the two investigative research processes. Chapter Seven details this process, *i.e.* moving from the RSM designed to be applied to any generic form of decision making process, towards a conceptualisation specific to coastal risk decision making. As noted in Section 1.2, there are currently no existing mechanisms by which to examine coastal decision making. Furthermore, no methodology within the reviewed literature has been identified which assesses the role and application of task information, such as natural coastal change science, and other sources of input to aid and support the decision maker. It is, therefore, posited that a conceptual model of coastal risk decision making (with supporting empirical indicators) provides a research lens and intellectual framework to address both decision making and evidence base. Thus, the research makes a clear contribution to the literature.

1.5 Thesis Structure

The thesis has three main parts, organised into eight chapters. An overview of the structure is depicted in Figure 1.3. This illustrates the relationship between the three main parts of the thesis and their constituent chapters. This figure will be used to orientate the reader at the start of each chapter to the location of the chapter within the wider thesis structure.

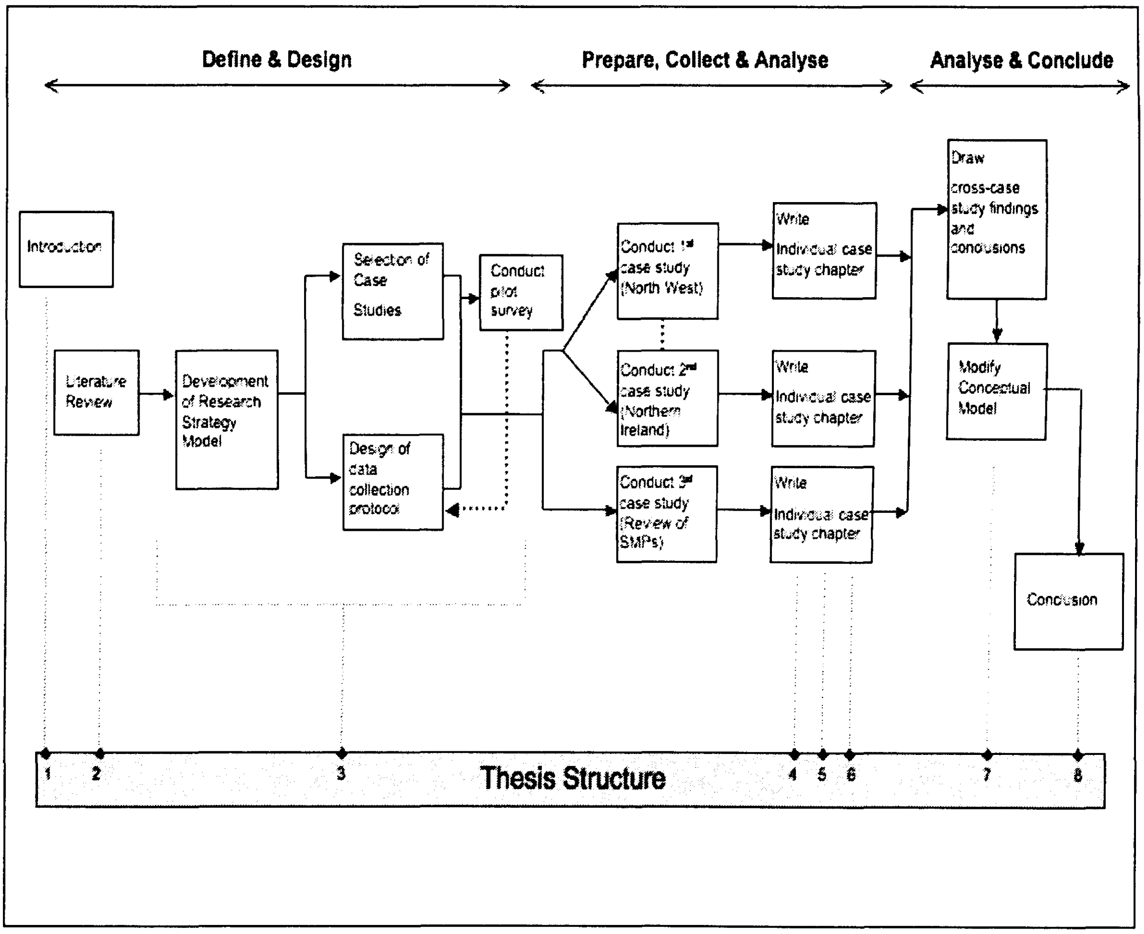


Figure 1.3 Thesis Structure

Source: after COSMOS Corporation, cited in Yin (2000, pg. 50)

The following paragraphs summarise the main components and rationale of the three parts of the thesis:

- *Define and Design: Chapters 1-3*

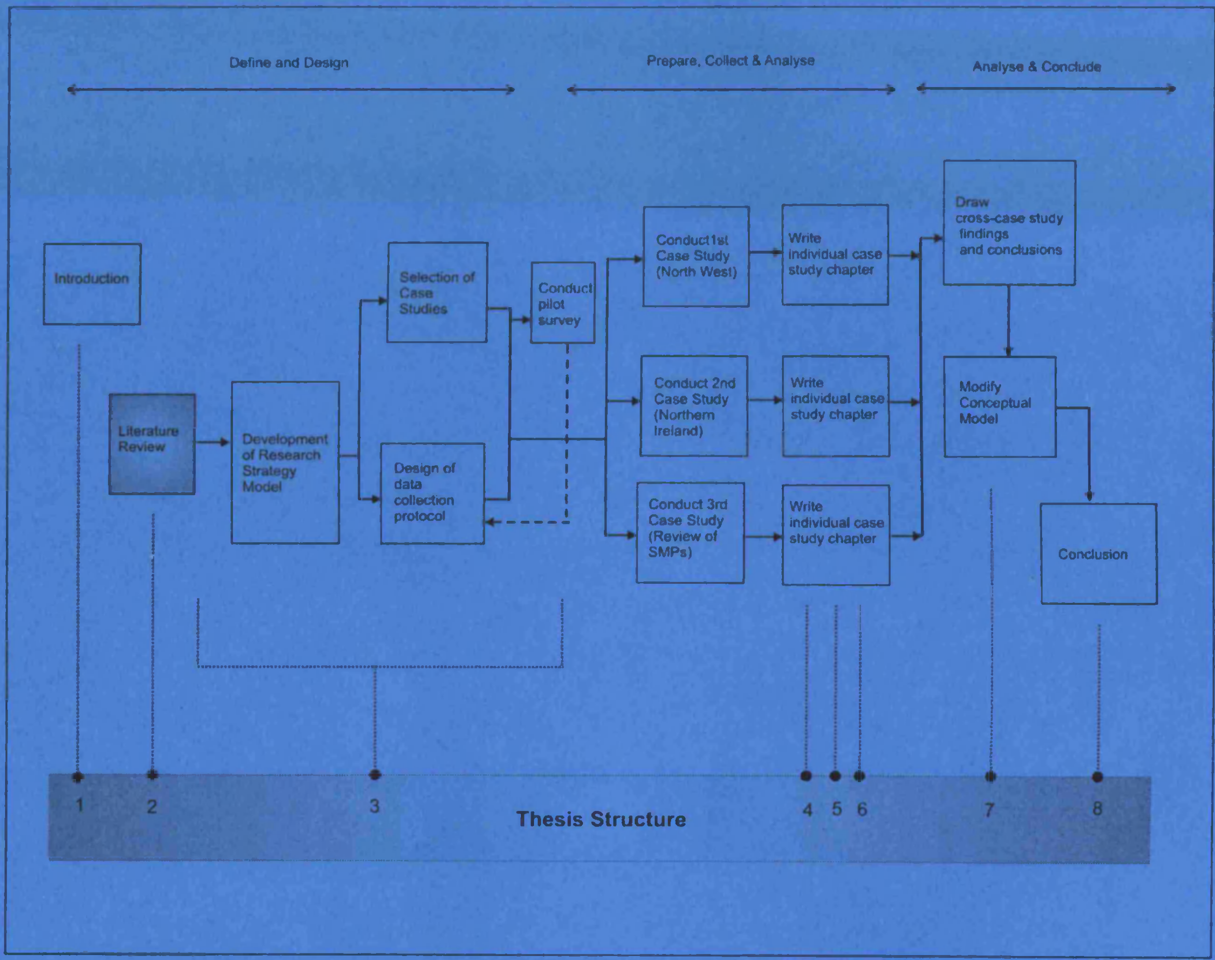
Chapter One provides an introduction to the research, identifies the context and rationale for this study, presents the thesis aims and objectives and an overview of the methodological approach of the thesis. Chapter Two then presents the Literature Review. Chapter Three outlines the overall research methodology, the techniques associated with the various stages of the Research Strategy Pathway and the boundaries and limitations associated with the chosen methods.

- *Prepare, Collect and Analyse: Chapters 4-6*

This part of the thesis comprises the three case studies and represents the thesis' primary data collection and subsequent analysis (interpretation and results). Chapters Four and Five present data and findings associated with the two geographical case studies of thesis, the North West and Northern Ireland, respectively. Chapter Six focuses upon the third case study, the 'Review of SMPs'.

- *Analyse and Conclude: Chapters 7 & 8*

Chapter Seven contains a number of key thesis outputs. Firstly, a synthesis of the geographical case studies findings in relation to the underlying case study selection hypothesis is presented. This discussion represents 'Theory vs. Practice' as the RSMs underlying constructs are tested against empirical findings. This is followed by an evaluation of the documentary review of the third case study. An important component of this cross-case study chapter is the development of a coastal risk decision making conceptualisation. This utilises lessons learnt from the two contrasting investigative employed for the case studies. This chapter details the formulation and function of the conceptualisation and supporting Empirical Indicators. Finally, Chapter Eight identifies the contribution of the research, briefly discussing the limitations of the study before concluding with an outline of potential future research pathways.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Draw cross-case study findings and conclusions
Modify Conceptual Model
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2 Chapter Two Literature Review

2.1 Introduction

The chapter presents the Literature Review which, in light of the multi-disciplinary nature of the thesis, has appraised the literature from a number of fields and disciplines. The three predominant areas of literature that have been reviewed are:

- Coastal management-related literature;
- Science-related literature; and
- Decision and policy making-related literature.

The chapter is divided into several areas that commence with an examination of the world of science, dealing with the evolution of modern science, including definitions of scientific enquiry (Section 2.2). Section 2.3 explores the science-policy interface that exists in many disciplines, including coastal and environmental management. Section 2.4 then identifies and examines theories concerning decision making and policy making. This includes a review of models and conceptualisations identified in the literature. Section 2.5 reviews literature pertaining to general environmental hazards, followed by approaches to coastal hazards and risk management. This section also explores aspects of the underlying natural coastal change scientific evidence base. A synthesis of existing research is then presented (Section 2.6.1). Following on from this is a discussion of the key shortfalls and perceived strengths of the existing research, (Section 2.6.2). The chapter then closes with a short conclusion.

2.2 Science: Its origins and relationship with society

Science has been in existence for centuries (Gallopin *et al.*, 2001). In Moore's (1993) discussion of the evolution of modern biology, he documents the origins of Western science back to the ancient Greeks. Within the scientific-related literature, there is a notable segment that addresses the question 'what is science?' Due to the importance of 'science' to the thesis, it is considered worth briefly deconstructing the term, concept and practice of science.

Philosophical attempts to define science and to characterise what makes something scientific, provide clarity as to what can be considered scientific subjects and diagnostic features of the scientific method. Moore (1993) observes that it was Aristotle who established a pattern of learning that today can be recognised as a scientific approach. It was during this time that learning, specifically the analysis of nature became rational and the data used being empirical in nature. This is considered the theoretical origin of empirical thought (*ibid*). A definition of science that reflects the underlying philosophical and historical foundations is provided by Wilson (1998, pg. 57, emphasis in original), "Science, to put its warrant as concisely as possible, is the *organised, systematic enterprise that gathers knowledge about the world and condenses the knowledge into testable and principles".* The distinctive features of science lie in the procedures and techniques integral to scientific practices. These include: induction; experimental testing; systematic observation; theory construction and repeatability (Wilson, 1998; Okasha, 2002; Jordan and Grotzinger, 2008). Concomitantly, the subjects of science, such as physics, chemistry, biology and geology are regarded as being scientific activities. Fundamentally, there is agreement in the literature that science is distinct and unique from other forms of cultural and societal activities (Woolgar, 1988).

C.P. Snow's widely publicised public lecture in 1959 titled "The Two Cultures and the Scientific Revolution" is an important development in the organisation of science, launching a public debate over the social standing of science (van Dijck, 2003). In doing so, Snow created an academic landscape that for decades would be divided. The use of polar extremes, such as, those used to differentiate between basic/pure and applied science (Jasanoff and Wynne, 1998; Jasanoff, 2003), becomes harder in light of inter and multi-disciplinary modes of knowledge production, referred to as the 'post-modern condition of sciences'.

Sarewitz and Pielke Jr. (2007) state that the function of most scientific research is to support, advance and aid the achievement of particular sets of goals extrinsic to science itself. The demonstrable benefits including the utility of science, have changed over time (Heazle, 2004). Few challenge the assertion put forward by Funtowicz *et al.* (1998) that science and technology have increased mankind's capacity for exploitation. O'Riordan (2000) considers, for example, the expectations of society for scientific solutions are greater now than ever, with society reaping the benefits both in technological advances in health and in medicine. Salomon (2001, pg. 326) notes that no government and few industries can undertake their management and day-to-day activities without relying on science, "...as a *guide*, as a *method*, as *evidence*, as a *result*, and even as a *promise*". Knowledge and science is, therefore, problem orientated, produced for end-users (Jasanoff, 2003, emphasis in original).

Davies *et al.* (2004) note that one of the most marked changes in government in the 20th Century is the number of pressure groups and organisations seeking to influence government policy and action *via* the use of evidence. In their examination of what constitutes 'evidence', they reflect on the wide range of possibilities, and conclude that the unifying theme of evidence is that it can be independently observed and verified and that there is broad consensus regarding its content. Clearly these components of 'evidence' are aligned with the diagnostic features of science previously outlined. The UK government has had to respond to a number of social changes, including rising expectations of the electorate by developing responsive, informed and effective policies based on sound evidence (Bullock *et al.*, 2001; Davies *et al.*, 2004). This is visible in their 1999 White Paper on 'Modernising Government' that demands, "...better use of evidence..." in policy making (Cabinet Office, 1999a, pg.16). In examining what modern policy making should look like, the government's Strategic Policy Making Team identified, "...policy decisions should be based on sound evidence...Good quality policy making depends on high quality information, derived from a variety of sources..." (Cabinet Office, 1999b, para.7.1).

The role of science specifically within environmental policy is considered by Steel *et al.* (2004) who cite the work of Levein (1979). Levein (1979) put forward the proposal that there are three ways that science should be involved in the environmental policy process, summarised as follows:

- Science and scientists can facilitate an understanding of the basic dimensions of environmental problems;
- Science and scientists can identify and describe potential appropriate solutions to these problems and

- Science can attempt to aid the resolution of these problems through providing information on the economic, environmental, political and social consequences of proposed solutions on different demographics.

These points highlight what can be considered to be not only the role, but, also the value of scientific involvement within environmental management policy formulation.

The literature review also sought to identify the role of science specifically within coastal policy making. In doing so, relevant coastal research undertaken by the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) was identified. Based upon the work of the GESAMP Task Force on Integrated Coastal Management, 'The Contributions of Science to Integrated Coastal Management', articulates the scientific inputs into five stages of coastal policy making (Table 2.1). It is clear that throughout this process, GESAMP regards the involvement of both natural and social scientists as critical in the development and implementation of coastal management.

Table 2.1: Summary of the scientific inputs into coastal policy making (GESAMP, 1996).

Stage 1. Issue identification and assessment

• Information gathering by natural and social scientists, including an assessment of:
  o The relevance and quality of the information gathered;
  o Gaps in scientific knowledge and implications;
  o Feasibility (time and cost) of filling these gaps;
  o Prioritisation of the issues to be addressed.
• Preparation of a scoping document that sets out the issues that the ICM programme will operate under.

Stage 2. Program preparation

• Programme planning phase to include:
  o Explanation and expansion of the findings of Stage 1;
  o Details of research studies to fill in information gaps.
• Early research studies should cover:
  o Characteristics and conditions of coastal systems that cause concern;

- The governance process;
- Identification of factors and processes that regulate these characteristics and conditions

- For each priority issue, the research and monitoring statement methodology should include:
  - What is to be measured and why;
  - What facilities and personnel are needed;
  - Specific research questions.

Stage 3. Formal adoption and funding

- Access to natural and social scientists should be available, including on advice on topics such as:
  - Cost/benefit decision analysis;
  - Confidence in the expected outcomes of proposed actions *e.g.* supporting the programme.

Stage 4. Implementation

- Scientific monitoring should generate data that allows for assessment of change and progress;
- Scientists should assist other ICM team members in the analysis of this monitoring data, including advising on necessary revisions /adaptions of the programme.

Stage 5. Evaluation

- Natural and social scientists should evaluate:
  - Relevance, reliability and cost-effectiveness of scientific information generated;
  - How attributable observed changes are to the ICM programme measures.

The five stages used by GESAMP arise from the conceptualisation of Integrated Coastal Management (ICM) developed by Olsen *et al.* (1997) that will be discussed later (Section 2.4.3). Other literature on the role of science within coastal management included the work of Thia-Eng (2006). This notes that decision makers require accessible and reliable scientific information (Thia-Eng, 2006). Thus, confirming

GESAMP findings concerning the clear role for science and scientific support throughout all the various stages of coastal policy making.

The shift towards problem-orientated, policy-relevant science has created challenges for the scientific community, including: criticism for pro-industry bias; some sectors of academia have been scrutinised for alleged pro-environment and anti-technology biases; and above all, the accusation that many researchers have sacrificed objectivity in exchange for funding (Jasanoff, 2003). The term 'objectivity', the potential of science to be objective, value free and detached, is at odds with what some authors consider to be the reality of science. For example, that it is, "a socially situated product" (Wiltshire, 2001, pg. 622). Some authors assert that science is in danger of loosing its credibility. For example, Heazle (2004) states that science now contains a mixture of fact and fiction. According to Cortner (2000, pg. 23.), "There is no such thing as "objective science. It is a myth". Consequently, there is growing recognition in the literature that science is "...value-laden" (O'Riordan, 2000, pg. 2). Concerns regarding the assurance of quality and reliability of science have arisen, in addition to more traditional concerns of safety, efficacy and economic efficiency (Jasanoff, 2003). Indeed, Functowicz and Ravetz (1990) believe that the need for quality control in science, technology and decision making is urgent. Whilst this opinion is informed from an American perspective in the light of cases of scientific fraud and misconduct in the 1980s; the governance of science is increasingly receiving attention elsewhere, for example the UK's House of Lords Select Committee on Science and Technology Third Report 'Science and Society' (HoLSCST, 2000). Functowicz *et al.* (1998) state that involvement of both policy-makers and the public in the quality assurance in science and technology overall is necessary.

2.3 The Science – Policy Interface

Despite the value and need for science within policy making and decision making, the literature contains numerous papers that seek to highlight issues regarding the way in which the scientific community and practitioners relate and interact with each other (for example: Allio *et al.* (2006); Pohl (2008); Jones *et al.* (1999); Burbridge and Humphrey (1999); Gallopin (1999) and Jacobs (2003)). According to Gallopin (1999, pg. 407), "Science / policy dialogues are the basic locus of integration between understanding and action". Cortner (2000, pg. 29) states, "...more attention should be paid to understanding the culture of science and bridging the differences between citizens and scientists and science and policy".

Pohl (2008) highlights the need to increase information exchange between the scientific and policy cultures. Russell (2001, pg. 271) asserts, "Communication is basic to the nature and practice of science". Scientific communication platforms, such as, journal articles, books and conference presentations, are formal in nature and steadily remain as the main outputs of the research process (Russell, 2001; Crane, 1970). Clarke (2003, pg. 198) considers that traditionally science has been explained as a one-way flow of dissemination, with scientific information being delivered to a non-specialist audience, "...to understand, accept and applaud it". Technological innovations are, however, considered as having transformed and facilitated communication by allowing information to be processed, stored, shared and analysed in different environments, consequently increasing the ease and speed of communication (Russell, 2001). Interestingly, Functowicz *et al.* (1998) regard the communication gap within this science-policy interface as being possible to overcome through a process of, scientists communicating more effectively, policy-makers articulating their needs better and accepting uncertainty and the general public using discrimination on scientific questions as with other areas of public concern.

This aspect of the literature review identified a number of handbooks and texts addressing the science-policy interface (for example: NERC (2005)). One particularly pertinent to this discussion is based within the climate change science-policy arena, 'Connecting Science, Policy, and Decision Making: A handbook for researchers and science agencies' by Jacobs (2003) provides a number of apposite points including:

- Understanding the context in which policy decisions are made;
- Defining the users of the science and understanding their perspective;
- Appreciating the importance of timing and scale;
- Need to develop communication strategies including platforms for collaborative processes and
- Determining the credibility of the information and communicating uncertainty.

(*ibid*). This last point concerning uncertainty is explored further in Section 2.5.5 in relation to natural coastal change.

The National Research Council's 1995 report 'Science, Policy and the Coast: Improving Decision making' provides advice to both coastal practitioners and researchers on improving the interaction between science and policy. It is based on findings from coastal experts and case studies in Northern America and states that coastal scientists and policymakers rarely interact sufficiently to ensure that decisions and policies are adequately based on science (National Research Council, 1995). These findings are echoed in papers by Taussik and Carter (2000), Turnhout *et al.* (2008) and Tribbia and Mosser (2008), that discuss scientific communication, management experiences from the Wadden Sea and climate change information needs of coastal managers, respectively. Similarly, within the coastal risk management field in England and Wales, several reports and papers note the science-policy disconnect (for example: MAFF (2000); English Nature (2005); McCue (2000)). In research on the implementation of the European Union's Water Framework Directive, Willems and de Lange (2007) identified that science-policy interrelationships were not as efficient as they should be. They report that this is due to limited operational links between water-related research projects (and their researchers) and water managers. Whilst this research relates to the Water Framework Directive, it confirms the need for greater interfacing between the policy community and the scientific community.

Policansky's (1998, pg. 617) paper on water resource management states that whilst policy decisions should be informed by scientific evidence, "...values, economics, politics, and other considerations go into them". According to Orians (1986, pg. 12), "...it is abundantly clear that there is considerable scope for expanding the role of science and scientists in environmental problem solving". In a study by Allio *et al.* (2006) into the role of science within a number of Extended Impact Assessments and Explanatory Memoranda published by the European Commission, it was concluded that the extent to which scientific advice was taken into account was not clearly specified, scientific uncertainties were not reported and scientific advice provided by experts was often confused with opinions. They state, "...scientific evidence is a key knowledge input for decision making" relating to the management of environmental risk (*ibid*, pg. 6). These authors state as part of their findings that most scientific evidence provided to policy makers is *via* a process of scientific assessments by experts that combines 'known' scientific evidence along with the application of judgement and opinion. The details of how policies are formed and who policy makers are will be examined within Section 2.3.2. However before this, it worth highlighting the findings of the European Policy Centre Working Paper on 'Enhancing the role of science in the decision-making of the European Union' (Ballantine, 2005, pg. 5-6). This study identified, in addition to a number of advantages and good practices, the following limitations:

- Policy makers and decision makers are often unable to make use of scientific advice;
- There is a lack of public confidence in the utility of scientific evidence;
- Difficulties can occur in obtaining 'independent' and 'excellent' scientific advice, and in obtaining it within the appropriate time scales and
- Some influential groups do not accept that scientific evidence is an appropriate input.

In summary, this report considered that, whilst steps had been taken to improve the quality and credibility of scientific evidence since the mid-1990s, a number of weakness in the use of science in decision making by the European Union remain (*ibid*).

2.4 Decision Making

This section explores the world of decision making (Section 2.4.1) and policy making (Section 2.4.2). Before examining and critiquing conceptual models of policy making and decision making (Section 2.4.3).

2.4.1 Decision Making: General, Environmental and Coastal

Gilligan *et al.* (1983) identify that decision theory has received very little academic attention compared to other aspects of business studies. Within the decision literature several authors have put forward categories of types of decisions. The earliest and best-known of these are 'programmed and non-programmed' decisions proposed by Simon in 1960 (*ibid*). The first are routine and regular programmed decisions, "A procedure for handling programmed decisions exists in the organisation and the problem-solving process involves referring to past experience" (Jabes, 1992, pg. 55). In contrast, non-programmed decisions are *ad hoc*, random and unstructured, with, "no guidelines for a step-by-step solution" (*ibid*, pg. 55). Jabes (1982, pg. 53), in reference to individual decision making, defines a decision as, "...goal-directed behaviour made by the individual, in response to a certain need". Interestingly, a definition of what makes a good decision is provided by Gilligan *et al.* (1983, pg. 1) who state that a decision, "...achieves an objective that has been set out in advance". The decision making process succinctly put by Jabes (1982, pg. 53), is that it, "starts with a problem identification and ends with a choice".

According to Jabes (1992), economists conceptualise the decision maker as a rational person who weighs up each alternative. Conversely, behavioural scientists propose a decision maker who simplifies the world around them to suit their values and quite often uses chance phenomena to make their decision. A parallel was found in the literature of public administration and Organisational Decision Making (ODM). This identifies and debates rationalistic and incrementalist models of decision making (Smith and May, 1982). Rationalistic models assume that an actor, "...becomes aware of a problem, posits a goal, carefully weighs alternative means, and chooses among then according to his estimate of their respective merit, with reference to the state of affairs he prefers" (Smith and May, 1982, pg. 117). The incrementalist model is more widely accepted and referred to in the literature; initially proposed by Lindblom in 1959 as 'muddling through' or 'disjointed incrementalism' (Kenchington and Crawford, 1993). This model portrays the decision maker, "...as starting not with some ideal goal but with the policies currently in force..." (Smith and May, 1982, pg. 118). This viewpoint sees only a small or rather restricted number of policy or decision alternatives reviewed and only a limited number of outcomes of choices considered (*ibid*). The decision making process according to Kolkman *et al.* (2005) involves choices between alternatives, with the option of 'doing nothing' also being an alternative. The multi-criteria analysis technique can be used to assist decision makers once alternatives have been identified (Westmacott, 2001). Belton and Stewart (2002) suggest that this approach is often invoked when decisions are contentious various / multiple criteria have to be considered.

The literature suggests decision making may occur at a variety of scales with several authors citing the following three-tiered hierarchy:

- Strategic decision making;
- Tactical decision making and
- Operational decision making.

(Gilligan *et al.*, 1993; Fabbri, 2002; French and Geldermann, 2005). Fabbri (2002, pg. 62) considers that the strategic level of decision making, "deals with overall objectives…relevant to policy making and long term planning", tactical level, "aims to assess policies and target issues" and operational "tends to be more project-orientated". It appears that within the literature that the tactical level of decision making does not have such a clearly defined remit or scope in comparison to strategic and operational levels.

The information requirements of environmental decision making were identified as multi-disciplinary in nature, requiring a combination of techniques and fields, such as, statistics, systems thinking, social sciences, earth sciences, ecology, biology, chemistry and physics (Institute for Environmental Studies, 1994; Lekakis, 2000). Science, in the realm of environmental management, is required to, "…confirm perceived environmental problems, identify the causes of these problems, separate the sources and provide the economical, statistical, and sociological justification for solutions…" (Benoit and Lefebvre, 2005, pg. 2). Interestingly, Dimento and Ingram (2005, pg. 287) declare that normal science (*i.e.* rational knowledge that is objective and neutral) is no longer adequate to deal with complex environmental decisions or 'wicked problems', such as normal science, "…can go only so far in directing decision makers to sound solutions".

They provide the characteristics of complex contemporary environmental problems as including:

- Multiple data types;
- Numerous possible sources of problem;
- Interpretative judgements required across disciplines and
- Communication of risk and
- Multi-foci of agencies studying the problem (*e.g.* health and environment).

These characteristics are mirrored in the work of Fabbri (2002) in examining coastal-related decision making. This states that coastal decisions exhibit a number of traits, including complexity with regard to temporal and spatial scales and interactions and inter-linkages with numerous stakeholders from multi-disciplinary fields.

2.4.2 Policy Making: General, Environmental and Coastal

Within the policy science literature many authors attempt to describe the world of policy making (for example: Wiltshire, 2001). This literature was reviewed to determine an understanding of how policies are made and who policy makers are.

Wiltshire (2001) notes a dichotomy within the term 'policy makers'; this author uses the term to encompass both policy advisors and elected officials, *i.e.* ministers and government. The UK's government-funded Natural Environment Research Council (NERC), in their guide to 'Communicating NERC science to policy makers' however define policy makers as:

- Ministers, MPs and MEPS;
- Parliamentary committees;
- Civil servants in government departments and agencies and
- Regional and local government bodies;
- Scientific and political advisors and advisory bodies (which involve scientists).

(NERC, 2005).

Interestingly, this definition widens the scope (horizontally and vertically) of policy makers to outside the civil service, as well as importantly noting the scales of policy making. The identification of, for example, local, regional and national government mirrors, to some extent the three tiers of decision making referred to previously (Section 2.4.1). The definition of policy makers used by Kay and Alder (1999) is wider still and includes the non-public sector, such as, private businesses, NGO's and community groups. These definitions are challenged by Jordan and O'Riordan (2000, pg. 82) who state that, "...much policy is made in informal institutions outside the reach of formal democratic controls, parliamentary scrutiny or ministerial responsibility...".

Jordan and O'Riordan (2000, pg. 80) describe the term policy as, "slippery", due to the various models and theories that can be found in the literature that attempt to define it. Similarly, Persson (2004) highlights that the term 'policy' has a variety of uses that lead to its imprecise definition. A number of definitions will now be considered. Miles (1989, pg. 214) in his paper on sea use management and planning, defines policy as, "...a purposive course of action followed by governmental or nongovernmental actors in response to some set of perceived problems"; he then goes on to define a policy problem as, "...the necessity of identifying and choosing between alternative courses of action" (Miles, 1989, pg. 214). Kay and Alder (1999, pg. 112) asserts that, "Policies attempt to steer a course if action by deliberately affecting decision making...". The UK Government's 1999 'Modernising Government report contains the following definition of policy "...the process by which governments translate their political vision into programmes and actions to deliver 'outcomes'- desired changes in the real world" (Cabinet Office, 1999a, pg.15).

According to Jasanoff and Wynne (1998), policy is a product of interactions amongst four distinct domains or cultures, *viz,* bureaucratic, economic, civic and academic (Figure 2.1). Each domain, which can be regarded as an actor network or community, is made up of stakeholder groups that have their own rationale. These domains come into contact and interact in order to influence the policy formulation process.

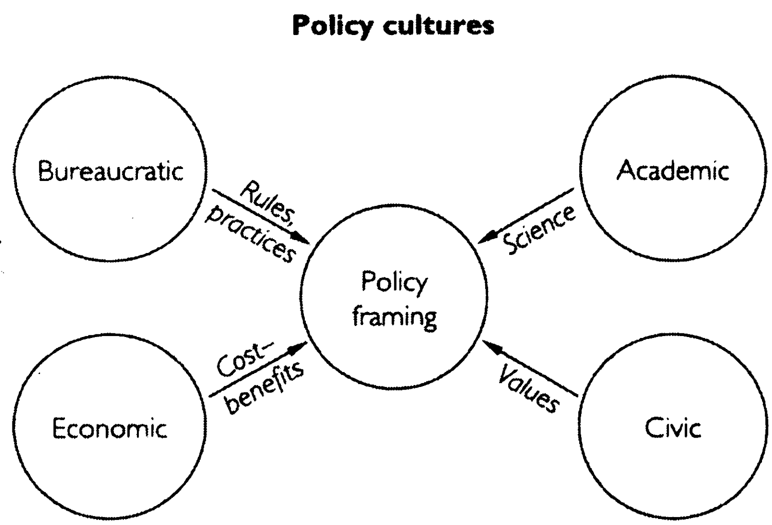


Figure 2.1: Policy cultures as the locus of science and policy interactions
Source: Jasanoff and Wynne (1998, pg.14)

Pohl (2008) interprets Jasanoff and Wynne's (1998) four policy cultures as:

- Academic policy culture – *informing*;
- Bureaucratic policy culture – *regulating*;
- Economic policy culture – *selling* and
- Civic policy culture – *participating.*

The literature was reviewed to ascertain whether or not environmental-related policy making was considered as a discrete category in the policy studies literature. The following observations suggest that environmental policy making is a dynamic process of interactions and negotiations amongst actor networks, and is indeed separate from other forms of policy making. According to Quevauviller *et al.* (2005, pg. 203), "The development of environmental policies is complex process…", due to intensive multi-stakeholder consultations that they consider to contain a mix of:

- Legal requirements;
- Issues of technical feasibility;
- Scientific knowledge and
- Socio-economic aspects.

In addition, Pridham (2002) claims that environmental policy making requires a policy infrastructure that contains various facilities and resources, such as, expertise in planning and monitoring. With regard to the policy cultures contained in Figure 2.1, Jasanoff and Wynne (1998) propose that the delivery of environmental policy lies ultimately with the bureaucratic policy culture domain that seeks consensus amongst the electorate.

Specific to coastal policy making, Olsen *et al.* (1997) propose policy making, within Integrated Coastal Zone Management (ICZM) programmes and initiatives, as containing five cyclically linked stages, presented in Table 2.1 (Section 2.2). This conceptualisation will be considered next (Section 2.4.3).

2.4.3 Conceptualising Decision Making and Policy Making

Wiltshire (2001) makes a critical point in his paper on policy making that is, in order to understand the content of policy, there is a need to examine the process by which it was made. This section addresses this by examining the descriptive and visual conceptualisations of both decision making and policy making found to exist in the literature, including decision theory, business studies, Organisational Decision Making, environmental management, coastal management and UK-government 'grey literature'. The rationale behind this review was therefore to gain insight into the key constructs and ideas running through these different literature spheres concerning decision making and policy making. An additional and important task within this process was the identification and critique of conceptual decision making models to identify patterns, recognise themes and carry out a cumulative synthesis. Caldwell (1991, pg. 82) attempts to define policy making as a, "...continuum, emerging through a progression of incremental decisions...". The models that will now be discussed depict some of the key stages in policy making that require decisions.

A generic policy making model is provided by Jasanoff and Wynne (1998) (Figure 2.2). This model contains five stages within a cyclical cycle. It is proposed that this model has influenced subsequent models in other disciplines.

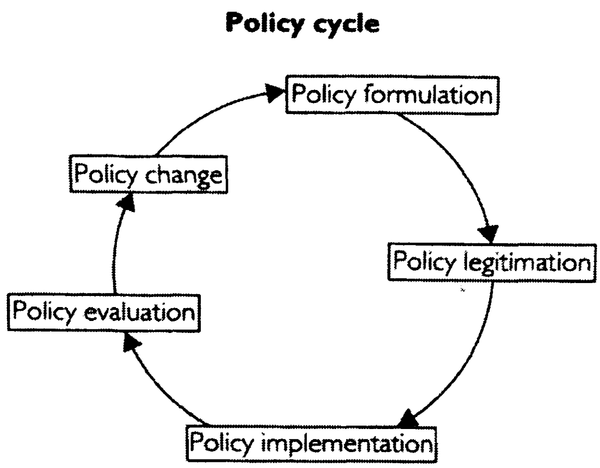


Figure 2.2: The General Policy Cycle
Source: Policy Cycle (Jasanoff and Wynne, 1998, pg. 11)

Moving on from generic policy making, the policy formulation process within the UK education planning system is described by Williams (1982) as being both "technocratic" or "political", corresponding to 'consensual' and 'conflictual' models of policy formulation. The technocratic process is proposed as being one of consensus, dealing with broad strategic objectives. In contrast, the political model does not involve a group of policy makers, but, instead, the outcome is achieved through a series of exchanges and tactical decisions amongst a plethora of pressure groups and vested interests (Williams, 1982).

In the development of public sector policy, Johnston and Plummer (2005) propose a descriptive nine-stage process applicable to the private and public sector:

1. Identification of an issue;
2. Recognition that there is a problem associated with that issue;
3. Acceptance of the postulated cause of the problem;
4. Acceptance that the problem can be tackled and remedied;
5. Identification of the resources necessary to tackle the problem;
6. Winning acceptance for the proposed solution;
7. Gaining political commitment to the solution;
8. Implementation of the solution and
9. Evaluation of the implementation.

The National Research Council when discussing the coastal policy making processes, cite Knecht's model (1995) that depicts various stages that compose the policy process (Figure 2.3).

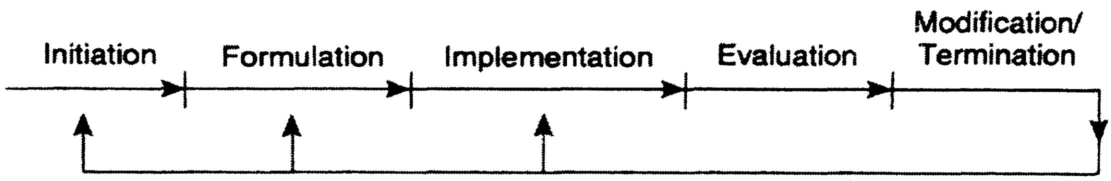


Figure 2.3: Stages in the Policy Process
Source: Knecht (1995) cited in National Research Council (1995 pg. 29)

A key model often cited in the coastal management literature is the policy cycle developed by Olsen *et al.* (1997). This contains five stages (Figure 2.4), whilst referring to policy making, it is more aligned to the development and initiation of coastal management programmes, projects and plans. Therefore it is not 'policy' in the traditional sense. Interestingly, it mirrors the previous model by Jasanoff and Wynne (1998) (Figure 2.2). Furthermore, it is clear that this model has built upon the basic components of Knecht's 1995 model (Figure 2.3). For example, the Program Preparation stage in Olsen *et al.*'s model can be considered as mirroring the

Formulation stage in Knecht's model. Additionally, both models include explicit stages for policy Implementation and Evaluation.

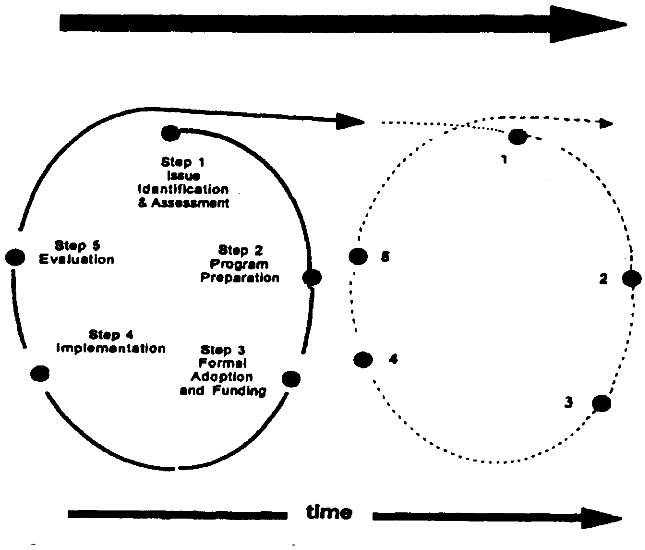


Figure 2.4: Integrated Coastal Management Policy Cycle
Source: Olsen *et al.* (1998, pg. 162)

The cyclical nature of all these conceptual models reflects a temporal aspect of reiteration. This is, therefore, important as it offers policy makers the ability to modify policy in light of the evaluation stage. The provision of feedback on the success of the policy can facilitate adaptivity, refinement and potentially innovation. The models contained in Figures 2.2 and 2.4 both commence with issue identification, and, importantly, include some form of assessment. Interestingly, despite the identification of an issue, according to Johnston and Plummer (1982), it will not automatically become relevant for policy makers unless the second stage is achieved. That is, it needs to be determined that the issue is a 'problem' requiring a solution. Additionally, an identified problem will only have policy relevance if its, "...causes are understood..." (Johnston and Plummer, 2005, pg. 152). It is proposed that this process is aligned with Jasanoff and Wynne's (1998) 'Policy Legitimation'.

Within the review of literature pertaining to decision theory, a conceptualisation of the decision cycle by Gilligan *et al.* (1983) (Figure 2.5). This model is set in the world of business decision making and attempts to produce a realistic process for both individual and collective or organisational decision-making process.

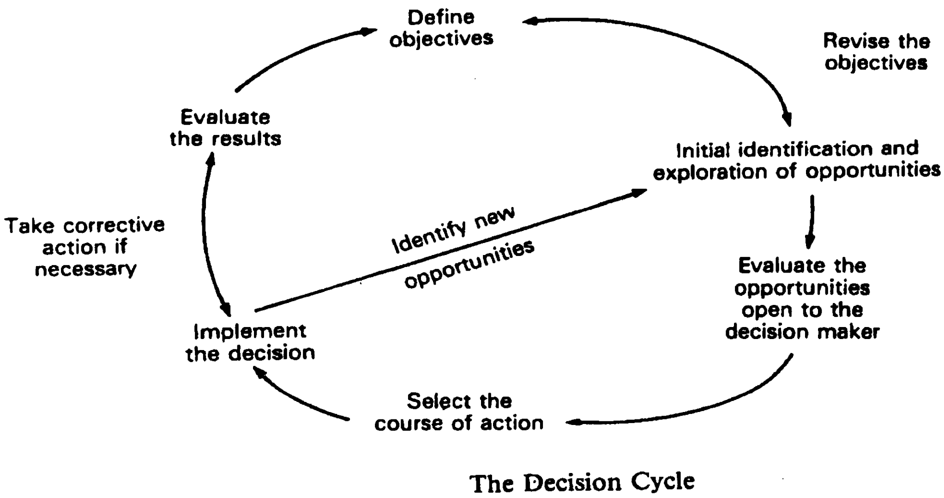


Figure 2.5: Open System Decision Cycle
Source: Gilligan *et al.* (1983, pg. 8)

Being an open systems model, the author considers that it deals with the forces that act on the decision maker and the organisation, such as, a changing environment. Human elements, or forcing factors, in the process, that are recognised in the incrementalist approach to decision making (see Section 2.3.1), are fully embraced.

Azapagic and Perdan (2005) state that regardless of decision context, the following three stages occur within the decision making process:

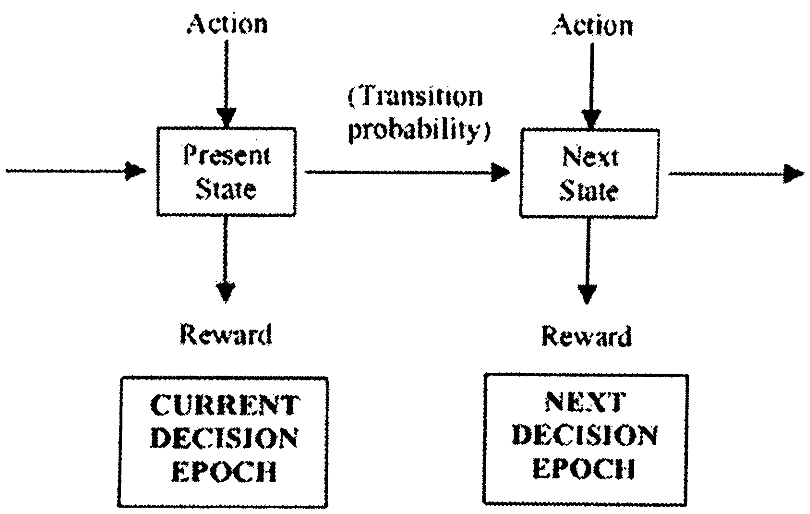
1. Problem structuring;
2. Problem analysis and
3. Problem resolution.

Another three-stage description of decision making is offered by French and Geldermann (2005), *viz*:

1. Formulate Problem;
2. Evaluate Options and
3. Review Decision.

The final stage in French and Geldermann (2005)'s proposal differs most from that of Azapagic and Perdan (2005), as this does not contain 'Review Decision'. This stage is more aligned to the policy making models (Figures 2.2, 2.3 & 2.4).

A second decision making conceptualisation was identified within Sharma and Norton's (2005) paper on integrated environmental assessment (Figure 2.6). This model represents an analytical decision model for integrated assessment on global change. It is considered of interest due to integration of time and as such, was unique amongst the reviewed models. Each decision stage or epoch is clearly separated from other epochs by time. In addition to this temporal delineation, is the use of Markov property. This element means that the effects of an action taken in an epoch depend only on that specific state and not on prior history or experience in other epochs (Sharma and Norton, 2005). Sharma and Norton (2005) point out that this type of model introduces uncertainty into the decision making process, and as such, is an extremely valuable tool for the policy maker or decision maker.



A probabilistic sequential decision-making model

Figure 2.6: Probabilistic Sequential Decision Making Model
Source: Sharma and Norton (2005, pg. 360)

The last two models reviewed deal with aspects of information within the decision making process. Willis (1995) states that decision makers, who are professionals, are likely to make intuitive judgments in the decision making process. However, these intuitive judgements are susceptible to error. Therefore, this author proposes that the decision making process, based on the varying amounts of information to support the decision maker, can be seen as a continuum with intuitive judgements being at one end of this continuum and scientific experiment at the other (Figure 2.7). This model is underpinned by the Cognitive Continuum Theory proposed by Hammond (1978). This states that there are modes of cognition employed by those undertaking a decision making task. Furthermore, it suggests that there are two forms of cognition, *viz,* analysis and intuition. Willis (1995) applies this theory to decision structuring, with the proposition that well structured decisions engage high levels of analytical cognition, whilst in contrast, ill-structured decisions engage intuition.

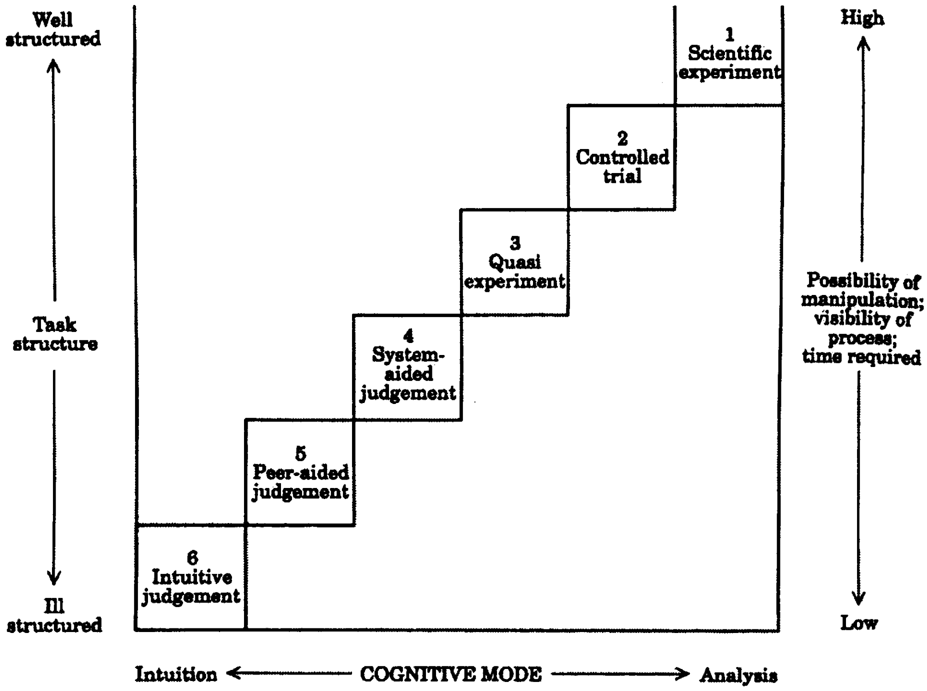


Figure 2.7: Cognitive continuum, illustrating degree of decision structuring
Source: Willis (1995, pg. 252, after Hammond, 1978)

In a similar conceptualisation, French and Geldermann (2005) propose relationships regarding the structuring of decisions and the application of analytical cognition.

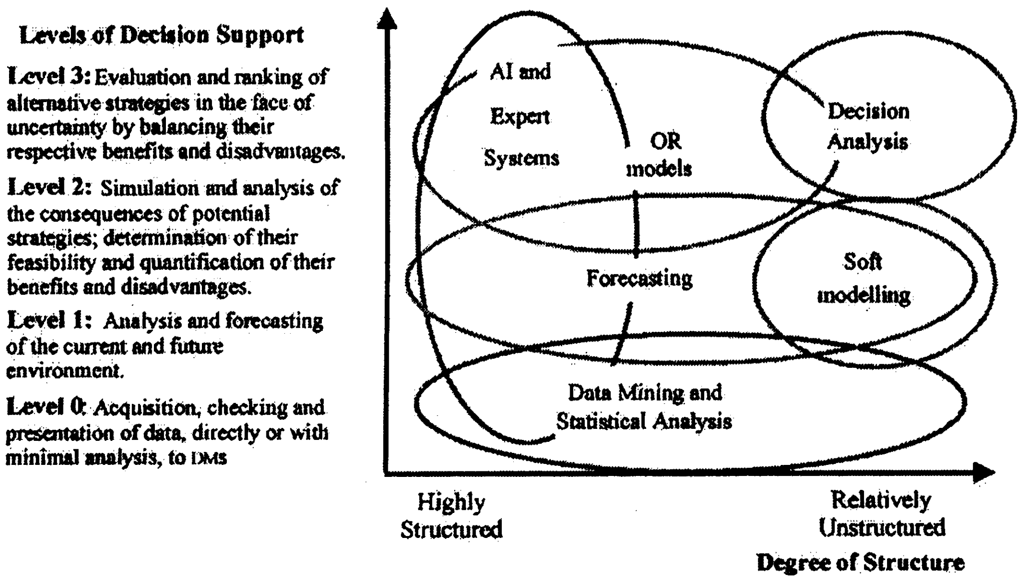


Figure 2.8: Levels of support and degrees of structure in decision making process
Source: French and Geldermann (2005, pg. 388)

The connecting factor between the Cognitive Continuum (Willis, 1995) and French and Geldermann's model is the role of information utilised by the decision maker. Schrah *et al.* (2006, pg. 44) define task information as "…information about the task that the decision-makers acquire via their own information search". They importantly distinguish between task information and advice; they define advice as, "…a recommendation concerning a specific course of action" (Schrah *et al.*, 2006, pg. 44). Skinner (1989) states that all decision makers require information to inform the decision making process and this task information requires cognitive thought.

In summary, the review of decision making and policy making descriptive and visual conceptualisations offer a number of different perspectives. Despite variations, a number of reoccurring constituent parts were observed; these are considered to be the salient characteristics true of both decision making and policy making processes. Furthermore, pertinent observations were ascertained regarding, levels of decision making, decision maker cognitive thought and decision structuring. A summary of these points follows:

- The process of both decision making and is conceptualisation as being of a cyclical nature (*e.g.* Figures 2.2, 2.3, 2.4 and 2.5);
- Policy making commonly contains the following stages:
    - Issue/problem identification;
    - Scoping of alternatives, application of assessment criteria and formulation of course of action;
    - Implementation and adoption;
    - Monitoring and feedback and
    - Evaluation and refinement.
- Decision making can occur at the following tiers: Strategic, Tactical and Operational (Section 2.4.1) (Gilligan *et al.*, 1993; Fabbri, 2002; French and Geldermann, 2005);
- All decision makers require information to inform the decision making process, this task information requires cognitive thought (Gilligan *et al.*, 1983; French and Geldermann; Skinner, 1989);
- The Cognitive Continuum Theory proposed by Hammond (1978) suggests that there are two forms of cognition, *viz* analysis and intuition (Hammond, 1978 cited in Willis, 1995) and
- The literature suggests a relationship between decision maker cognition and decision structure (Willis, 1995; French and Geldermann, 2005).

During the review of decision making a large number of papers pertaining to Decision Support Systems (DSS) were observed. It is, therefore, worth briefly considering their role in supporting the decision making process. DSS's are computer-based software methodologies that integrate various knowledge bases in order to provide decision makers with a tool to aid aspects of the decision making process. DSS have been created for several environmental fields, such as, coastal management (Westmacott, 2001), integrated water management (Fazlollahi *et al.*, 1997) and forest management (Reynolds, 2005). Westmacott (2001) states the function of a DDS as a, "...computerised system capable of supporting and assisting decision making in ICM..." (Westmacott, 2001, pg. 56). The components of this DSS were stated as being typical and included a user interface and a knowledge base or database a series of models (*ibid*). Due to DSS being computer-based software methodologies designed to support the decision making process, they are considered peripheral; however, there is, recognised merit in bearing them in mind when strategically considering factors and influences upon the decision making process.

2.5 Coastal Risk Decision Making

The general picture of environmental hazards and risks are considered first (Section 2.5.1), before moving onto examining coastal hazards and risks (Section 2.5.2). Literature concerning management responses to coastal risks are then presented (Section 2.5.3). Finally, the natural coastal change evidence base of coastal risk is investigated (Section 2.5.4).

2.5.1 Environmental Hazards and Risks

Jordan and Grotzinger (2008) highlight the large number and variety of hazardous phenomena that occur within the Earth system which present both risk and danger, including: severe storms; landslides; earthquakes; volcanic eruptions and flooding. Events produced by natural processes that have the potential to kills or damage the built environment, are considered to be natural hazards by these authors. These natural hazards have, according to Smith (1992, pg. 3), '...always been a part of human history". In addition, man-made hazards also exist, such as, industrial explosions and major transport accidents (including marine-related accidents *e.g.* the catastrophic Exxon Valdez oil spill (Clark, 2001)). Whilst a distinction exists between natural and man-made, there is growing recognition that many natural hazards are linked to societal interactions within ecosystems, as first reported by Gilbert White in the early 1970s, cited in Smith (2007). Referred to as context hazards (global environmental change) these relate to a number of areas, including environmental degradation, including deforestation and desertification (Smith, 2007).

Although the terms hazard and risk are taken as being synonymous, a clear distinction between hazard and risk is essential. Hazards are defined by Smith (1992) as, 'a potential threat to humans and their welfare', whilst risk is considered to be 'the probability of hazard occurrence'. Other definitions exist, for example, O'Riordan (1995), Kay and Alder (2005) and Jordan and Grotzinger (2008). Whilst there are no universally accepted definitions, risk commonly use terms such as chance, probability or likelihood of something occurring. Environmental hazards are considered by Smith (2007) to be hazards to people (*e.g.* death and disease), hazards to goods (*e.g.* economic loss) and hazards to the environment (*e.g.* loss of flora and fauna). Furthermore, vulnerability is considered to be 'high risk combined with an inability to cope'. Mitchell *et al.* (1989) depict the natural hazard system (Figure 2.9) and show the interrelationships between hazards, risks, and importantly, societal responses.

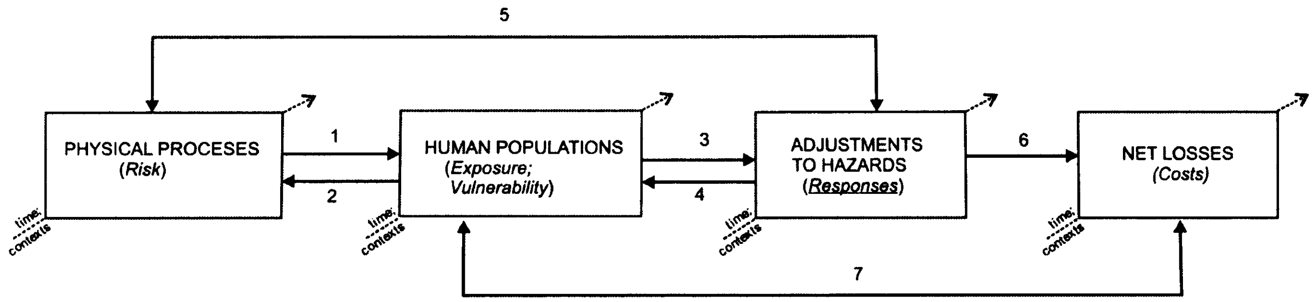


Figure 2.9: Natural Hazard System illustrating the complex connections between physical risks, exposure and vulnerability to these, societal responses and cost over time.

Source: Mitchell *et al.* (1989)

An important aspect regarding environmental hazards is the heightened public concern and societal awareness of hazards. This has been propagated by media coverage, and, in part, by the apparent increasing frequency of extreme natural events occurring since the 1970s due to fluctuating climate conditions (Smith, 1992). Historically, the management of environmental risk has relied upon technical assessments containing both the probability of particular events occurring and the seriousness of the results. Smith (2007) asserts that risk perception has to be regarded as a component of risk management, as management involves choices determined by judgements that are in turn, formed upon values, beliefs and perceptions. Risk management according to (O'Riordan 1995) involves the following stages:

- Hazard identification;
- Risk estimation;
- Consequence analysis;
- Risk assessment;
- Risk evaluation;
- Risk mitigation and

- Risk monitoring.

An additional aspect of risk management that is not explicit here, but, which occurs at the risk evaluation stage is the economic factor. Smith (2007) considers this to be a dilemma within risk management that sees risk managers asking, "Where should we spend our money to best effect (*e.g.* saving lives)?". Risk management is undertaken by regulatory authorities at various spatial scales (*ibid*), for example by policy makers, as highlighted earlier (Jasanoff, 2003). As Barrow (1999, pg. 129) notes, "...humans have the potential to recognize and to respond consciously to opportunities and to threats-natural or anthropogenic, perhaps to avoid or mitigate them". Tobin (1999, pg. 23) reflects, however, that experience has shown the current hazard response and mitigation in the United States often sustain communities, "...in an completely artificial environment" without developing community resilience.

2.5.2 Coastal Hazards and Risks

The coast as an attractive location for settlement is considered within the literature to be both a contested and congested space, with many urban areas being situated at or close to the coastline (Nichols, 1999; Smith *et al.*, *in press*). Lee (1993, pg. 169), in reference to England and Wales, highlights, "Many parts of the coast are subject to natural hazards ranging from flooding to erosion and deposition". Ricketts (1986) considers coastal erosion and deposition of sediments as fundamental attributes within UK coastal systems. Coastal hazards are defined by LGACSIG (2004) as, "a naturally occurring or human-induced coastal process of event, with the potential to create loss. Natural coastal hazards include coastal erosion, instability and flooding". New Zealand's Ministry for the Environment guidance manual for local government on coastal hazards and climate change defines coastal risk as, "The chance of an 'event' being induced or significantly exacerbated by climate change, which will have an impact on something of value to the present and/or future community. It is measured in terms of consequence and likelihood" (Ministry for the Environment, 2008, pg. 46). These coastal-specific definitions of risk mirror closely those of a more general nature (Section 2.5.1). However, the introduction of climate change is a very recent phenomenon and some coastal texts, such as, that by Kay and Alder (2005) still referring to older, more established generic definitions of hazard and risk, *e.g.* Smith

(1992) and O'Riordan (1995). This aspect of the Literature Review and the thesis research, therefore, recognises that coastal risk is in fact a sub-set of risk.

According to Kamphuis (2006) most beaches around the world are eroding, due in part to these beaches being deposited at earlier geological times when larger supplies of sediment were available. It is estimated that as much as 80% of the United States shoreline is eroding (Pilkey, 2000). The European Environment Agency identified that coastal erosion has had a major impact upon on Europe's coast, with 25% experiencing erosion (European Environment Agency, 2004; Doody *et al.* 2004). Coastal erosion is part of the ever changing coastal processes occurring at the coast, and as such is considered by Burgess *et al.* (2007, pg. 271) as only being, "... considered a problem because of man's presence on the coast". The temporal scale of erosion, due to rising sea levels, is creating accelerated coastal erosion along some stretches of coast. For example, on the south-east coast of England due to relative sea level change is rising 1mm per year. This has resulted in a loss, through erosion, of over one third of the saltmarsh area during the early 1970s and early 1990s (Sharpe and Huggett, 1998). In response to coastal erosion, human intervention has taken place; with subsequent disruption to the natural coastal system (Ballinger *et al.*, 1994; Burgess *et al.*, 2007). Coastal erosion can, therefore, be both natural and man-induced (Ricketts, 1986).

Flooding is the most common environmental hazard worldwide, after disease and transport accidents (Smith, 2007). This is a direct result of the geographical distribution of river valleys and low-lying coastal areas that have attracted human settlement for centuries. The nature and scale of flood risk can vary significantly, for example, Smith (2007) citing Parker (2000) and Blanchard-Boehm *et al.* (2001) present the following country-by-country comparison of flood-prone percentages of the population at risk:

- France 3.5%;
- United Kingdom 4.7%;
- United States 12%;
- Netherlands 50%;
- Vietnam 70% and
- Bangladesh 80%.

From these figures it can be seen that UK flood risk, whilst mild by global standards is still a notable natural hazard (Tunstall *et al.*, 2004). England and Wales in particular has a serious coastal flood risk due to the potential for North Sea and Irish Sea storm surges and sea level rise (Pottier *et al.*, 2005). Regularly cited flooding events in England and Wales include the flooding in Towyn, North Wales in February 1990, along with more recent events, such as, the Easter floods of 1998, Boscastle flash flooding in 2005 and the extreme flooding in Gloucestershire in 2007 (Parker, 1995; Robson, 2002; Wheater *et al.*, 2002; Pitt, 2008). The most referred to event within the literature is, however, the North Sea extreme storm surge of January 31st 1953 on the east coast of England. This claimed 300 lives and caused severe and extensive damage to property (Fleming, 1992; Simm *et. al*, 1995; Pettit, 1999; Penning-Rowsell, 2001; Tunstall *et al.*, 2004). Whilst there has been an anti-floodplain encroachment policy in England and Wales (encroachment is considered by Pottier *et al.* (2007) as invading the functional floodplain with development), it has been estimated that in Wales in 2007, 52,000 properties were at risk of fluvial flooding and 58,000 at risk of coastal flooding (ICE Wales, 2007). The cited numbers of residential and commercial properties at risk from tidal/sea flooding and coastal flooding in England and Wales in 2001 was put at just over 1.2million (Halcrow *et al.*, 2001). The capital value of assets at risk from sea/tidal flooding and coastal erosion in England and Wales was estimated in 2001 to equate to £139.9 billion (*ibid*).

2.5.3 Approaches to the management of coastal risk

"Throughout history, man has tried to control the coast and how it behaves..." (Burgess *et al.*, 2007, pg. 270). Man has altered coastal landscapes for centuries; in England, Italy and the Netherlands for example, coastal modifications can be traced back to the 6th Century (Woodroffe, 2002). In the Netherlands, there is a particular history of controlling natural coastal processes by dune management (polderisation) and hard sea defences, driven by a safety and protection function to protect large parts of the country from inundation by the sea (Klein *et al.*, 1998; Doornkamp, 1992). Human intervention has resulted from advances in civil engineering construction and facilitated 'permanent' coastal settlements behind artificially stabilised and engineered coasts. Traditionally, however, human settlements made trade-offs between flooding and erosion risk and the maintenance of livelihoods that benefited from their coastal or estuarine locations (Riddell, 1992).

Coastal structures, including coastal defences that have existed for centuries, are to be found along shorelines around the world, including man-made harbours used for the development of ports, shipping and fishing (Fleming, 1992; Pettit, 1999; Ballinger *et al.*, 1994; Simm *et. al.*, 1995; West, 1992). The European Environment Agency (citing data from the EUROSION project) states that approximately 10% of Europe's coasts are artificially defended with coastal defences and / or harbours. According to Haslett (2000), the presence of these structures, in most instances stimulated hinterland development, such as, infrastructure (bridges and roads) and the creation of major urban centres. More historic sea defences were also constructed, not to protect development, but land claim, for example, 10th Century reclamations in the Severn Estuary, UK (French, 2001; Burgess *et al.*, 2007).

The last two centuries, in particular, have witnessed changing coastlines that have been significantly altered by man (McInnes, 2003). The amenity and leisure value of the coast, due in part to the Victorian fashion to take in the sea air and sea bathing, has had a particularly notable influence on coastal modifications and engineering (*ibid*). In England and Wales for example, this influence saw small seaside villages and fishing coves transformed into coastal resorts, attracting huge numbers of visitors during the summer season. Esplanades, piers and sea walls were constructed to enhance aspects of access to the coast. This pattern was mirrored in other parts of Europe, including France (Hanna, 2002; French, 2001; Fleming, 1992; McInnes, 2003). There is, therefore, an inheritance of extensive lengths of engineered coast, a significant proportion of which are nearing the end of their design life (French, 2001; Evans, 1992). Major storm events and their associated devastating effects on coastal communities have also significantly driven contemporary coastal engineering activities, with a reactive approach prevailing as the *modus operandi* (Tunstall *et al.*, 2004).

It was identified that the protection of shorelines around the world has followed in the majority, hard engineering solutions (Woodroffe, 2002). Similarly within the UK, a notably, "...hard edge approach dominated..." approach towards dealing with matters of coastal erosion is noted (Fleming, 1992, pg. 5). This traditional approach relies on coastal engineering to create artificial 'hard' static physical structures or barriers between the land and the sea, that resist or absorb the energy of tides and waves, therefore, protecting the area immediately behind the structure / hinterland (French, 2001; Fleming, 1992; Ricketts, 1986). This hard-engineering approach has been supplemented with 'softer' engineering options. The latter are regarded as being 'soft' due to their less interventionist approach, which aim to work with natural coastal processes or use natural materials, for example, managed realignment and beach nourishment (MAFF, 1993). However, the usage of these is still dwarfed by the presence of static engineering responses, despite the growing awareness and appreciation of the benefits of soft solutions (Fleming, 1992; Evans, 1992; Hutchison and Leafe, 1995). An overview of a number of hard and soft engineering solutions is contained in Table 2. 2.

Table 2.2: A summary of coastal protection measures (after French, 2001; Haslett, 2001 MAFF, 1993; McInnes, 2003)

Management issue	Method	Examples of Engineering Solutions
Coastal Erosion	Hard	• Sea walls (*e.g.* revetment, stepped, curved, vertical, rubble mounds, bulkheads)
		• Gabion baskets
	Soft	• Beach nourishment
Coastal Inundation	Hard	• Sea walls
		• Flood embankment
		• Tidal Barriers/ barrage
Beach Stabilisation	Hard	• Groynes
		• Breakwaters
	Soft	• Beach nourishment
Slope Stabilisation	Hard	• Slope reprofiling by excavation
		• Soil /Slope reinforcement
	Soft	• Drainage
		• Slope vegetation

Coastal engineering measures, even those of a 'hard' nature, are however, often only a temporary solution. As noted by Ballinger *et al.* (1994), they create a false sense of security amongst those communities that have been afforded the protection of these structures. Furthermore, the presence of coastal defence often leads to on-going coastal development in hazard areas, that further necessitates defence works, as depicted in the 'development-defend cycle' (Figure 2.10) (Carter *et al*, 1999). The design life of coastal defences typically ranges between 20 to 50 years (Nicholls *et al.*, 2007). Clayton and O'Riordan (1995, pg. 159-160) highlight these structures, "...rarely last more than 40 years, and some fail quite soon after construction if the coastal geomorphology is not fully understood". The sustainability of coastal structures is, therefore, possible only by a conscious effort to maintain them; maintenance is a matter of economic resources, which in turn, is related to political and societal will.

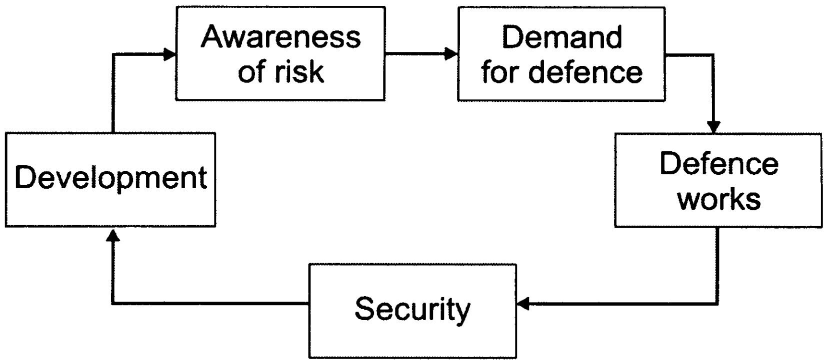


Figure 2.10: Development – Defend Cycle
Source: Carter *et al.* (1999)

The traditional approach to flood management in the UK, as in other parts of the world, such as the United States, has been protective, with similar structural approaches being used as with coastal erosion. For example, flood embankments and engineered river channels and walls all being common engineering approaches (Parker, 1995; Werrity, 2006). Maddrell *et al.* (1995) state that there were nearly 1300 kms of flood defence in England and Wales, encompassing 2000 flood defence structures. Fleming (2002) highlights that floods are natural, and as such, cannot be prevented, only mitigated against. Other forms of non-structural flood hazard reduction measures include flood forecasting, flood warning systems, public awareness campaigns, in addition to the traditional regulatory technocratic structural approach (Werrity, 2006).

It is clear that coastal hazards and their associated risks are not new to coastal resources managers, coastal engineers and planners; with differing approaches in various coastal localities. The literature highlights that in England and Wales, historic arrangements have been notably fragmented and sectoral due to legislative divisions between terrestrial planning, coast protection and sea defence (Pettit, 1993; Howarth, 2002; Taussik, 2007). The Coast Protection Act 1949, which provides the foundations for coastal defence activities in England and Wales, does not cover Northern Ireland (Coast Protection Act, 1949). With respect to flooding, Tunstall *et al.* (2004) state that the UK has often acted reactively in response to major events, such as catastrophic floods. As Jollife (1983, pg. 67) stated in respect to the UK, "Our traditional approaches to such problems as coastal erosion and flooding need questioning". In England and Wales, central government recognises that reliance on hard engineering approaches from a technocentric perspective cannot be sustained, due partly to the high capital and maintenance that create false expectations for future structural interventionist approaches (Defra, 2006a). The recent EU Floods Directive has called for food risk management planning to undertaken by all Member States (European Parliament, 2007). Furthermore, the independent response to the fluvial flooding of 2007 in England and Wales, the 'Pitt Review', publicly questioned traditional management approaches (Pitt, 2008). An additional driver is climate change and its effect on future coastal risk (Defra, 2005; WAG, 2006; Ministry for the Environment, 2008). England and Wales, have recently seen the transition by government from flood and coastal defence strategies towards Flood and Coastal Erosion Risk Management (Defra, 2005; WAG, 2006). Whilst in other parts of the UK, for example Northern Ireland, policy developments are underway with respect to flood risk management, however a legislation and policy vacuum for coast protection remains (RPS, 2006; RPS, 2007; Rivers Agency, 2008).

Coastal Risk Management involves integrated management of coastal hazards using a risk-based framework. It seeks to minimise risks of natural hazards through reducing vulnerability, largely by controlling future development and investing in sustainable flood and coastal risk measures (Environment Agency, 2009). What differentiates Coastal Risk Management from the traditional management so far discussed, is its broad holistic approach that encompasses the activities of all those involved for example, planners and engineers, with a view to developing shared responsibility for managing coastal risk (LGACSIG, 2004). The need to adopt a more holistic view of the coast is recognised by many authors for example, Nicholls and Branson (1998) and Ballinger *et al.* (2002). However, whilst the need of a shared approach to the management of coastal risk exists (Ballinger *et al.*, 2002; LGACSIG, 2004), it is yet to be fully enacted in the UK (MAFF, 2000; English Nature, 2005).

2.5.4 Science for Coastal Risk Management

The evolving nature of natural coastal change science that underpins coastal risk management should be recognised. For example, scientific understanding of coastal processes is relatively young (20th century). Fleming (1992, pg. 18) regards the level of understanding that evolved between the 1940s and early 1990 as being, "...profound and rapid". Kamphuis (2006, pg. 134) states that prior to 1950, coastal science and engineering was, "mainly concerned with large issues of national interest, such as national defence, transportation and safety from flooding".

Knowledge and understanding of natural coastal change has, and continues to be driven by developments in research by scientists and coastal engineers; international conferences on coastal engineering, for example, began in 1950 (Kamphuis, 2006). The influence of American government-funded research programmes provides an example of a transfer of knowledge; the US Army Corps of Engineers has produced many publications that have received widespread acceptance, *e.g.* the 1954 'Shoreline Protection, Planning and Design – Technical Report No.4'. In addition, other notable research centres have made significant scientific contributions including Wallingford Hydraulics Research Laboratory in the UK and Deflt Hydraulics in the Netherlands (*ibid*). It is worth noting that most coastal studies, up until the 1960s, were dominated by empirical studies of coasts in northwest Europe, North America and Soviet States (Woodroffe, 2002). Interestingly, Woodroffe (2002) suggests that concerns regarding sea level rise and global change have given rise to a new impetus in the study of coasts.

It was not until 1993 that the mapping of sediment cells around the English and Welsh coast occurred, upon which modern shoreline management in England and Wales is based, followed in 1997 by a similar survey in Scotland (Hansom *et al.,* 1997). These sediment cells, also referred to as littoral cells, are defined as discrete sections of coast within which the movement of sediment is relatively self-contained. The study by Motyka and Brampton (1995) identified 11 coastal sediment cells and 46 sub-cells around the English and Welsh coast. Contrastingly, the technical underpinning of flood defence was regarded as, "stable and conservative up until the end of the twentieth century" (Evans *et al.,* 2007, pg. 5). The methods used for estimates of inland and coastal flooding were based upon statistical analyses of historic data; a major technical advance came from computational hydraulic modelling between the 1970s and 1990s. These advances enabled, "...major shifts in the breadth and scope of flood studies and schemes..." (Evans *et al.*, 2007, pg. 5-6). The Foresight Project on Flood and Coastal Management, 'Future Flooding', represents a significant and vital scientific study of the factors that affect flood risk in the UK, designed to inform appropriate planning and management of both flood and coastal erosion risk (*ibid*).

The importance of conceptual models and modelling, both qualitative and quantitative, to the study of coasts is considered critical within the literature. Models offer scientists both a simplification of reality and a conceptual framework to frame their knowledge and understanding of coastal evolution (Woodroffe, 2002). Conceptual and simulation models of coastal evolution are increasingly, "...more rigorous and more complex" (*ibid*, pg. 7); however, this author goes on to indicates that in many cases, "...calculations are rarely tested empirically..." (*ibid*, pg. 117).

This last point brings to light an additional aspect to the knowledge base associated with natural coastal change, uncertainty. This is widely acknowledged within the literature, for example, coastal processes and coastal geomorphology and their interactions and impacts of humans within coastal systems (Woodroffe, 2002; Kamphuis, 2006; Burgess *et al.*, 2007; Nicholls *et al.*, 2007; Benoit and Lefebvre, 2005). Burgess *et al.* (2007, pg. 273) state, "Little reliable information or confidence exists with regards to long-term future changes in waves, storminess or surge conditions...". Within the scope of scientific communication, the communication of uncertainty receives much attention in the literature (for example: Functowicz and Ravetz (1990); Jasanoff and Wynne (1998); von Bodungen and Turner (1999); O'Riordan (2000); Wardekker *et al.* (2008)). The problem of scientific uncertainty, particularly within the natural sciences, appears to be a problem of communication (von Bodungen and Turner, 1999). It is also considered a problem of perception, *i.e.* uncertainty being associated with low quality in scientific information in policy context (Functowicz and Ravetz, 1990; von Bodungen and Turner, 1999).

Kamphuis (2006) believes that uncertainty has become a keyword in coastal engineering and needs to be more widely communicated and accepted. "It is not possible to predict in detail how coasts will respond in future"(Woodroffe, 2002, pg. 34). The modelling of coastal processes on greater time scales, such as decades to centuries, is, for example, not known to any great certainty (Hinton *et al.,* 2007). "Modern models and interpretations are based on the research and insights of many past coastal scientists"; the increasing knowledge base that exists today, "...will be revised as that body of knowledge increases further" (Woodroffe, 2002, pg. 8). Hinton *et al.* (2007, pg. 145) states that "...our ability to make morphological predictions is hampered by a lack of good quality, long-term data sets...". Indeed, Nicholls *et al.* (2007, pg. 410) state, "A fundamental gap in our knowledge is long-term morphological prediction over decades of natural coastal units such as coastal cells or estuaries". This evolutionary state of knowledge and understanding, therefore, creates a degree of uncertainty in natural coastal change science.

"Explaining the geomorphological changes that are occurring on the coast is becoming increasingly important in order to manage coastal resources in a sustainable way..." (Woodroffe, 2002, pg. 1). Surveys of coastal protection structures in England and Wales were carried out in the early 1980's and 1990's, including the national sea defence survey in England conducted by the National Rivers Authority (West, 1992; Hutchison and Leafe, 1995). Whilst a survey conducted by the Ministry of Agriculture, Fisheries and Food in 1994 identified significantly eroding lengths of coast where no protection existed. At the time of survey there remains no full mapping of erosion extent around the UK coast. Additionally, high-resolution topographic mapping of flood areas is not consistently available (Halcrow *et al.,* 2001). Despite this, coastal defence schemes have in the past been built on the basis of an academic or theoretical understanding of coastal processes, with the local understanding often not present. Many decisions have, therefore, been based upon an inaccurate or inadequate understanding of the coastal problem (Ricketts, 1986; French, 2001).

Several authors cite examples of instances where a lack of geomorphological foresight has been the basis for coastal engineering schemes failing to alleviate problems, and in some cases, exacerbating problems both locally and regionally (Evans, 1992). It is believed that a poor lack of understanding of coastal processes has underpinned the parochial basis for undertaking coastal engineering, with little regard for the implications for neighbouring areas and environmental impact (Carter, 1988, Tunstall *et al.*, 2004; Evans, 1992). Whilst this may be the case, there has been a rapid advancement in knowledge and understanding of coastal processes, with engineering solutions becoming more complex and sophisticated (Fleming, 1992). Evans (1992, pg. 53) highlights, "...structured input from applied geomorphology is a necessary precursor to successful coastal management strategies". The mapping of sediment cells in England and Wales has directly been applied to shoreline management planning in these localities (Potts, 1999a). In a study of Northern European approaches to coastal erosion management practices (EUROSION project), the concept of coastal sediment-cells was considered a major breakthrough, with sediment-cell based management strategies regarded as best practice (National Institute of Coastal and Marine Management of the Netherlands, 2004). However, the study did not identify this approach as being common place, with the majority of past and some present approaches managed from a local perspective (*ibid*).

2.6 Discussion and Conclusion

Section 2.6.1 draws together prominent findings from the previous few sections (Sections 2.2 – 2.5), before discussing the perceived strengths and gaps within the current state of knowledge contained in the literature (Section 2.6.2)

2.6.1 Synthesis of Existing Research

Major changes in the organisation and practices that have occurred within Western science were documented in Section 2.2. In particular, Jasanoff (2003) indicated the shift towards problem-orientated and policy-relevant scientific research; Wiltshire (2003) highlighted that science has, consequently, become socially situated and constructed. A number of challenges facing scientists were identified, most notably were those associated with the issue of scientific uncertainty, as documented by Functowicz and Ravetz (1990). This was found to be true for coastal and, particularly, natural coastal change scientists (von Bodungen and Turner, 2001; Kamphuis, 2006).

The emergence of evidence-based decision making and policy making was documented by Davies *et al.* (2004); this was further identified within current UK government practices (Cabinet Office, 1999a & b). The increasing emphasis upon scientific evidence-based environmental policy making was also observed within the literature (Policansky, 1998; Steel *et al.*, 2004). However, several papers reported that whilst science is a key knowledge input that informs the decision making process, it is considered to be not the only factor (Cortner, 2000; Allio *et al.*, 2006). Policy making, according to Jasanoff and Wynne (1998) and Pohl (2008), is the result of numerous interactions between four distinct cultures that interact to influence the policy outcome, *viz,* academic, bureaucratic, economic and civic (Figure 2.1). Following on this from this, limitations pertaining to the role of science in policy making were found in a number of papers, for example, Ballantine (2005) and Allio *et al.* (2006).

In addition to the literature findings regarding the limitations to the role of science within policy making, a perceived division between science and practice was found to be the basis of many papers from a number of disciplines, including coastal management and climate change studies (Jones *et al.*, 1999; Burbridge and Humphrey, 1999; Gallopin, 1999; Jacobs, 2003; Allio *et al.*, 2006; McNie, 2007; Pohl, 2008). In particular, McNie (2007) and National Research Council (1995) identified the need for greater interfacing between policy makers and scientists; with the traditional linear model of science to policy not considered as satisfactory to address the complexities of environmental management, including coastal decision making.

The review noted the work of Smith (1992; 2007) concerning environmental hazards and risks. This was then considered in relation to the literature concerning coastal hazards and risks. It was posited that the work of Smith (1992; 2007) continues to act as the foundation for the theoretical understanding of coastal hazards and risk. Literature detailing traditional responses to coastal hazards and risks in the UK, Europe and worldwide, in the form of human intervention and coastal engineering were reviewed. This identified that the protection of shorelines around the world has followed in the majority, hard engineering solutions (Woodroffe, 2002). A number of conference papers by UK-based engineers and coastal managers within 'Proceedings of the Institute of Civil Engineers Conference Coastal Management' Barrett (1992) provided details of knowledge and experience of approaches to coastal engineering practices in the UK. Emanating from this, local perspective, site specific and reactive practices were revealed as the dominant historical approach, facilitated by advances in civil engineering technologies (Fleming, 1992). The EUROSION study of practices across Northern Europe found this management response to be commonplace (Doody *et al.*, 2004). An inadequate understanding of coastal processes was reported for a number of UK cases in which reactive and parochial coastal engineering schemes had exacerbated erosion problems (Evans, 1992). Fleming (1992) highlighted the evolving nature of the underpinning natural coastal change science. Hanson *et al.* (1997) discusses the advances that occurred *via* the mapping of coastal sediment cells around the coast of England and Wales in 1993, which have advanced shoreline management planning in these localities. Woodroffe (2004) and Hinton *et al.* (2007) both attest to the additional aspect to the knowledge base associated with natural coastal change, uncertainty. Consequently, Nicholls *et al.* (2007) report the current limitations with regard to long-term coastal morphological predictions for the management of coastal flooding and erosion in the UK.

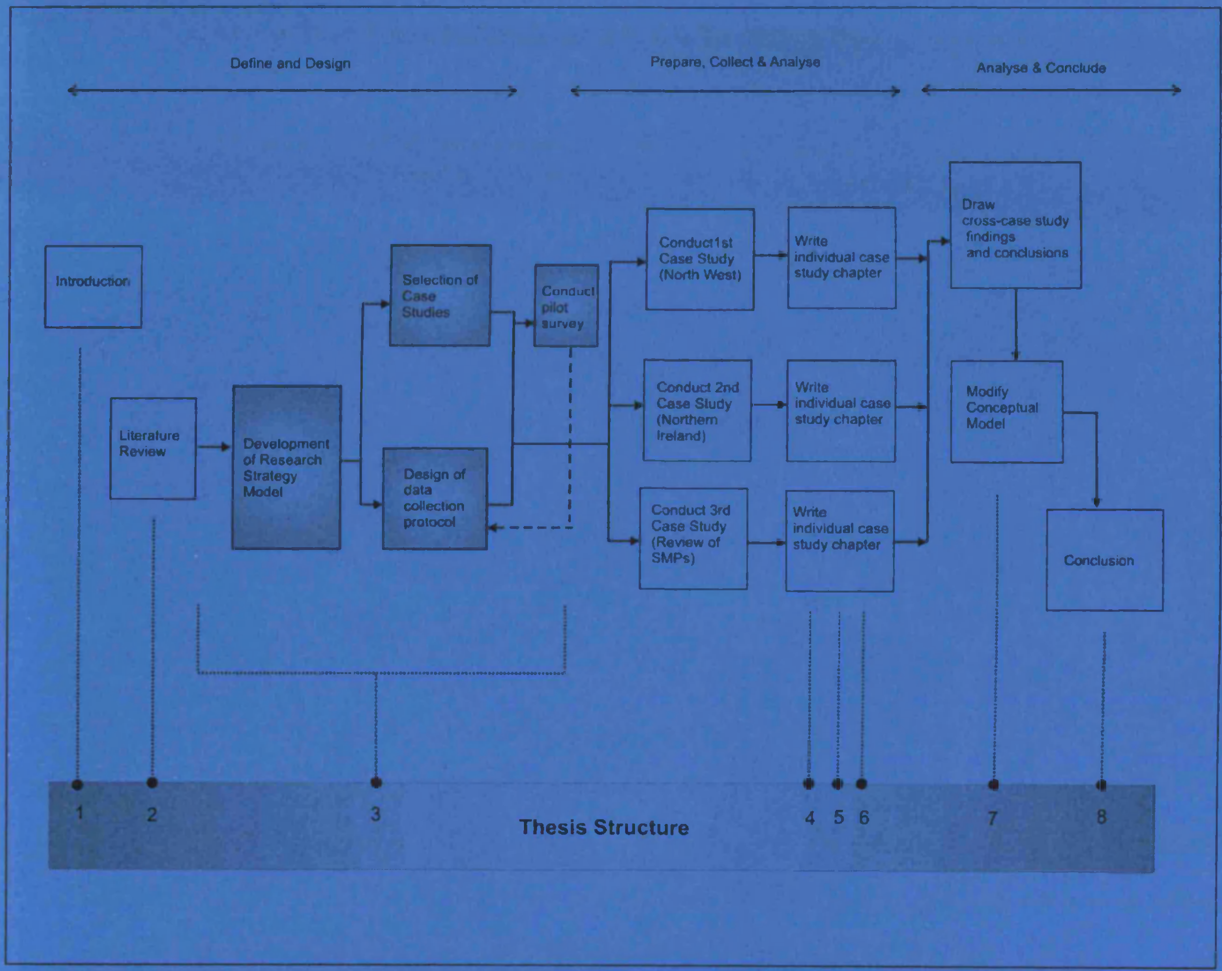
2.6.2 Strengths and Shortfalls of Existing Research

It is has been noted that much of the literature on the role of science within policy, for example, Jasanoff (1990; 2003) emanates from the United States. This was counterbalanced by literature based upon empirical studies from Europe, for example, Ballantine (2005) and Allio *et al.* (2006). Additionally, when considering definitions in the literature regarding coastal risk and hazards, the dominant and prevailing definitions appear to stem from the work of Smith (1992; 2007) (Section 2.5). Literature on coastal risks and approaches to coastal flooding and erosion in the UK and Europe was sourced from government, academic and practitioner-based literature (Sections 2.5.2 & 2.5.3). This was reviewed to determine comprehensively past, present and future management approaches to coastal risk.

Section 2.4.3 highlighted that a number of conceptual models of both decision making and policy making exist within various fields. Concomitantly, it was considered that many of the coastal-specific policy making models (Knecht (1995) and Olsen *et al.* (1997) mirror generic policy making conceptual models, for example, by Jasanoff and Wynne (1998). This, therefore, raises speculation as to the reliance of this coastal research by research from other disciplines. As the literature does not provide information on the underpinning knowledge base for the coastal-specific models, the reader cannot determine whether the models represent reality based upon empirical research in the field or hypothesised conceptualisation of how the authors consider coastal policy making ought to be. Consequently, is not possible to ascertain whether the prevailing conceptualisations truly and adequately reflect the complexities of coastal policy making and decision making and the externally forcing factors at play.

Whilst the existing research goes some way toward providing an understanding of coastal policy making, one of the most significant shortfalls of the reviewed literature was the absence of documented mechanisms or procedures to assess or examine the role of science within either a generic or coastal-specific decision making processes. Furthermore, no coastal-specific conceptualisations of decision making were identified. Hence, there is a need for further research into this area.

Arising from this Literature Review are a number 'working' definitions for key thesis terms. The review of decision theory identified a number of overlapping definitions for 'decision making'; whilst 'policy making' was less clearly defined in the literature, and found to be used in several ways by a number of authors. In light of these findings, the thesis defines 'decision making' as encompassing both decision making and policy making, and is considered as "a chosen course of action, or inaction, to address a problem with a desired outcome". Lastly, in the thesis science refers to the natural coastal change information needed to understand and explain changes occurring on the coast.


Define and Design
Prepare, Collect & Analyse
Analyse & Conclude
Introduction
Literature Review
Development of Research Strategy Model
Selection of Case Studies
Design of data collection protocol
Conduct pilot survey
Conduct1st Case Study (North West)
Conduct 2nd Case Study (Northern Ireland)
Conduct 3rd Case Study (Review of SMPs)
Write individual case study chapter
Write individual case study chapter
Write individual case study chapter
Draw cross-case study findings and conclusions
Modify Conceptual Model
Conclusion
1
2
3
Thesis Structure
4
5
6
7
8

3 Chapter Three Methodology

3.1 Introduction

This chapter presents a structured outline of the methodology adopted to address the thesis aim and objectives. In light of the direct and fundamental relationship between the methodology and the thesis aim and objectives (Chapter One), it is worth restating them here:

Thesis aim:
'To examine the role of science within coastal decision making, with particular reference to decisions pertaining to coastal risk.'

This central aim translates into two thesis objectives, as follows:
'To identify the salient decision making characteristics particular to coastal risk.'

'To evaluate the application of natural coastal change science as evidence used within coastal risk assessment and its associated decision making procedures.'

These objectives can be translated into two main research questions, namely, '*how are coastal risk management decisions made?*' and '*what is the role of natural coastal change information within this process?*'.

The methodology predominantly employed qualitative data collection techniques. The conceptual basis for the thesis (Chapter Two) established the suitability of this form of research for studying complex processes, such as, behavioural decision-making. Furthermore, the very nature of sustainable management of the coast and its resources that is the research context, *i.e.* a multi-disciplinary, multi-layered and multi-objective process, necessitated the application of qualitative research practices that allow the study of social phenomena. Consequently, many research outputs within the field of coastal management, as highlighted by Stojanovic (2002), are in the form of a qualitative evaluation-based research, for example, Pettit (1993) and Potts (1999a).

This chapter commences with the underlying theoretical foundations of the thesis and addresses the implications of this for the research methodology (Section 3.2). Section 3.3 outlines the Research Strategy Pathway in the logical sequence of its design and implementation, highlighting the research instruments utilised for data generation and the construction and application of a Research Strategy Model. In particular, it presents many of the issues influencing the design of the multiple-case study approach. Sections 3.4 and 3.5 then provide detailed discussions of the methods employed within the case studies; in doing so these cover the major pieces of qualitative research, *i.e.* two geographical case studies and a documentary survey as the third case study. The chapter concludes with consideration of the limitations of the research strategy pathway.

3.2 Theoretical Underpinning and Philosophical Assumptions

In order to research the thesis aim and objectives a research strategy was devised. However, before this is discussed, the theoretical underpinning and philosophical assumptions of the thesis need to be provided. This necessity stems both from the challenges faced by using qualitative research, the criticism that this field of research receives and the fundamental need to understand how knowledge is known and constructed. The following quote from May (2001, pg. 28) is primary to this discussion, "Data are not collected, but produced. Facts do not exist independently of the medium through which they are interpreted...". Social theory is the lens used for the interpretation of empirical data; that is, the ability to explain and understand research findings within a conceptual framework is constructed *via* a social theory (Mason, 2002). The implications of the particular social theory upon the research process employed cannot be overstated. The relationship between the data produced in the thesis and the social theory used to produce and explain it will now be discussed.

Firstly, the ontological perspective of the thesis, *i.e.* the conception of the nature of reality, is the assumption that knowledge is both situated and contextual. Secondly, the epistemological perspective of the thesis is critical to the development of the research strategy pathway and the underlying research philosophy. The thesis research has exercised a deductive reasoning approach, or what Mason (2002) terms the 'hypothetico-deductive method'. This is aligned with the Positivism school of thought, defined by May (2001, pg. 11) as, "...to collect and assemble data on the social world from which we can generalize and explain human behaviour through the use of our theories". Lastly, stemming from the epistemological position and connected to the ontological perspective, is the intellectual puzzle of the thesis. Figure 3.1 contains four intellectual puzzles that according to Mason (2002), all qualitative research can be distilled into by considering research in term of the words 'what, why and how'. Using a hypothesis generated in advance of generating data, a combination of mechanical and comparative puzzles were employed to generate and produce a distinctive social explanation of the data. This last point has driven the construction of case studies and will be discussed in greater depth in Section 3.3.2.

Developmental Puzzles: How and why did *x* and *y* develop?	Mechanical Puzzles: How do *x* or *y* work?
Comparative Puzzles: What can we learn from comparing *x* and *y*?	Causal / Predictive Puzzles: What causes *x* or *y*?

Figure 3.1: Intellectual Puzzles
Source: Mason (2002)

3.3 Research Strategy Pathway

This section comprises three sub-sections, the first of which examines the construction of theory and the development of the Research Strategy Model, followed by a detailed discussion of the case study approach. The section concludes with the process of drawing together empirical findings to enable the modification of theory in the form of a conceptualisation of coastal risk decision making. An overview of the Research Strategy Pathway is presented in Figure 3.2.

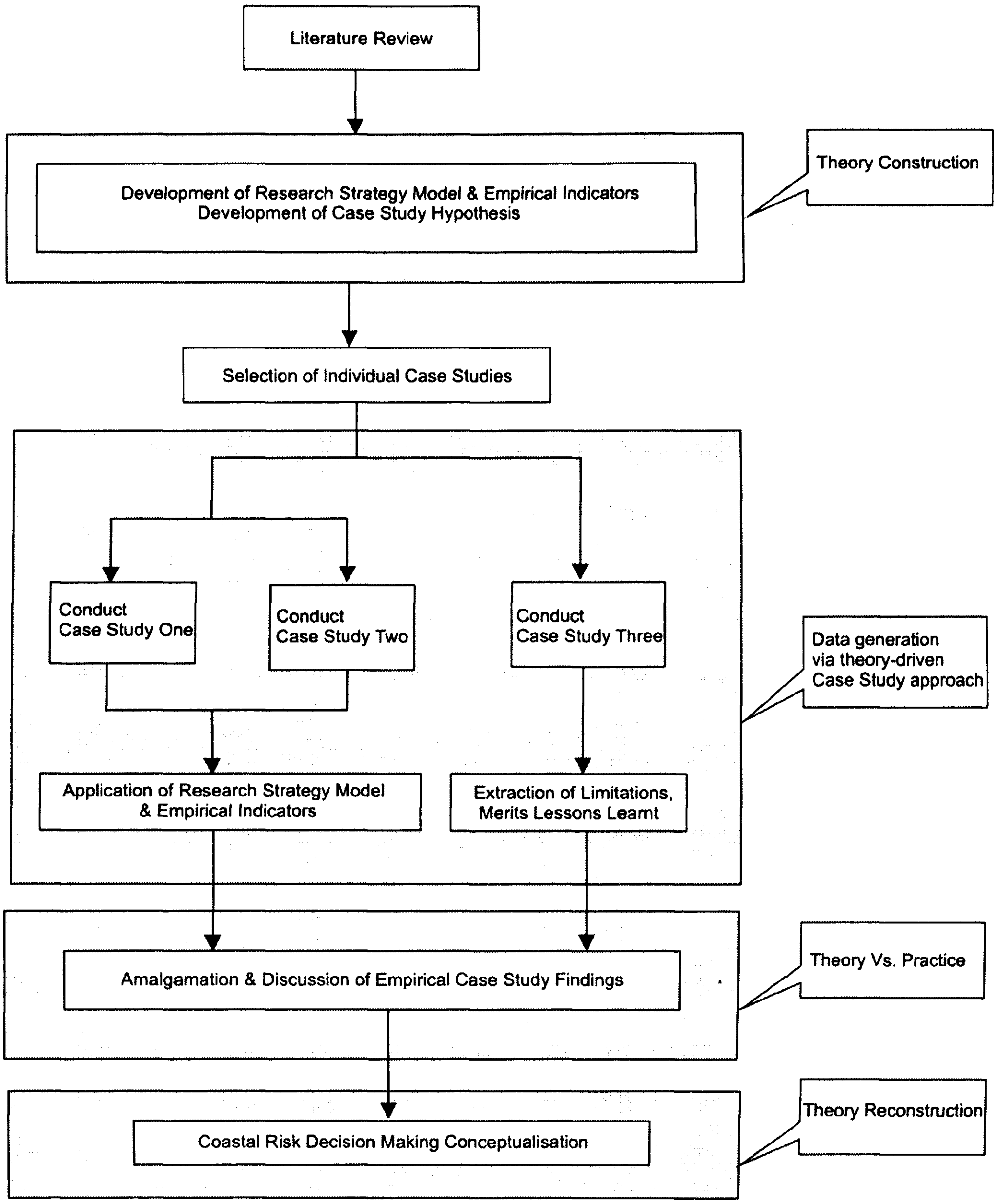


Figure 3.2: Research Strategy Pathway

Source: Original

3.3.1 Theory Construction: The Research Strategy Model

As stated, a deduction method was employed; central to this was the generation of theory. The definition of the 'hypothetico-deductive' term by Mason (2002, pg. 180) encapsulates the research process undertaken with regard to the theory generation, "...theoretical propositions or hypotheses are generated in advance of the research process, and then modified... by the empirical research". At the heart of the deductive method, and the process taken by the thesis, is a set of propositions underpinning a theory; this theory is then in turn tested *via* prediction and empirical observation.

Theory is defined by Handfield and Melnyk (1998, pg. 327) as, '...a statement of relationship between units observed or approximated in the empirical world". It is also worth stating the purpose of theory to the research process. Strauss and Corben (1998) establish that a theory provides an intellectual framework of understanding and offers an explanation about phenomena. Another role that theory can play is the utilisation of earlier studies, insights and relevant work in an attempt to overcome perceived weakness or absences of conceptual and theoretical underpinnings (Wolcott, 2001). The importing and utilising of knowledge and perspectives from other disciplines in particular, suggests offers 'significant explanatory power' when the imported theories are consistent, meaningful and important and of interest within the applied field of study (Wacker, 1998). Furthermore, May (2001, pg. 30) highlights that social theory can be developed "...to give representation and a research agenda for those issues that other forms of theorizing have overlooked". These points have been at the heart of the development of theory and the subsequent construction of a Research Strategy Model.

The thesis objectives can be distilled into two areas of concern, herein referred to as research questions. The construction of the Research Strategy Model (RSM) was based directly upon the findings of the Literature Review, and explicitly serves to address the two research questions (Section 3.1). The route from the Literature Review to the RSM will now be detailed. It is worth highlighting that the process of constructing the RSM integrates for the first time current thinking within the literature on numerous aspects of both decision making and policy making, into one single integrated theory.

To address the first research question, *'how are coastal risk decisions made?,* a critical review of literature was undertaken to help understand the conceptual basis of generic decision making, generic policy making, and to identify literature detailing aspects of coastal-specific decision making and policy making processes (Sections 2.4.1 & 2.4.2). As the review of literature was broad in scope and incorporated a number of disciplines and contexts, the rationale was therefore to gain insight into the key constructs and ideas running through these different literature spheres. An additional and important task was the identification and critique of conceptual decision making models to identify patterns, recognise themes and carry out a cumulative synthesis (Section 2.4.3).

In summary, it was identified that the conceptualisation of both decision making and policy making was predominantly of a cyclical nature (*e.g.* Jasanoff and Wynne's (1998) Policy Cycle; Knecht's (1995) cited in National Research Council (1995) Policy Process; Olsen *et al.*'s (1998) Integrated Coastal Management Policy Cycle; Gilligan *et al.*'s (1993) Open System Decision Cycle). These apposite conceptualisations were found to commonly contain the following stages:

- Issue / problem identification;
- Scoping of alternatives, application of assessment criteria and formulation of course of action;
- Implementation and adoption;
- Monitoring and feedback and
- Evaluation and refinement.

Decision making is considered by a number of authors from several disciplines as occurring at Strategic, Tactical and Operational tiers (For example: Gilligan *et al.*, 1993; Fabbri, 2002 and French and Geldermann, 2005). Emanating from this critique of the literature was the construction of Part A of the RSM entitled 'Decision Process Tracing'. This comprises two components 'Decision Pathway' and 'Decision Making Tiers'. The first of these presents a theoretical, normative and rational decision making model of the idealised process or decision pathway sequence that a decision maker may undertake.

These components integrate together (for the first time) knowledge and conceptual representations of both decision making and policy making, and contains the following five stages of the decision pathway:

1. Problem Framing;
2. Scoping of Alternatives & Determination of the Course of Action;
3. Implementation;
4. Monitoring / Feedback and
5. Refinement.

The second component of Part A proposes the three following Decision Making Tiers:

- Strategic;
- Tactical and
- Operational.

Together 'Decision Pathway' and 'Decision Making Tiers' comprise Part A 'Decision Process Tracing'. This RSM is presented in Figure 3.3.

To address the second thesis research question, *'what is the role of natural coastal change information within this process?'*, literature addressing the role of information within environmental and coastal decision making and policy making was reviewed (Section 2.4). Additionally, literature concerning the science-practice interface was examined to facilitate an understanding of issues associated with the use of scientific information within both decision and policy making (Section 2.3). Key findings from these aspects of the Literature Review that directly informed the theoretical underpinning and construction of Part B were:

- All decision makers require information to inform the decision making process, this task information requires cognitive thought (Gilligan *et al.*, 1983; French and Geldermann; Skinner, 1989). The Cognitive Continuum theory proposed by Hammond (1978) suggests that there are two forms of cognitive thought, *viz* analysis and intuition (Hammond, 1978 cited in Willis, 1995);
- The literature suggests a relationship between decision maker cognition and decision structure (Willis, 1995; French and Geldermann, 2005);
- Payne *et al.* (1993) state that for some decision problems, the decision maker is required to balance expert judgement and choice with prior experience and knowledge;
- Fabbri (2002) states that coastal decisions exhibit a number of environmental decision making traits, including complexity with regard to temporal and spatial scales and interactions and inter-linkages with numerous stakeholders from multi-disciplinary fields;
- Decision complexity is regarded by Gilligan *et al.* (1993) as a function of decision frequency and structure;
- Kolkman *et al.* (2005) consider that all decisions and their associated choices to a certain degree are framed. Jasanoff and Wynne (1998) state that policy making is the product of interactions amongst the four distinct domains, academic, bureaucratic, economic and civic.

These key findings and propositions were translated into Part B of the RSM, entitled 'Decision Making Aid and Context'. This component presents hypothesised assertions regarding the role, and relationship, between task information used by the decision maker, referred to in the RSM as the level of 'Decision Support', and the complexity of decisions, referred to in the RSM as the level of 'Decision Structure'. The conceptualisation contains a hypothetical relationship illustrated as a spectrum between Decision Support and Decision Structure (Figure 3.3). The Decision Structure component considers external influences upon the decision making process, and comprises the following considerations:

- The level and extent of pathway framing and
- The routine nature and frequency of the decision.

Together these are used to determine decision complexity, ill-structured through to well-structured presented at either end of the spectrum (with ill-structured decisions being considered more complex in nature than well-structured decisions). The Decision Support component of the spectrum relates to the task information that the decision maker uses. This element of the RSM employs Hammond's (1978) Cognitive Continuum, with the two forms of cognition, analysis and intuition being located at opposing ends of the spectrum (Section 2.4.3). In its simplest interpretation, Part B of the RSM proposes a direct relationship (positive correlation) between ill-structured decisions (*i.e.* multi-disciplinary, multi-objective, infrequent, complex, and uncertain decisions) and the application of highly intuitive cognitive thought and judgement within the decision's task information (Decision Support).

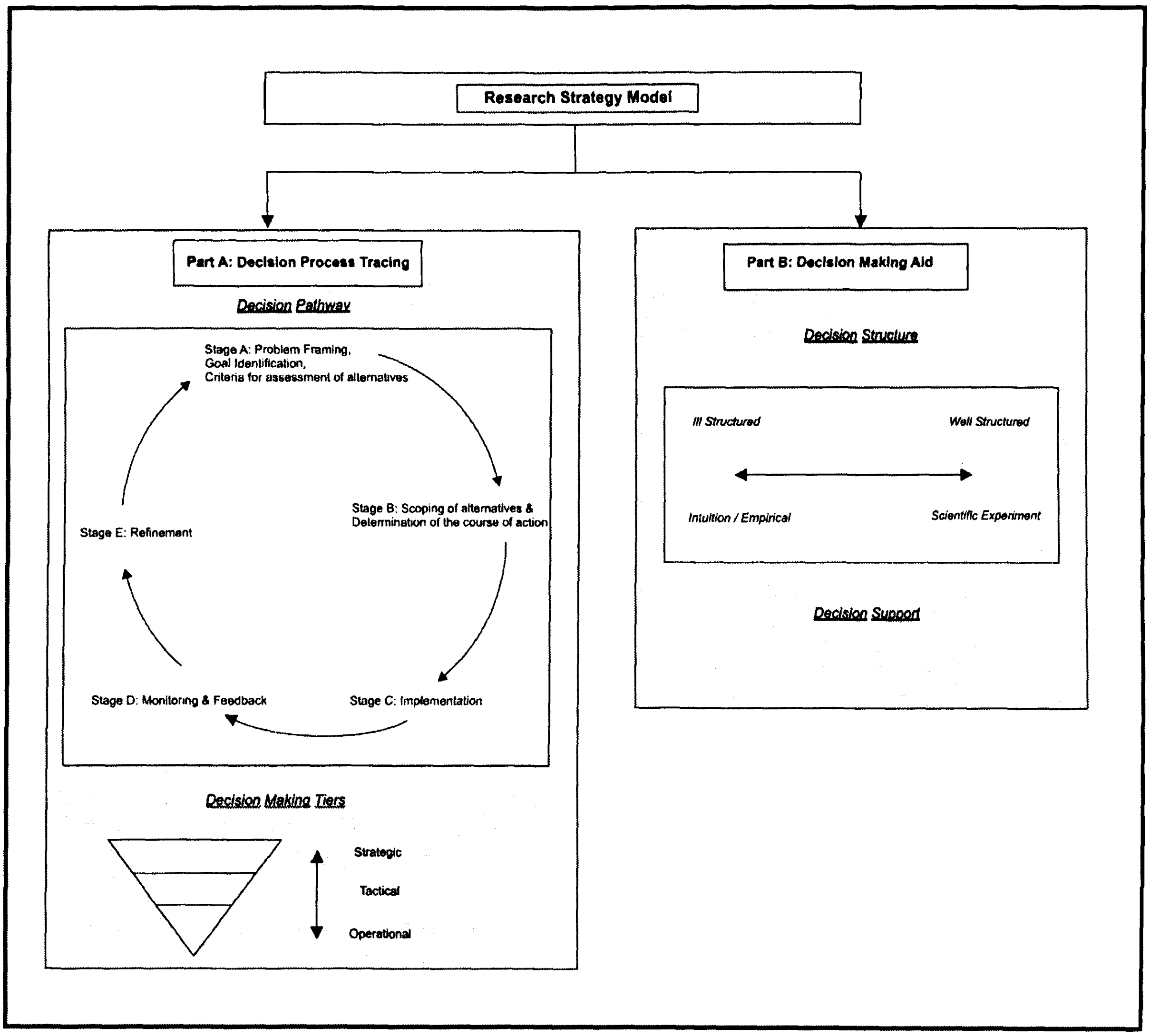


Figure 3.3: Research Strategy Model

Source: Original

To strengthen the RSM and take forward the thesis research, a series of Empirical Indicators were developed (Table 3.1). Empirical Indicators can be defined as a 'group of measurement items which are thought to measure the construct' (O'Leary-Kelly and Vokurka, 1998). In this instance, the RSM represents a number of constructs regarding decision making and the role of information within the process. The indicators translate and connect the RSMs underpinning theoretical propositions into research questions (Empirical Indicators - EIs) that can be applied to the real world, thus providing an empirical research lens. O'Leary-Kelly and Vokurka (1998, pg. 387) state, "The ability to correctly identify significant relationships among variables depends on our ability to adequately measure variables". The construction of EIs facilitates empirical assessment structured by the theory contained in the RSM.

The RSM EIs capture the findings and propositions reported earlier. The data generated by the application of these indicators to the empirical case study data allows for a comparison of the idealised decision making construct, as portrayed in the RSM, with that being investigated (Chapter Seven). Additionally and importantly, it uniquely allows for a detailed analysis and consideration of the role of information (evidence base) through appraising the potential impacts of decision context, complexity, uncertainty and other aspects of decision structure upon the decision maker's assimilation of task information (Chapter Seven).

Table 3.1: Research Strategy Model Empirical Indicators

RESEARCH STRATEGY MODEL: EMPIRICAL INDICATORS	
Part A Decision Process Tracing	Part B Decision Making Aid
Decision Pathway	*Decision Structure*
• Who is the decision maker being examined? • What is the context / sectoral domain of the decision being examined? • Are there discrete stages to the decision pathway and what stage is being examined? • Is the decision pathway connected to other decision pathways (past, present and future)? • Is the decision pathway connected with those occurring within other decision contexts / sectoral domains?	• Is the pathway of the decision cycle framed? • What is the frequency of this type of decision?
Decision Making Tiers:	*Decision Support*
• What level or scale of decision making is being examined? • Can the three scales of decision making, Strategic, Tactical and Operational, be identified within the examined decision context?	• What is the nature/characteristics of the task information involved? • What mechanisms (internal and external) were engaged to aid the retrieval and application of task information? • Do different decision making tiers require different task information? • Were aspects of the decision pathway aided by other sources in addition to task information? • What is the level of certainty regarding decision outcome?

3.3.2 Data Generation: The Multiple-Case Study Approach

The Research Strategy Pathway so far described in Section 3.3.1, detailed the generation of theory and associated development of the RSM (and supporting EIs). The next stage saw the selection of the case study approach for data generation purposes. As stated in Section 3.1, the suitability of qualitative research was aligned to the nature and context of the subject being examined, *i.e.* coastal risk decision making. In a similar vein, the selection and suitability of the case study approach aligns itself with both the 'hypothetico-deductive' approach and qualitative data collection techniques. The following quotation provides the underlying motivation and justification of this decision, "the great strength of the case-study method is that it allows the researcher to concentrate on a specific instance or situation and to identify, or attempt to identify, the various interactive processes at work" (Bell, 1987, pg. 6). Furthermore, the technical definition of a case study provided by Yin (2003, pg. 13) indicates the appropriateness of this approach for addressing the thesis' research questions, "an empirical inquiry that investigates a contemporary phenomenon within its real-life context...". The case study approach therefore provided the framework for examining the processes by which coastal risk decisions are made and the role of natural coastal change information within this real-life context. A case study protocol was developed that addressed a number of issues, such as data collection procedures and reporting, to ensure a systematic and organised process, guided strategically by the RSM.

An additional strength and flexibility of the case study approach is the ability to use a number of research methods and instruments, for example, interviews, field studies and questionnaire surveys. This multi-method strategy is considered to achieve a broader research perspective (Wolcott, 2001). Concomitantly, multiple-case studies can increase depth of study and allow greater generalisation with regard to findings if (within the varied circumstances of the case studies) common patterns can be identified (Yin, 2003). In essence, differing sources of evidence used in combination, can increase the justification and external validity of the research findings. Furthermore, Flynn *et al.* (1990) state the value of multiple-case studies for theory building and theory verification. In recognition of these merits, the thesis adopted a multi-method strategy with three case studies using both interviews and documentary analyses.

Figure 3.4 provides an overview these, highlighting the case studies' associated:

- geographical scale;
- decision making tier and
- survey instruments.

Whilst details of the specific aims and requirements of these are addressed in Sections 3.4 and 3.5, the goal of enquiry and rationale behind the use of the three case studies will now be provided.

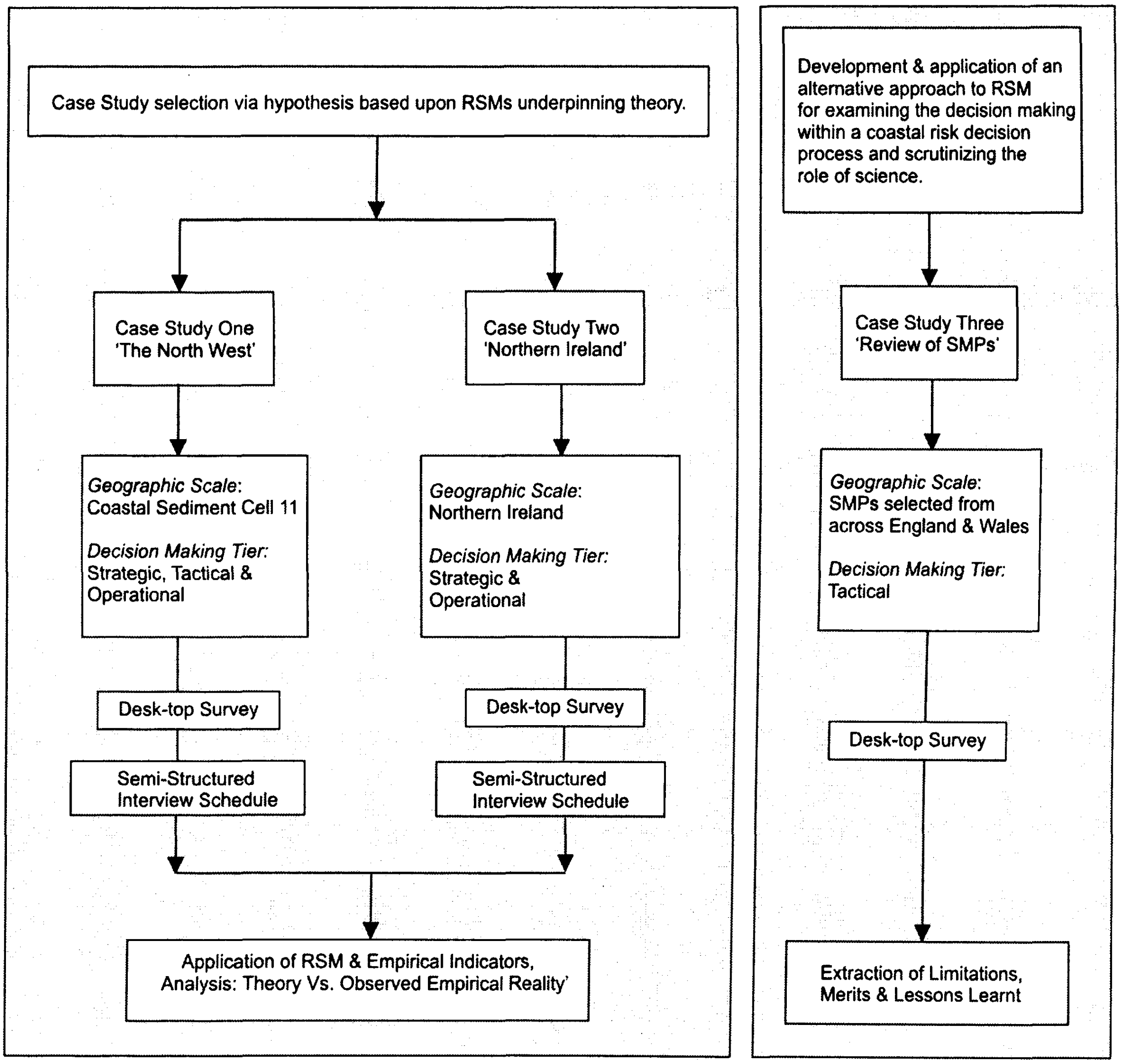


Figure 3.4: Overview of Multiple-Case Study Approach

Source: Original

The case study approach used three case studies, two geographically based (One and Two) and one, a documentary review (Three). All three concentrated upon coastal risk decision-making and the role of evidence base (specifically, natural coastal change information) within this process. The adopted multiple-case study approach facilitated the ability to examine the three tiers of decision making contained within Part A of the RSM (Strategic, Tactical and Operational). Sections 3.4 and 3.5 provide greater detail, however, in summary, the geographical case studies comprise empirical investigations of coastal risk at both Strategic and Operational scales, whilst Case Study Three presents a detailed review of a coastal risk decision making component that occurs at the Tactical tier.

In order to undertake the case studies, and to address the thesis objectives, the case studies employed two investigative approaches, *i.e.* in order to explore coastal risk decision making, two unique and divergent techniques were developed and applied. Case Studies One and Two were selected using a hypothesis-based approach stemming directly from the RSM to examine coastal risk decision making. Case Study Three in contrast, devised a prototype method for assessing the role of science within a coastal risk decision making process. The three case studies are inextricably linked by the two thesis research questions utilising contrasting research methods. The development of these methods was underpinned by the identification from the Literature Review (Sections 2.5.3 & 2.5.4), that no procedures or mechanisms exist to assess the role of science within a decision making process, in either general or coastal-specific terms. The methods devised were therefore exploratory, experimental and pioneering.

The intellectual puzzle of the thesis (Section 3.2; Figure 3.1) was used to structure and align the goal of enquiry of the three case studies in the following way:

- How do x and y work?
- What can we learn from comparing x and y?

With regards to the x and y in the first of these statements, they represent the process of coastal risk decision making (x) and the role of natural coastal change information (y) within each case study. The case study protocol ensured that comparable data were collected to facilitate this. The comparative aspect of the second statement saw the amalgamation and consideration of empirical findings from all three case studies to identify areas of distinction, similarities and recognisable themes and issues.

The rationale behind the selection of the geographically based case studies used the premise of gaining insight by considering extremes. The Literature Review (Section 2.5.3) discerned that within the United Kingdom, the approach to coastal risk differed notably in England and Wales compared to Northern Ireland. In particular, the review identified differences in government legislation and policy on coastal defence and coastal planning, development of strategic planning mechanisms, *i.e.* Shoreline Management Plans, and accompanying natural coastal change evidence base. Furthermore, it was ascertained that there had been greater strategic coastal defence research effort in England and Wales, as evidenced by Defra and the Environment Agency's Joint Flood and Coastal Defence Research and Development Programme. It was hypothesised that in those areas where no government coastal defence legislation, policy and Shoreline Management Plans existed, decision making processes would exhibit different traits; additionally, the role of science would differ in relation to the level of government investment on coastal defence-related matters. This hypothesis can be translated back to the RSM and the ends of the Decision Making Aid and Context spectrum (Part B, Figure 3.3). Using this hypothesis, Northern Ireland and the North West of England and Wales were identified as suitable geographical localities for case studies or 'test-sites'. In addition to political and administrative differences, they span a range of coastal environments with differing coastal processes hazards. Both case studies were designed to gather information to provide answers regarding how coastal risk decisions were made in particular localities and secondly, generate data concerning the role of natural coastal change information; both of which could then be compared and contrasted. Section 3.4 details the aim and specific data requirements, along with the methods undertaken.

Case Study Three whilst having geographic boundaries was framed and constructed through a documentary review and the development of a unique process of survey and content analysis to Shoreline Management Plans (SMPs). The focus of this case study was stimulated by the reviewed literature (Section 2.5.4). This identified that SMPs emerged in England and Wales in the mid-1990s as a new approach to coastal defence distinctively based upon coastal sediment-cell management. Their proclaimed merit in delivering sustainable shoreline management policies for fifty to one hundred year timeframes utilising natural coastal change information, such as, coastal processes and geomorphology, made the plans of significant interest and pertinent to the thesis' research questions. Furthermore, their key role in delivering coastal defence government policy in England and Wales befits concentration within a case study. This study devised an innovative approach to reviewing both the scientific basis and decision making transparency of the coastal defence management policies contained within the plans (Section 3.5). Moreover, as indicated previously, the examination of SMPs afforded the explicit consideration of the Tactical level of decision making not addressed in great detail within the geographical case studies. Whilst sediment-cell based management aligns itself to geographical boundaries, SMPs as planning documents represent the Tactical tier of decision making by translating government strategic policy and guidance into coastal defence policy recommendations at the Tactical tier of decision making.

3.3.3 Theory Reconstruction: Towards the conceptualisation of coastal risk decision making

Section 3.3.2 detailed the case study approach for data generation, entailing case studies which adopted two different techniques for interpreting and investigating the objectives of the thesis and associated research questions. This process produced empirically based data; the next stage of the research process involved explaining and understanding these findings within a conceptual framework. Known as critical thinking, the activities of connecting, clarifying, reflecting, inferring and judging, were engaged within the process of data interpretation (Mason, 2002). The move between hypotheses, data and causal findings and explanation must be seen within the wider context of the 'hypothetico-deductive method', adopted by the thesis that led to the case study approach being selected.

Central to the thesis Research Strategy Pathway has been the generation of theory and the hypothesis designed for the selection of the geographical case studies (Section 3.1; Figure 3.2). As theoretical considerations may appear abstract, the design of the Research Strategy Pathway recognised the need to establish congruity between theory and reality. May (2001) notes that the ability to locate research findings from a specific field or discipline within a more general body of theory, *i.e.* to transcend one area and make links with other, can be regarded as abstraction from theory to social realities and wider contexts. Interestingly, this author asserts there is more to assessing social theory than just assessing it in terms of its empirical utility. For example, the logical coherency and the insights provided can be more constructive and productive in research terms.

The Research Strategy Pathway took the thesis research forward using the premise of the 'hypothetico-deductive method', in which theories are tested for truth or falsity by empirical observation and experimentation and then modified (Mason, 2002). In research, theory is generally set against practice; if theory were to be considered as abstract ideas about a phenomenon, then practice would be the action of 'doing something' (Handfield and Melnyk, 1998). Interestingly, Handfield and Melnyk (1998, pg. 321) state, "Without theory, empirical research merely becomes data-dredging". The selection of hypothesis-based geographical case studies generated empirical data (from the real world) on the practice or 'reality' of coastal risk decision making in England, Wales and Northern Ireland, thus, reflecting the two research questions. The application of the RSM EIs (Table 3.1) to case study findings is proposed as the testing of the hypothesis within the examined localities by evaluating decision making processes and the role of science in coastal risk decision making. As Handfield and Melnyk (1998, pg. 321) observe, "...empirical research, is after all, the most severe test of all theory and research". This comparative aspect was driven by the investigate puzzle of the thesis and by the multiple-case study approach. Flowing from these analyses were findings regarding the nature of the observed phenomenon in comparison to the theory proposed in the normative decision making process contained in the RSM. Information regarding the validity of the RSMs theoretical basis facilitated the development or 'reconstruction' of theory regarding coastal risk decision making. Concurrently, this process of theory modification was enhanced using findings from the third case study, in which the merits, limitations and lessons learnt concerning the applied of the methods utilised, were extracted.

3.4 Case Studies One and Two

The geographical case studies (Figure 3.5), as stated in Section 3.2, utilised a hypothesis-based approach to select localities that exhibited opposing decision making coastal risk management structures and processes. The overview of the case study approach (Figure 3.4) and the strategic discussion (Section 3.3.2) will now be expanded to provide the detailed methodology and evidence base of the geographical case studies. Case Study One is referred to as 'the North West case study' and Case Study Two 'the Northern Ireland case study'.

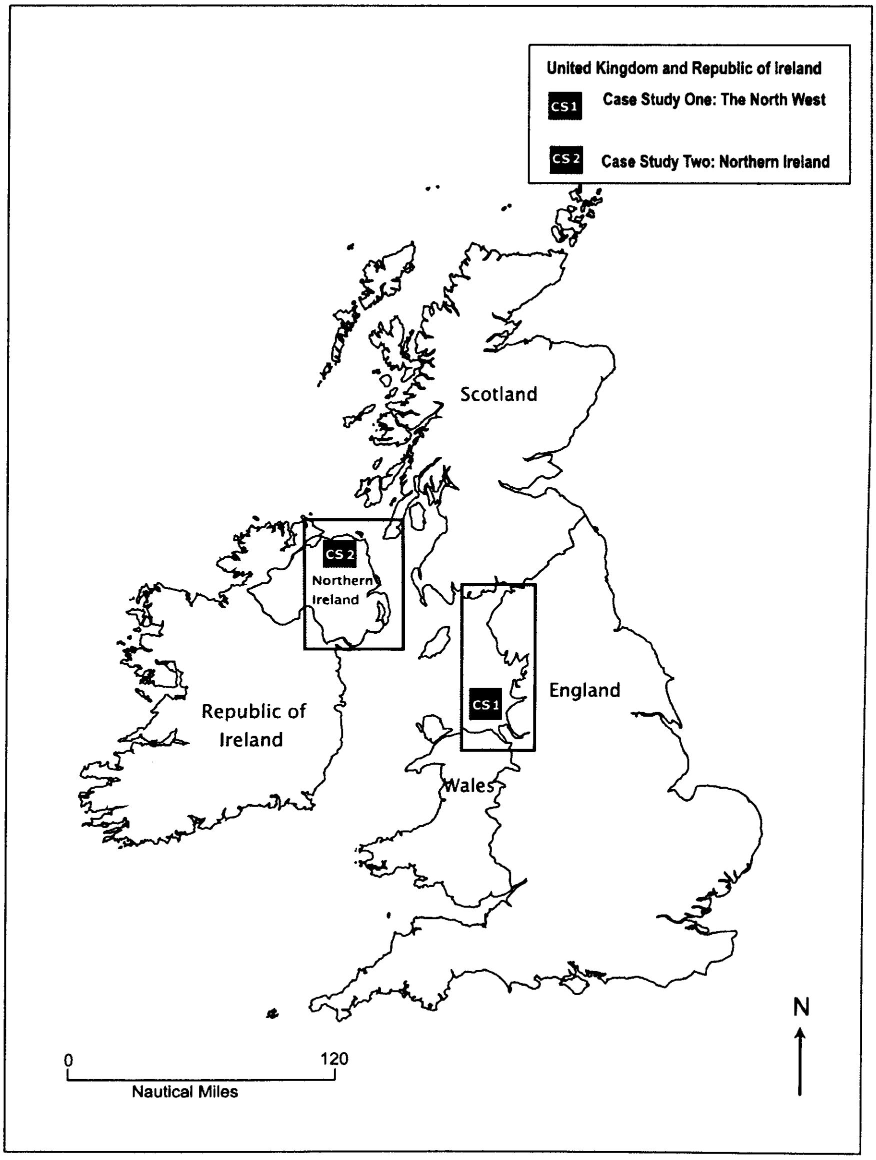


Figure 3.5: Geographical Case Study Locations

Source: Original

3.4.1 Data Requirements and Case Study Characteristics

The North West and Northern Ireland case studies, using mirrored research instruments (semi-structured interviews and documentary reviews) examined in detail the coastal risk decision making frameworks and the associated natural coastal change information evidence base. To fully explore the full range and components of coastal risk decision making, the coastal defence and coastal planning sectors were examined both individually and cross-sector to identify inter-linkages pertaining to coastal risk decision making.

The specific data requirements of both case studies were as follows:

- Identification of the coastal defence and coastal planning legislative and policy frameworks;
- Examination of the coastal defence and coastal planning operational landscape, including the implementation interface between the two sectors;
- Detailed review of documentation relating to coastal planning and coastal defence;
- Assessment of coastal defence and coastal planning decision making (legacies, drivers and policy directions; past, present and future) and
- Identification of the natural coastal change evidence base utilised by coastal defence and coastal planning decision makers.

The strategic case study data requirements were then considered to identify the most suitable method for gathering data, *i.e.* primary or secondary sources. This was then translated into data collection tasks of either documentary reviews or interviews. For example, *the identification of the coastal defence and coastal planning legislative and policy frameworks* within the case studies was possible and appropriate to desk-based documentary reviews as the data collection method. In contrast, *the identification of the natural coastal change evidence base utilised by coastal defence and coastal planning decision makers*, required the development of interview schedules with a range of stakeholders involved in aspects of coastal defence and coastal planning, such as, coastal planners and coastal engineers.

The North West case study (Chapter Four) was defined by the boundary of coastal sediment cell eleven that stretches from the Great Orme in Wales northwards up to the English-Scottish border of the Solway Firth. This encompasses some of the UK's largest estuaries, numerous ports and sea-side resorts and other water-front developments. Significant stretches of this 1100 km coastline are artificially defended from coastal risks, such as flood and coastal erosion risk. Furthermore, much of the area is at risk from sea-level rise and there is a history of significant flood events in parts of the region. This locality contains the Dee Estuary that is administratively divided between Wales and England; consequently this cross-border aspect amplifies the complex and multi-layered coastal risk decision making framework in place, administered nationally, regionally and locally by numerous Operating Authorities.

Case Study Two (Chapter Five) addressed coastal risk decision making throughout Northern Ireland. This coast is similar to the North West with respect to its vulnerability to continued pressures from substantial commercial and recreational activity. However, the 650 km coast exhibits different geological and geographical attributes, with large scale flooding rare and coastal erosion only a localised phenomena, and as such, perceived as a minor concern to government.

3.4.2 Semi-Structured Interview Schedule

The use of interviews for data collection was considered to be the most appropriate method, when compared to other possible methods, such as questionnaire surveys and participant observation. The merits of interviews include:

- The high response rate compared to postal or Internet surveys (May, 2001);
- The data being sought were of an explanatory nature and therefore best suited to interview rather than questionnaire survey (May, 2001);
- The depth and complexity of the data being generated did not suit translation into predeterminable categories; the interview process allowed the interviewee to talk at length and provide strong and clear explanations to questions (Bell, 1987);
- The ability of the interviewer to substantiate answers and the possible collection of supplementary documentation (Yin, 2003) and
- The adaptability of the interviewer to probe responses and gauge and investigate interviewee feelings on key issues (Bell, 1987).

In contrast, Yin (2003) establishes the following weaknesses with interviews as a source of case study evidence:

- Bias through poorly structured questions;
- Response bias;
- Reporting errors and
- False information provided by interviewee.

In addition to these weaknesses, there are various assumptions implicit within the interview technique. For example, the interviewee may not be open and honest and understand the meaning of the questions being asked of them. These issues and concerns were considered in the design and development of the interview schedule; interview structuring, interviewee selection and briefing and transcription practices will now be discussed.

3.4.2.1 Structure and Medium

Of the four interview types available, (structured, semi-structured, unstructured and group interviews), a semi-structured interview schedule with specific themed questions offers the greatest number of strengths. Regularly cited advantages of semi-structured interview include, the ability to seek clarification and elaboration on the answers given that can increase the qualitative depth of the data generated, whilst allowing for standardisation and comparability (Bell, 1987; May, 2001; Mason, 2002). Furthermore, the selection of a semi-structured interview schedule was favoured due the qualitative and ontological perspective of the thesis. As stated in Section 3.2, the ontological perspective necessitated that data be recorded in context. Additionally, the epistemological position required that situated and meaningful knowledge be produced by the interview process. For example, by constructing questions that were situational and specific and not abstract, interviewees were able to provide contextual knowledge and experiences (May, 2001; Mason, 2002).

The medium of the interview (in person, by telephone and over the Internet) varied between Case Studies One and Two. The forcing factors (and constraints) upon this decision were predominantly related to cost and time. The North West case study gained an external funding grant (Crown Estate Marine Stewardship Fund) that facilitated two phases of travel and face-to-face interviewing. The Northern Ireland case study benefited from its participation in the European Interreg IIIB 'COREPOINT Researcher-Exchange Programme'. Whilst being hosted by academics at the University of Ulster, Coleraine campus in Northern Ireland, telephone interviews were conducted due to time constraints and the prohibitive costs of face-to-face interviews.

3.4.2.2 Sampling and Piloting

The use of interviews as a research instrument is dependent upon the good will and availability of interviewees. Such matters can be a constraining factor in the selection of potential participants (Bell, 1987). The research design of both case studies had desired target samples, with every effort being made to have representative and corresponding sample populations, where possible.

To address the first research question (Section 3.1) and fully explore coastal risk decision making, interviews were conducted with those decision makers involved in various aspects of coastal risk management. These included local and central government bodies and agencies with statutory and permissive coastal defence and coastal planning responsibilities. To explore the second research question in a wider context, interviews were also conducted with engineering consultancies and Higher Education establishments, in order to explore coastal-related scientific networks. Table 3.2 presents the interviewed respondents for both case studies. Table 3.3 contains an overview of the interview questions used. Appendix A1 contains Case Study One interview documentation and interview questions. Appendix A2 contains Case Study Two interview questions.

Table 3.2: Semi-Structured Interview Schedule

Case Study:	**North West**	**Northern Ireland**
Interview Medium:	Face – to – Face	Telephone
Conducted:	Two Phases: March 2007 & February 2008	Two Phases: December 2007 & September 2008
Institutions Surveyed:	• 11 Local Authorities • 3 Government Agencies • 1 Higher Education Institution • 3 Engineering Consultancies • 3 Coastal Group Chairs	• 9 Local Authorities • 5 Government Departments • 1 Higher Education Institution
Individual Interviewees:	• 20 Local Authority Officers • 4 Government Agency staff • 1 Academic • 4 Consultants	• 9 Local Authority Officers • 6 Government Agency staff • 2 Academics
Total Interviewees:	29	16

Table 3.3: Case Study Interview Question Sets

Case Study One Interview Questions:	**Case Study Two Interview Questions:**
• Local Authority Engineers	• Local Authority
• Local Authority Policy Planners	• Rivers Agency
• Consultancy Firms	• Planning Service
• North West Regional Assembly	• Translink
• Natural England	• Environment and Heritage Service
• Environment Agency	• Department of the Environment

• Coastal Group Chairs	• Higher Education
• Higher Education Institution	

An important undertaking within the design of the semi-structured interview schedule was the conducting of a pilot survey and subsequent pilot interviews, in line with good research design practice (Robson, 1993; Flynn *et al.*, 1990; Mason, 2002). Due to the nature of the research questions and the absence of applicable methodologies and assessment techniques regarding the role of science in decision making, there was a need to identify forms of coastal risk decision making in the United Kingdom and to explore mechanisms that could probe the evidence base and its use by decision makers. Whilst desk-based documentary reviews provide a strategic understanding of the processes and institutions involved, an understanding of how decision makers utilise information in specific coastal risk decision making instances was also required. Visiting an English coastal Local Authority (Sefton Borough Council) coastal defence team for several days in Summer 2006 to conduct the pilot survey facilitated this understanding and awareness. Using predominantly unstructured questions, discussions were carried out with the Local Authority coastal Engineer, an Information Officer and a Research Assistant. A wealth of information emanated from these discussions. This included, *inter alia,* the range of coastal risk management activities and decision making for this stretch of coast, the types of information that may be used in this process, as well as the governing structures, frameworks and institutions.

The pilot survey confirmed the choice of semi-structured interviews for the majority of data collection, along with the use of documentary evidence (Section 3.4.3). The pilot survey also highlighted the role of both coastal defence and coastal planning within coastal risk management, and confirmed that interviews with engineers and planning officers were essential. The content and mapping of the interview format and content was then undertaken. Once prepared, two pilot interviews were undertaken to trial proposed questions to determine their suitability, the range of responses and to estimate interview length. Stemming from this, several changes were made, including the clarification of some questions, and importantly comments from the pilot interviewees regarding interview format and the order of questions.

As previously stated, the semi-structured interview schedule utilised a certain level of structuring. This translated into interview questions being grouped into central themes that facilitated standardisation of data and allowed comparability, *viz*:

- Interviewee personal background questions;
- Organisation-specific questions and
- Natural coastal change information-related questions.

Interviewee briefing outlined the interview layout and themes of the questions. Additionally, during the interview, transition statements were used to alert interviewees of changes of themes. For interviewees within local and central government for example, a consistent pattern regarding interview layout and question themes was utilised. This commenced with questions regarding personal information, (for example their background and training, length of time with the organisation), before moving on to institution-specific questions regarding the type and range of coastal risk activities undertaken. The next theme addressed the science involved in their coastal risk activities, for example, coastal monitoring and commissioning of coastal-related research. Higher Education and engineering consultancy interviews followed a similar pattern, starting with personal information progressing onto questions regarding the extent of their coastal-related research activities. In the case of consultancies, this explored the range of services offered and their client base.

Interviewee selection and response rates varied between Case Study One and Two (Table 3.2), due to two aspects of the coastal risk management *modus operandi*. Firstly, the smaller size of the area reduced the number of potential suitable interviewees in Northern Ireland. Secondly and more importantly, the absence of government legislation and policy on coast protection matters, meant that the identification process of suitable representatives was complicated and time consuming. It relied upon recommendations of academics at the University of Ulster. Of the twelve coastal Local Authorities in Northern Ireland, only nine government officers felt comfortable answering coastal risk related questions, largely due to peripheral role of such coastal matters with Local Authorities. In comparison, of the twelve coastal Local Authorities in the North West case study, twelve coastal engineers were readily identifiable, with eleven choosing to participate. In contrast, a greater number of government personnel were interviewed in Northern Ireland reflecting the greater role and responsibilities of this tier. In light of these institutional differences and constraining factors, the response rate and range of interviewees were considered adequate, balanced by the depth of information gathered and supporting documentary evidence.

Once interviewees agreed to participate, they were briefed *via* email prior to face-to-face interviews, or verbally over the telephone at the time of the interview. The written documentation used in the North West case study established what was expected from the interviewee following good practice (Bell, 1987) (Appendix A1). This informed them about the interview structure, purpose, context, expected duration and recording (tape-recorded with permission). With regard to the latter of these, it was explained that interview transcriptions would be sent to interviewees post-interview for verification. The interviewee was also informed that the interview relied upon them sharing their knowledge, experience and personal views and that there were no correct or incorrect answers. This fostered a situation in which the interviewee felt comfortable, with full confidentiality. To ensure interviewee confidentiality it was felt necessary, in light of the nature and sensitivity of some questions, to use anonymous, non-attributable quotations in the thesis.

3.4.3 Desk -Top Audit and Review of Planning Documents

To strengthen the case studies and the data generated from the semi-structured interviews, a range of documentary evidence was examined. This entailed an extensive desk-based analysis of government-produced documents, including policy documents and operating guidance relating to coastal risk. Additionally, coastal risk-related documents were gathered and reviewed.

To reflect the critical importance of statutory planning documents to coastal planning decision making, an audit and review of existing planning documents, including both regional and statutory local plans, was undertaken in both case studies. A review proforma was devised and applied consistently to all reviewed plans. An extract of this is contained in Table 3.4, with the full document displayed in Appendix A3. The development of this proforma was informed by the academic and 'grey literature', most notably that by Taussik (1996) and Ballinger *et al.* (1995). These focused upon surveys of development plans in England and Wales in 1993 and development plans in Wales in 1995, respectively. A key objective of the review was to ascertain the coastal content of planning policies within the documents. Whilst land-use planning is limited to land above the Low-Water Mark, coastal planning in England and Wales is undertaken principally by Local Authorities and their adopted development plan documents. These plans are the principal means of avoiding and reducing flood and coastal erosion risk to and from new development (Taussik, 1995). Similarly, in Northern Ireland, land-use planning is guided principally by Area Development Plans produced by the Planning Service. Accordingly, the proforma sought to identify policies relating to coastal erosion, flood risk and risk avoidance and mitigation. Additionally, policies pertaining to coastal defence and shoreline management planning where sought to examine the interface between coastal planning and coastal defence / coastal risk management. Furthermore, the supporting scientific evidence base of identified coastal-related policies was appraised in line with the second research question. This included geographically presented information on aspects of coastal risk, such as, flood maps and areas of coastal erosion.

In total, Case Study One reviewed seventeen regional and local planning documents (comprising Regional Spatial Strategies, Structure Plans, Local Plans and Unitary Development Plans). Case Study Two reviewed six Area Development Plans for the twelve coastal Local Authorities (Table 3.5). Plans were accessed (where possible) online from Local Authority or central government websites, and, where not available online, accessed in hard copy. Table 3.6 contains reviewed plans associated with both case studies.

Table 3.4: Extract from Planning Review Proforma

Explicit Policies on:-
• Policies which **restrict development** in areas at **risk** (tidal flooding, coastal instability and coastal erosion)
• Policies relating to the need for coastal defence and land drainage **considerations** to be taken into account for development in areas at **risk**
• Policies which include requirements for measure to **mitigate risk**
• Policies which refer specifically to development which may **interfere** with coastal defence work
• Policies which **relate directly** to **proposed coastal defence work**
• Policies which refer to potential **effects** of development on **coastal process**
• Policies which refer to shoreline management plans, catchment flood management plans, coastal habitat management plans
AND / OR policies that refer to:-
• Development and coastal erosion
• Development exacerbating flooding (sea/tidal/river)
• Development in flood risk areas
• Development and coastal / fluvial defences
N.B. If Supplementary Planning Guidance exists, the above points are to be considered in relation
Others aspects commented upon where present:-
• Coastal chapter or section
• Definition of coastal zone
• Reference to Coastal Partnerships and/or their strategies
• Reference to the Precautionary Principle
• Maps:- coastal zone, flood zones, coastal erosion

Table 3.5: Reviewed Planning Documents

NORTH WEST CASE STUDY		
Planning Authority	**Document Title**	**Plan Status**
Conwy County Borough Council	Gwynedd Structure Plan	Adopted 1993
	Colwyn Borough Local Plan	Adopted March 1999
	Conwy Unitary Development Plan Written Statement	Consultation Draft April 2001
Flintshire County Council	Flintshire Unitary Development Plan 2000-2015	Deposit Draft 2003
Denbighshire County Council	Denbighshire Unitary Development Plan	Adopted 2002
Wirral Metropolitan Borough Council	Wirral Unitary Development Plan	Adopted 2000
Sefton Metropolitan Borough Council	Sefton Unitary Development Plan 2006	Adopted 2006
Wyre Borough Council	Wyre Local Plan 1991-2006	Adopted 1999
Lancaster City Council	Lancaster District Local Plan 1996-2006	Adopted 2004
South Lakeland District Council	South Lakeland Local Plan	Adopted 1997
Barrow Borough Council	Barrow Local Plan Review 1996-2006	Adopted 2001
Copeland Borough Council	Copeland Local Plan 2001-2016	2nd Deposit Version 2005
Allerdale Borough Council	Allerdale Local Plan	Adopted 1999
	Allerdale Local Plan First Alteration	Adopted June 2006
North Wales Regional	Regional Planning Guidance for	Adopted October 2002

Planning Group	North Wales	
Government Office for the North West	Regional Planning Guidance for the North West	March 2003
North West Regional Assembly	The North West Plan: Submitted Draft Regional Spatial Strategy for the North West of England	Submitted January 2006

NORTHERN IRELAND CASE STUDY

Local Authority	**Planning Service applicable plan**	**Plan Status**
Derry City Council	Derry Area Plan 2011	Adopted May 2000
Limavady Borough Council Coleraine Borough Council Moyle District Council	Northern Area Plan 2016	Draft Plan May 2005
Larne Borough Council	Larne Area Plan 2010	Adopted March 1998
Carrickfergus Borough Council Newtownabbey Borough Belfast City Council North Down Borough Council	Belfast Metropolitan Area Plan 2015	Draft Plan November 2004
Ards Borough Council Down District Council	Ards and Down Area Plan 2015	Draft Plan December 2002
Newry & Mourne Council	Banbridge / Newry and Mourne Area Plan 2015	Draft Plan August 2006

3.4.4 Analysis

The reporting of a case study, *i.e.* the presenting of results and findings is greatly determined by its composition (Yin, 2003). As indicated in Sections 3.3.2 and 3.3.3 and illustrated in Figure 3.2, each of the results chapters present case study findings using a deductive approach (Chapters Four, Five and Six). In recognition of the multiple-case study approach and the multiple methods (Section 3.4.2 and 3.4), the composition of case studies utilised a standard structure and data reporting within these chapters.

The approach to the data analysis from the semi-structured interviews and desktop surveys utilised a two-phased analytic technique. For example, in addition to the reporting of the individual case studies within Chapters Four to Six, a further chapter conducts a cross-cutting case study synthesis and comparative analysis (Chapter Seven). This chapter makes connections between the findings, the methodologies employed and the theory constructed prior to the generation of empirical data.

3.5 Case Study Three

In addition to the two geographic case studies, a third case study, referred to as 'Review of SMPs', was undertaken (Chapter Six). Using a different and experimental approach compared to the other case studies, a prototype method was devised. This traced coastal risk decision making and role of science within a selection of SMPs from across England and Wales.

3.5.1 Development of Survey Instruments

The methods devised for the review are regarded as distinctive and innovative. Firstly, at the time of survey, no similar assessment had been undertaken with regards to SMPs and secondly, no other assessment framework to examine the role of scientific information within coastal decision making was found within the literature.

In light of this, a wide range of literature (coastal and non-coastal areas) was reviewed for appropriate knowledge and understanding of approaches for undertaking documentary reviews and assessment, including the use of checklists, criteria, proformas for recording information and the creation of classifications, grading systems and standards. This included the work of Harrop and Nixon (1999), Hirst (2001) and Budd (1998) into aspects of quality assurance within environmental assessments, the quality of Environmental Statements used in the context of the offshore oil and gas industry and coastal and marine Strategic Environmental Assessments, respectively. Gallagher's (2006) development of a Coastal Sustainability Standard was consulted with regard to the development of classifications and grading systems used for the allocation of the Coastal Sustainability Standard to Coastal Partnerships in the UK. Also, within the coastal context an important piece of research was Potts' (1999a) work examining the information needs of Coastal Groups in England and Wales. Not only was this a similar topic area, this research offers insight into the types of information that may be encountered within an SMP, such as coastal processes data, land ownership data, legislation data, geomorphological data and natural heritage data. Secondly, this body of research provides insight regarding the availability, quality and management of information, all of which has a bearing on the SMP process.

3.5.2 Review Components

The aim of the review was to examine the scientific underpinning and transparency of SMP decision making. In order to do so, the Strategic Coastal Defence Option (SCDO) aspect of each plan (*i.e.* the section of the plan containing the allocation of coastal defence option to a shoreline division) was assessed. The review devised and applied two survey proformas (*Preliminary Assessment* and *SCDO Grading*) (Figure 3.6). The utilisation of proformas allowed a systematic and consistent system within the review process for the collection of information from the SCDOs. The first proforma (*Preliminary Assessment*) was used to collect contextual information about the plan, *e.g.* SMP and SCDO-specific information.

To further the review of SMPs by examining emerging patterns in greater detail, another phase of SCDO analysis was undertaken. Using the second proforma (*SCDO Grading*) each SCDO underwent a:

- grading and assessment of its scientific basis and underpinning and
- grading and assessment of its decision making transparency and justification.

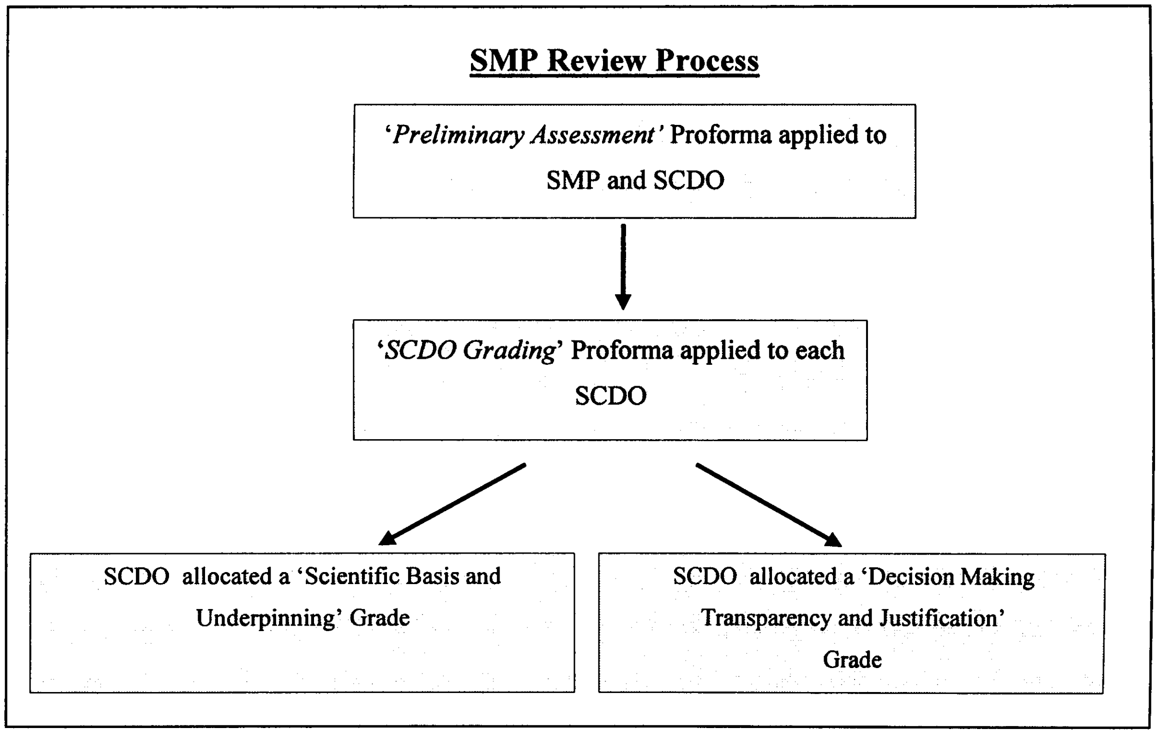


Figure 3.6: SMP Review Process
Source: Original

3.5.3 Selection of Plans and Analysis

The reviewed plans were selected based on a number of criteria, including geography, date of issue, types of coastal defence policies and the consultancy firms commissioned to develop them. This survey sample provides a representative range of plans prepared around the coast of England and Wales between 1995 and 2007. In total seven SMPs were reviewed, this saw twenty individual SCDOs graded for scientific underpinning and decision making transparency and justification. Selection criteria and corresponding SCDOs grades were cross-referenced and analysed to identify potential influencing factors. For example internal and external forcing factors on the scientific underpinning. In doing so, the review critically appraised the coastal risk decision making processes and the natural coastal change evidence base of these plans. It presents insight into the application and presentation of natural coastal change information, as well as the clarity and visibility of the decision making process related to coastal risk management policies within these plans.

3.6 Methodological Limitations

This section is organised into three sub-sections according to the boundaries of the research, limitations considered to be of a geographic and methodological nature.

3.6.1 Research Boundaries and Parameters

From the outset, the aim and objectives of the thesis imposed a number of boundaries upon the research, in particular those set by concentrating upon coastal risk decision making. The coast is a highly congested and contested space; consequently, decision making occurs within many different spheres and sectors, some operating autonomously of each other, others in a more integrated manner. The approach to the management of coastal risk relates to the latter, taking a holistic perspective to assessing and management of coastal hazards by numerous bodies. Coastal risk management as a particular realm of decision making, therefore, concerns itself with a number of decision makers, most notably engineering and planning (Section 2.5.3). Consequently, the thesis focused its efforts upon identifying, where present, coastal engineering and coastal planning activities and sought to explore the decision making process internally within these areas and the integration between them. In doing so, the thesis has not sought to investigate coastal decision making as whole, or all decision makers for several reasons, most notably that just highlighted due to the focus of the aim and objectives of the thesis, but also, it is suggested that this vast expanse of management does not align itself to the scope of a singular PhD research project. Coastal risk can be considered as a lens with which to focus or 'zoom in' on one area of coastal decision making. However, this is considered as being the boundary of the research.

The emphasis on the role of science within the thesis presented the need to define its parameters, due to the potential vast scope and mis-interpretation of the term 'science'. As the thesis concerns coastal risk, the affiliated science was investigated. The work of Potts (1999a) and Pettit (1993) in examining the information needs of Coastal Groups and the management of coastal erosion and flooding in England and Wales, respectively, provided the basis for determining coastal risk science as being predominantly natural coastal change information (Section 2.6.2). However, it is fully recognised that within decision making other forms of scientific information exist and may be used, for example, the social sciences and humanities.

3.6.2 Geographical Limitations

The geographical coverage of Case Studies One and Two, whilst encompassing significant parts of England, Wales and Northern Ireland, did not cover Scotland. The inclusion of a case study examining the coastal risk decision making occurring within this devolved administration would have strengthened the research in a number of ways. Firstly, it would have introduced a different geographical and geological locality. Resulting in a coastal system facing a number of contrasting pressures and coastal hazards to those in England, Wales and Northern Ireland, including intensive fish farming and intricate systems of sea lochs, open coastal systems and Firths. This may have borne interesting decision making examples that would have added to the construction of coastal risk decision making conceptualisation. Secondly, it would have facilitated the presentation of a UK-wide picture of coastal risk decision making. However, due to time, cost and constraints associated with the research being undertaken by a single researcher, the selection of a smaller geographical scope is considered valid.

An additional geographical-related limitation is specific to Case Study Two. This concerns the selection of the North West as a case study site. The use of this area as a representative part of the England and Wales was considered in terms of the presence of coastal hazards, management responses to these and the underpinning natural coastal change evidence base needs. Questions remain as to whether findings can be up-scaled up to those of England and Wales. However, observed practices in this locality can be compared with those undertaken elsewhere, for example *via* consideration of North

West European research project 'Eurosion' (Doody *et al.,* 2004). Key outputs from Eurosion include documents detailing current and historical coastal defence-related activities of North West European Member States; these can be used to benchmark coastal risk management activities in the North West.

The selection of SMPs in Case Study Three whilst, containing a number of plans from a wide geographical scope, had the potential to increase its coverage. For example, the inclusion of a SMP from each of the eleven coastal sediment cells in England and Wales. The use of plans from Sediment Cells One (b,c and d), Three (b), Eight (b) and Eleven (a,b,c,d,e,) in the review however, is considered to be a representative sample using a number of criteria (Section 6.5.3). The greatest limitation of this review was the accessibility of these documents, either in hard copy or electronic form, was found to be extremely variable and required considerable time and effort, thus constraining the inclusion of more plans in the review.

In light of the above, the review acknowledged that the representative sample of SMPs would facilitate the objective of the review. That is, the application of an experimental method for examining the role of science (natural coastal change information) within a particular coastal risk decision making process, *i.e.* shoreline management planning in England and Wales that is facilitated *via* SMPs.

3.6.3 Methodological Limitations

The multiple-methods used within the three case studies each have their own distinctive limitations. Section 3.4.2, for example, noted those concerning the use of interviews. Common to all case studies was the use of documentation as a source of evidence; this translated into a wide range of documents, that included *inter alia,* government documentation, administrative reports, commissioned studies and formal pieces of research undertaken by academics, consultants and practitioners. Whilst the previous section expounded access issues arising from the undertaking of a documentary review within Case Study Three, two significant weaknesses regarding the use of documentation are cited by Yin (2003) and May (2001). As such they are acknowledged as noteworthy methodological limitations; these are biased selectivity and reporting bias. With regard to the first of these, biased selectivity, the supplementary documents and literature used in the case studies and the Literature Review, are not considered to be totally exhaustive. Whilst the large volumes of material have been taken from a variety of sources, including a number of academic disciplines (including many peer-reviewed documents), commercially produced material (by consulting firms) and government ('grey literature'), they are not considered to be an acutely selective sample. However, in all cases systematic searches for relevant documents were undertaken. It is the second limitation however, the reporting bias, that causes most concern; the potential for unknown bias by the author was critically considered when using documentary evidence. This was particularly borne in mind when extracting information from government-related sources, for example, whilst the review of planning documents (Section 5.4.3) identified that the Precautionary Principle was present within some coastal-related planning policies in statutory plans, interviews within Planning Policy Officers did not corroborate this. Similarly, commissioned documentation produced by consulting firms was also used critically, especially due to concerns of neutrality and legitimacy. Furthermore, documentary evidence was considered in the same light as the ontological perspective of the thesis, *i.e.* socially constructed and contextual (the result of a social process).

At a more strategic level, methodological limitations pertain to the predominantly qualitative nature of the thesis. Many texts detailing the techniques and applications of qualitative methods, extol the strengths and merits of qualitative researching whilst simultaneously presenting warnings regarding the many challenges, limitations and criticisms that it can receive (for example: Mason (2002)). Mason (2002) cautions those operating a combination of research instruments and using different forms of analysis. Furthermore, critical thinking and the act of reflexivity is advised. As such, critical thinking has been used to evaluate the validity, reliability and importantly, the credibility of the research process undertaken. These methodological aspects will now be addressed.

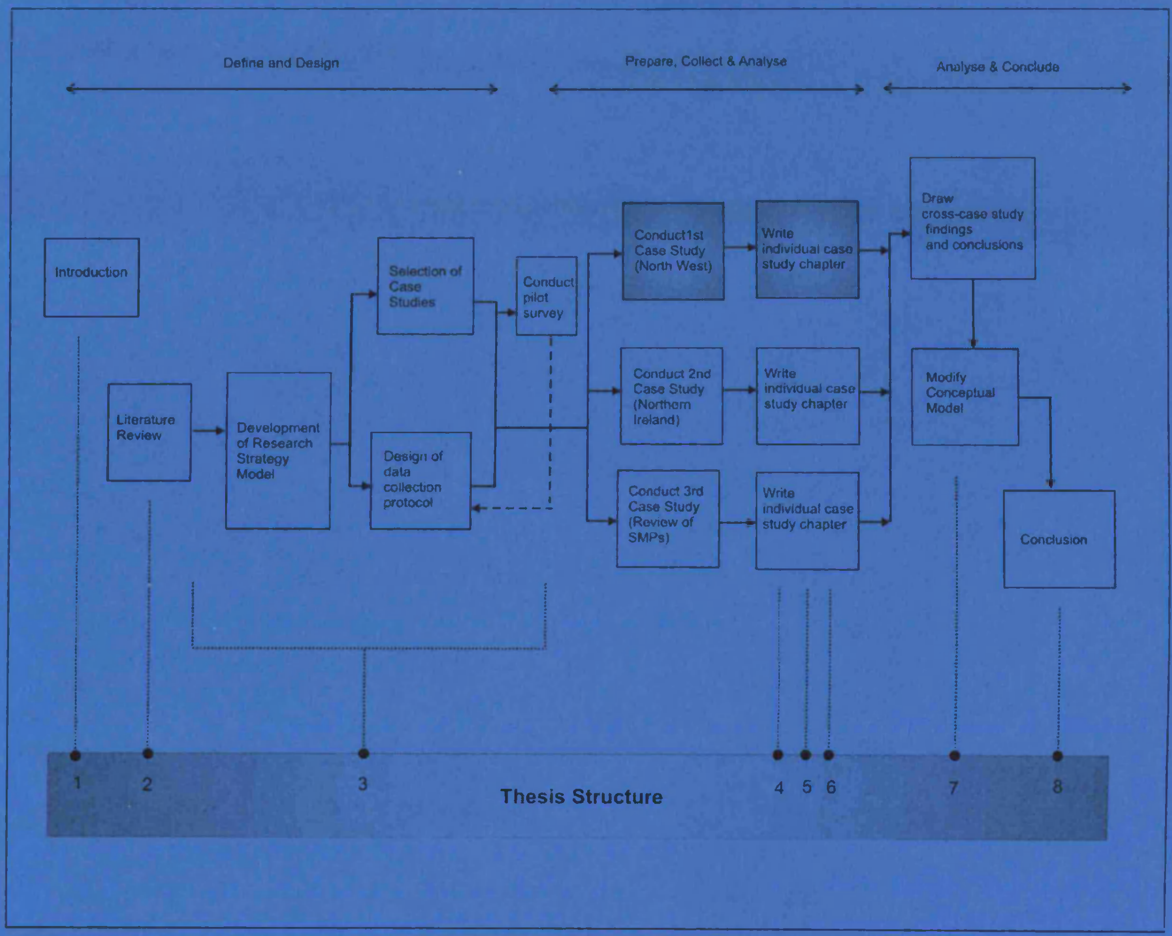
The reliability of the research methods and techniques (*i.e.* how accurately they produced data) is a consideration when utilising quantitative methods, such as, statistical analyses. However, the use of semi-structured interviews and documentary reviews also warrants consideration. Yin (2003) attests that the goal of reliability should be to minimise errors and bias. The use of good surveying techniques, such as piloting of surveys and interviews, the use of semi-structured questions and consistent interview formats are part of the process used to address standardisation for interviews (Mason, 2002). As is the verification of interview transcripts that increased accuracy and rigor (Poland, 1995). Similarly, the use of proformas within the documentary reviews, for example to review planning documents in the geographical case studies (Section 3.4.3) and SMPs in Case Study Three (Section 3.5), introduced replicability and standardisation. These procedures increased both reliability and validity of the research process and outputs.

The credibility of the research relates to 'hypothetico-deductive' process used in constructing and testing theory, establishing causal relationships, making a number of inferences based upon the empirical data, theoretical reasoning and the reconstruction of theory. Yin (2003) considers these issues as a problem of external validity. The basis for generalisations and theory development can stem from conducting replicable studies (Mason, 2002). The use of two varying geographical case studies (both from a decision making and scientific basis) to derive cross-contextual generalities provides weight to the validity of the thesis findings. However, as stated in Section 3.6.2, the potential for other test sites would only add to and strengthen the process of generalising findings. The extent to which the thesis makes general claims and theoretical statements is undertaken within the boundaries and research parameters established in Section 3.6.1.

3.7 Conclusion

This chapter has presented the methodology of the thesis, including the 'hypothetic-deductive' approach and the multiple case studies employed to generate empirical data. The semi-structured interview schedule and the documentary reviews as the significant research instruments of the three case studies were discussed and full justifications provided. The Research Strategy Pathway was presented that detailed the construction of theory and hypothesis, followed by data collection using two separate methods to trace coastal risk decision making and examine the scientific underpinning of the decision making process within the case studies. Flowing from these undertakings were a number of findings regarding the nature of the observed empirical phenomenon in comparison to the theory contained in the RSM. Information regarding the validity of the RSMs theoretical basis facilitated the development or 'reconstruction' of theory regarding coastal risk decision making. Concurrently, this process of theory modification was enhanced using the findings from the third case study, in which the merits, limitations and lessons learnt of the methods used were extracted. Importantly, this chapter has reflected upon the boundaries and parameters of the research, along with acknowledging the limitations of the methodology.

Lastly, it is recognised that the Positivism school of thought and underlying philosophies have had a fundamental influence upon the research. This has embodied the logic and rationality that has driven the Research Strategy Pathway and linked the construction of theory and hypothesis, the generation of empirical data and the reconstruction of theory (Figure 3.2).


Define and Design
Prepare, Collect & Analyse
Analyse & Conclude
Introduction
Literature Review
Development of Research Strategy Model
Selection of Case Studies
Design of data collection protocol
Conduct pilot survey
Conduct1st Case Study (North West)
Write individual case study chapter
Conduct 2nd Case Study (Northern Ireland)
Write individual case study chapter
Conduct 3rd Case Study (Review of SMPs)
Write individual case study chapter
Draw cross-case study findings and conclusions
Modify Conceptual Model
Conclusion
1
2
3
Thesis Structure
4 5 6
7
8

4 Chapter Four 'The North West Case Study'

4.1 Introduction

This chapter presents the results of the North West case study. This utilised the coastal boundary definition of coastal sediment cell 11 (Figure 4.2). By applying the thesis Research Strategy Model (RSM), this research traces coastal risk-related decision making processes, and assesses the natural coastal change scientific evidence base utilised by decision makers.

The chapter commences with an outline of the case study methodology. Section 4.2 presents an overview of the coastal geography, human usage and coastal hazards and risk, whilst Section 4.3 establishes the legislative and policy context. The subsequent four sections (Sections 4.4 - 4.7) present findings organised according to the four constituent elements of the thesis RSM Empirical Indicators (EISs) (Decision Pathway, Decision Making Tiers, Decision Structure and Decision Support). An integrated discussion follows (Section 4.8), which seeks to present synthesised research findings in relation to the aim and objectives of the thesis. The chapter then finishes with a short conclusion.

The associated research instruments presented in the Methodology Chapter (Chapter Three; Section 3.4.2) consisted of a semi-structured interview schedule and documentary reviews. The semi-structured interview schedule comprised twenty-nine interviewees (Figure 4.1; Appendix A1 contains Interview Question proformas). In light of the nature and sensitivity of interview content, the presentation of interview data uses non-attributable quotations that indicate the organisational or professional / institutional source, for example, Statutory Agency A, Engineer A or Planner A. The desk-top audit and review encompassed an extensive range of documentary evidence comprising two strands, *viz* coastal risk-related documentation and statutory planning documents. With respect to the latter, a standard review proforma (Appendix A3) was devised and applied consistently. Subsequent sections of this chapter contain a blend of primary data along with secondary evidence; clear signage of sources is provided.

The specific data requirements of Case Studies One and Two were directly influenced by the aim and objectives of the thesis, *viz*:

- Identification of the coastal defence and coastal planning legislative and policy frameworks (*Section 4.3*);
- Detailed review of documentation relating to coastal planning and coastal defence (*Sections 4.4-4.7*);
- Assessment of coastal defence and coastal planning decision making (legacies, drivers and policy directions; past, present and future) (*Sections 4.4.4 & 4.4.5*);
- Examination of the coastal defence and coastal planning operational landscape, including the implementation interface between the two sectors (*Sections 4.3 - 4.5*);
- Identification of the natural coastal change evidence base utilised by coastal defence and coastal planning decision makers (*Section 4.7*).

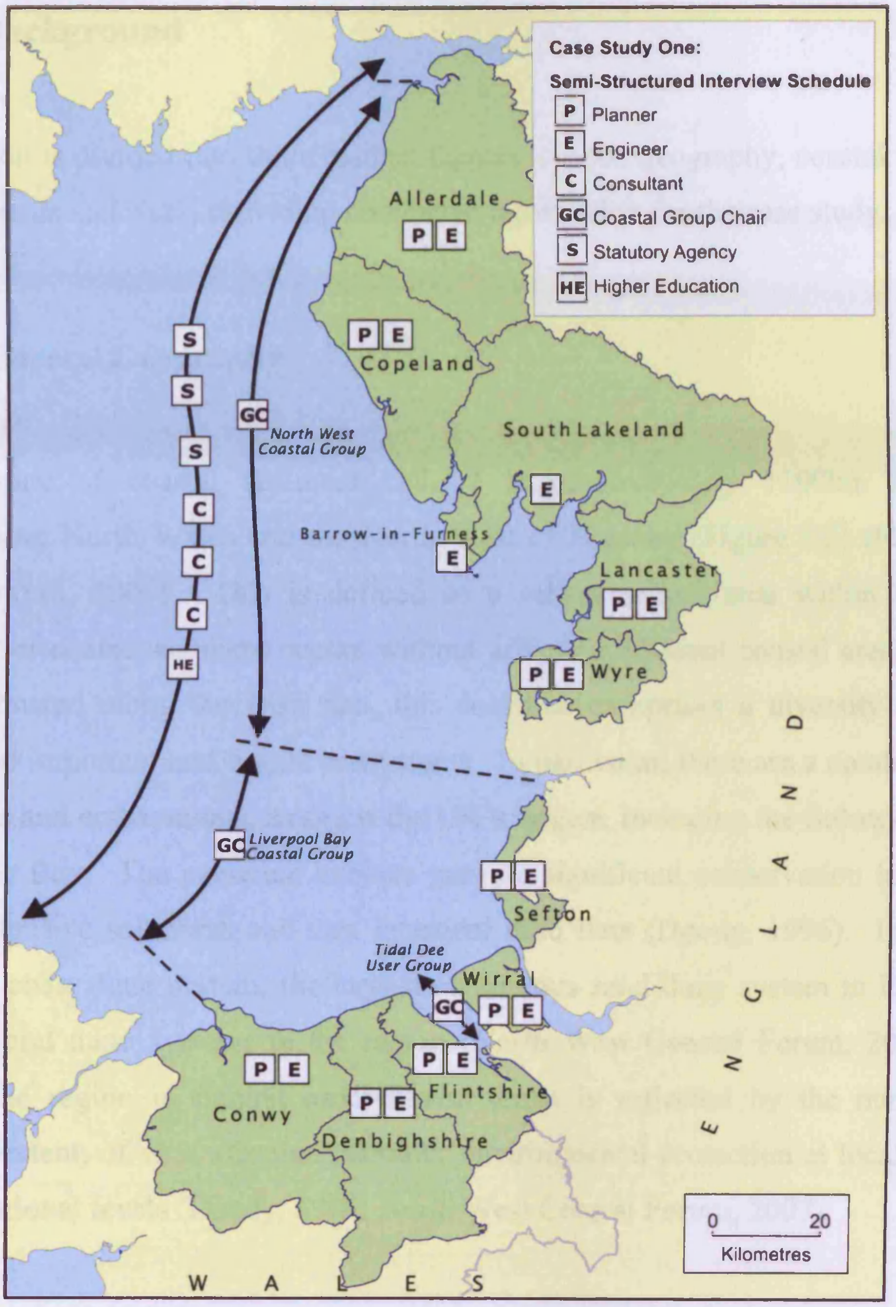


Figure 4.1: Case Study One Distribution of Semi-Structured Interviews

Source: Original

4.2 Background

This section is divided into three distinct themes: coastal geography, coastal usage and coastal hazards and risks, providing contextual information for the case study.

4.2.1 Coastal Geography

The coastline of coastal sediment cell 11 is approximately 1100km in length, encompassing North Wales and the North West of England (Figure 4.2) (North West Coastal Forum, 2007). This is defined as a self-contained area within which the movement of coarse sediment occurs without affecting adjacent coastal areas (Haslett, 2000). Situated along the Irish Sea, this coastline comprises a diversity of coastal habitats and important and fragile ecosystems. In particular, there are a notable number of estuaries and embayments, amongst the UK's largest, including the Solway Firth and Morecambe Bay. The estuarine habitats provide significant conservation interest and include extensive saltmarsh and vast intertidal mud flats (Doody, 1996). In addition, the Sefton coast dune system, the largest continuous sand dune system in England, is one of several dune systems in the region (North West Coastal Forum, 2007). The value of the region in natural environment terms is reflected by the number, and combined extent, of sites afforded statutory environmental protection at local, national and international levels (Doody, 1996; North West Coastal Forum, 2007).

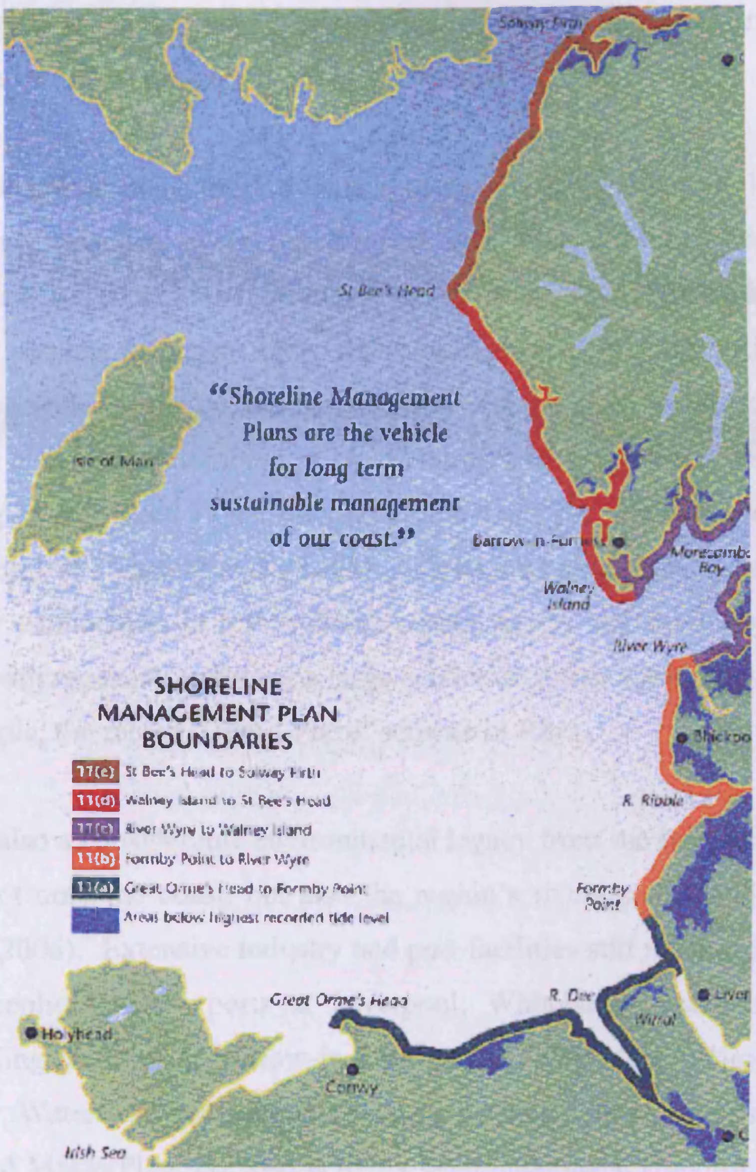


Figure 4.2: Coastal Sediment Cell 11 boundary

Source: Environment Agency (1999)

4.2.2 Coastal Usage

The North West coast poses many challenges to land-use planners and coastal engineers alike. It has an inherited legacy of human usage, with rich archaeological remains and evidence of human occupation dating back 200,000 years (Doody, 1996). This coast, like elsewhere in the UK, remains an attractive location for settlement, industry, tourism, power generation, ports and harbours (Fowler *et al.*, 1996). Accordingly, there are many stretches of continuous development and highly urbanised areas in the south-east, including Liverpool and the wider Merseyside area. In contrast, relatively undeveloped and rural areas, for example, in North Lancashire and Cumbria co-exist alongside estuaries, such as, the Dee and Mersey.

Under the influence of the Victorians, many North West coastal localities, often with wide sandy beaches, were transformed into prosperous sea-side resorts including, Llandudno, Blackpool and Southport (Fowler *et al.*, 1996). These, however, have suffered varying fortunes; many have undergone significant socio-economic decline since the 1960s, *e.g.* Rhyl and Morecambe. Others, such as Blackpool and Llandudno maintain high visitor numbers. Coastal tourism is a significant sector, with Blackpool receiving an estimated 17 million individual visits per year with an annual expenditure of £545 million (Vincent *et al.*, 2004). Efforts are being made in the region, particularly by Local Authorities, to revive many coastal towns and declining traditional sea-side resorts, with regeneration being a large economic driver behind development initiatives, for example, the recent 'Ocean Plaza' scheme in Rhyl.

There is also a considerable environmental legacy from the Industrial Revolution, which affects not only the coast, but also the region's rivers and inland areas (Environment Agency, 2006). Extensive industry and port facilities still remain, for example, Mostyn, and Birkenhead; ferry ports at Liverpool; Whitehaven Harbour; gas terminal and shipbuilding facilities at Barrow-in Furness and Sellafield and Heysham nuclear power stations. Waterfront redevelopment, such as the Mersey Waterfront scheme and the Blackpool MasterPlan, are also actively been undertaken (Environment Agency, 2006; North West Coastal Forum, 2007). Such economic activities significantly contribute to the region and the UK economy (Robson, 1996). In contrast, northern parts of the region, *i.e.* parts of Wyre, Lancaster and Cumbria, are used for agriculture, with extensive land claim on the Morecambe and Ribble estuaries occurring in the 18th and 19th Century to provide areas for grazing (Fowler *et al.*, 1996). Recent and emerging uses of the North West's offshore areas include offshore oil, gas and aggregate reserves and renewable energy sources, such as, offshore windfarms and tidal lagoon proposals (Regional Planning Guidance for North Wales, 2002; Allerdale Borough Council, 1999).

4.2.3 Coastal Hazards and Risks

According to Fowler and Halt (1996, pg. 209) in their examination of land use, infrastructure and coastal defence in the region, "Much of the coastline in Region 13 is considered at risk from sea-level rise...". Estimated regional net sea level rise allowances in the North West of England, for the period 1990-2025 are cited at 2.5mm yr^{-1}, with 3.5mm yr^{-1} in Wales (Defra, 2006c). Department for Environment Food and Rural Affairs (Defra) provide these data to inform their flood and coastal erosion risk management and planning. However, given the cross border aspects of the region, predictions for sediment cell 11 are currently not available from Defra, Welsh Assembly Government, the Environment Agency or Environment Agency Wales.

The risks from sea level rise are greatest in low-lying areas, with "sizeable populations" vulnerable to flood risk and requiring protection (Environment Agency, 2006, pg. 3). Tidal flood risk is a significant issue for several Local Authorities. In the case of Wyre Borough Council, this authority has the highest proportion of medium to high risk of flooding (Flood Zone 3) in England, outside the Greater London Area (DCLG, 2006). Similarly, Lancaster City Council has the second worst exposure to flood risk of all districts in the North West of England, with an estimated 30% of 59,000 living in Flood Zone 3 (Evans *et al.*, 2004). Other areas have also experienced significant flood events, on the Sefton and Fylde coasts in 1977 and in Morecambe in 1983 (Zong and Tooley, 2003). Most notable in the region is the 1990 Towyn incident that affected approximately 2,800 properties (Roberts, 1994). This saw a 400m long breach of Railtrack's Towyn sea defences due to a combination of westerly storm-force winds, a high tide with 1.5 m surge and extreme wave conditions (*ibid*). These events highlight the serious threat posed by a combination of storm surges and high tides in this part of the Irish Sea. Furthermore, aspects of the North West landscape, such as rivers that respond rapidly to rainfall, present a significant fluvial flood risk, for example, in parts of north Wales, Lancashire and Cumbria (Environment Agency, 2006). With recent fluvial floods occurring in North Wales in 2007 and Cumbria in 2005, the profile of flooding (coastal and fluvial) in the media and politically is high. In the case of coastal erosion, rates are variable in the region, for example, on the undefended parts of the Allerdale coast, average erosion rates vary between 0.5-1.5 m yr^{-1} (Allerdale Borough Council, 2001). With parts of the Sefton coast sand dune system at Formby Point eroding at up to 5 m yr^{-1} (Sefton Borough Council, 2007). Due to extensive stretches of artificially defended and static coasts in the south east *e.g.* north Wales, Wirral, Blackpool and parts of the Fylde coast, coastal erosion when compared to flood risk, is perceived as a minor concern.

In light of the flood and coastal erosion risk there are numerous coastal defence intervention structures are in place, with historical evidence suggesting such interventions date back hundreds of years. The Cistercian Monks of Furness Abbey for example, constructed coastal defences on Walney Island, Cumbria in the 13th Century (Barrow Borough Council, 2000). The range of coastal engineering works today includes rock armouring, beach groynes, sea walls and tidal embankments (Figure 4.3). These structures provide different standards of protection and are owned and maintained by several organisations including public bodies, such as, Local Authorities, Environment Agency, as well as private landowners *e.g.* Railtrack. The residual life of defences is variable, with many becoming redundant and vulnerable to climate change and sea level rise (Zong and Tooley, 2003). There is a mix of old, for example the 100 year old sea wall at Rhos-on-Sea, and more recently installed structures. Their presence has had a significant impact on the look, shape and use of the coast, in some parts creating an artificially static coastline for several kilometres. In north Wales for example, 45.3 km of Conwy Borough Council 73 km coastline is artificially defended, and represents a fifth of artificially protected coastline in the whole of Wales (Conwy Borough Council, 2001). There is often a clear relationship between heavily urbanised stretches of coast and the presence of coastal defence structures. Victorian sea-side resort development was a driver for many coastal works, with promenades and sea walls providing protection to significant hinterland development. It is not, however, always possible to ascertain the function of all coastal structures along this stretch of coast, *i.e.* coast protection or sea defence, with defences particularly in low-lying coastal areas, having a dual function of flood defence and coast protection (Fowler and Halt, 1996).

Rhos-on-Sea, Conwy Borough Council

Blackpool, Blackpool City Council

Cleveleys, Wyre Borough Council

Morecambe, Lancaster City Council

Walney Island, Barrow-in-Furness Borough Council

St. Bees Head, Copeland Borough Council

Workington, Network Rail

Silloth, Allerdale Borough Council

Figure 4.3: Examples of defence structures within coastal sediment cell 11

Source: Original

4.3 Legislative and Policy Context

Both coastal defence works or development at the coast are undertaken within a statutory framework of legislation and policy. This section presents findings concerning the legislative and policy related to coastal defence and coastal planning (explicitly the role of the terrestrial planning system for governing land-use at the coast).

The present legislative basis for coastal defence in England and Wales establishes a complicated basis for public responsibilities (Howarth, 2002). Howarth (2002, pg. 275) notes that the legislation is a combination of, "...a narrow range of mandatory duties..." and, "...extensive range of permissive powers". This distinction between permissive powers and legal duties, he attests as being related primarily to funding resources (*ibid*). Coastal defence is a composite term covering protection against both coastal erosion (coast protection) and flooding by the sea (flood defence) (Wright, 2004). The current statutory framework in England and Wales pertaining to coastal defence has developed *ad hoc* since the 15th Century. The following Acts of Parliament are the principal statues: Coast Protection Act 1949, Water Resources Act 1991 and the Land Drainage Act 1991(updating the 1976 Act) (Howarth, 2002; Berkeley-Thorn and Roberts, 1981) (Table 4.3).

The Coast Protection Act 1949 is the main piece of legislation relating to the protection of land against erosion, with works carried out under this known as 'Coast Protection'. Prior to this, McInnes (2003) notes that there were no general statutory powers to protect the coastal against erosion and instability. The act, however, led ultimately to the now entrenched division between coastal protection and sea defence, as it specifically excluded sea defence from its jurisdiction (Ricketts, 1986). The Coast Protection Act 1949 introduced a centrally regulated approach, removing the responsibility for coast protection from the individual landowner. It places this permissive function upon Maritime Local Authorities (termed Coast Protection Authorities under the act) with financial aid from central government (Ricketts, 1986). Such authorities therefore became responsible for the supervision of works to prevent erosion of the land by the sea and inundation (Fleming, 1992; Nicholls *et al.*, 2007).

The Land Drainage Act of 1976 (amended in 1991) applies to land liable to flooding with works carried out under this act being known as 'Sea Defence' (Fleming, 1992; Pettit, 1999). The other relevant pieces of primary legislation are the Water Resources Act 1991 (that amended the Water Act 1989) and the Environment Act 1995. These principally deal with the Environment Agency's predecessor, the National Rivers Authority and matters pertaining to Flood Defence Committees (Pettit, 1999).

The Land Drainage Act 1991 (as amended 1994), Water Resources Act 1991 and the Environment Act 1995, collectively empower the Environment Agency (previously the National Rivers Authority) with a general supervisory duty for managing flood defence in England and Wales (Nicholls *et al.*, 2007). Delivery of this is achieved through the Environment Agency, Local Authorities and Internal Drainage Boards. The Environment Agency has overall supervision of flood defence, including a duty to survey areas to indicate flooding potential and a responsibility to issue flood warnings. Additionally, it has regulatory powers to authorise works that have flood defence implications undertaken by bodies and individuals (Howarth, 2002; Ball and Smith, 2006). The role of the Environment Agency in England with regard to coastal defence has recently increased under Defra's Making Space for Water, 2005. The Environment Agency's Strategic Overview most notably sees the Environment Agency become the lead in managing all sea flooding risk in England and responsible for the funding and overseeing of coastal erosion works undertaken by Local Authorities (Defra, 2007; Environment Agency, 2009).

The Welsh Assembly Government (WAG) has responsibility for policy and guidance on flood and coastal defences in Wales; whilst in England, Department of Environment, Food and Rural Affairs (Defra) has overall policy responsibility (Jacobs Beatie, 2005; Ball and Smith, 2006). In 1993, Ministry for Agriculture, Fisheries and Food (MAFF) and the Welsh Assembly Government's predecessor, the Welsh Office, jointly published the landmark 'Strategy for Flood and Coastal Defence in England and Wales' (MAFF & WO, 1993). This discourages development in areas at risk of flooding and coastal erosion. Additionally, this policy encouraged the production of coastal defence schemes that were technically, environmentally and economically sound and sustainable (Fletcher, 1998; Ledoux *et al.*, 2005). This strategy, as identified in the Literature Review (Section 2.5.3), has been superseded by policy from Defra and WAG, which signify a new management approach to coastal defence and shoreline management. The drivers behind these include responses to major flood events, a growing awareness of climate change, increasing costs of defences and a desire to work more closely with coastal processes (Defra, 2008a). The approach in Wales is contained within WAG's Environment Strategy, which outlines WAG's vision for flood and coastal erosion risk management (WAG, 2006). Defra's 2005 'Making space for water: Taking forward a new Government strategy for flood and coastal erosion risk management in England' sets out the government's desire to implement a more holistic approach to managing flood and coastal erosion risks in England. This aims to manage risk to, "reduce the threat to people and their property; and deliver the greatest environmental, social and economic benefit, consistent with the Government's sustainable development principle" (Defra, 2005a).

In addition to central government (Defra and EA) and Local Authorities, a number of other interested parties in coastal defence in England and Wales were identified, including public and private bodies, Flood Defence Committees, Internal Drainage Boards and landowning NGOs (O'Riordan and Ward, 1997; Ledoux *et al.*, 2005).

The UK has in place a comprehensive system of town and country planning developed since the twentieth century (Rydin, 2003). Within England and Wales, the recent Planning and Compulsory Purchase Act 2004, re-enforced the plan-led aspect of planning reform and the explicit move away from land-use planning towards a system of spatial planning (Tyldsesly, 2005; Taussik, 2007). A tangible aspect of these changes has been the development of spatial planning portfolios by Local Authorities, *i.e.* Local Development Frameworks in England, Local Development Plans in Wales and Regional Spatial Strategies developed by Regional Planning Bodies in England. These documents guide the Development Control process conducted by Local Authorities and are informed by National Planning Policy.

4.4 Findings: Decision Pathway

This section presents findings concerned with the Decision Pathway facet of the RSM for the North West, addressing in sequence the following EIs:

- *Who is the decision maker being examined?*
- *What is the context / sectoral domain of the decision being examined?*
- *Are there discrete stages to the decision pathway and what stage is being examined?*
- *Is the decision pathway connected to other decision pathways (past, present and future)?*
- *Is the decision cycle connected with decision pathways occurring within other decision contexts?*

The Methodology Chapter (Section 3.6) highlighted limitations of the thesis and associated research boundaries. Accordingly, case study investigations of decision pathways did not attempt to audit and examine all decision pathways associated with coastal defence and coastal planning in the North West. Instead, representative and illustrative examples from both sectors were examined. Where possible complete decision pathways were considered. Signage indicates the level of decision making referred to, for example, a decision pathway at the operational level, such as, a coastal planning application (Section 4.4.3), or a decision pathway at the tactical level of coastal defence decision making, such as a Shoreline Management Plan (Section 4.4.4).

4.4.1 Who is the decision maker being examined?

Case study investigations of coastal risk in the North West identified multiple decision makers (*viz*, central government, local government (Local Authorities) and private landowners (Section 4.3)). This section firstly considers their statutory remit, discretionary powers and levels of activities for coastal defence, then coastal planning.

Operating Authorities for coastal defence along the Welsh section of the North West coast comprise three coastal Local Authorities (Conwy County Borough Council, Denbighshire County Council and Flintshire County Council) and two statutory agencies (Environment Agency Wales and the Countryside Council for Wales). It was identified that Welsh Local Authorities have a permissive Coast Protection function overseen, and funded in the most part, by grant aid from WAG. Welsh Local Authorities deliver various flood and coastal defence schemes (Engineer K). Environment Agency Wales has lead responsibility for sea defences and delivers flood warnings, and provide mapping of Flood Risk Areas (in addition to information contained with WAG's Technical Advice Note 15: Development and Flood Risk). Along the English section, no Internal Drainage Boards exist (Statutory Agency C). Whilst there are twenty-four coastal Local Authorities (including the Lake District National Park), case study investigations ascertained that only fifteen actively participate (permissively) in coastal defence activities providing coast protection, and in some cases, sea defence (Statutory Agency C).

A Defra commissioned report in 2006 entitled 'Review of Local Authority Skills and Capacity for Coastal Defence Functions', reviewed twenty-seven of the ninety English coastal Operating Authorities, comprising a minimum of five authorities from each English region (CCPL, 2006). Of the five North West Local Authorities included, the following varied levels of coast protection activities were cited:

- Blackpool Borough Council and Wyre Borough Council: *High Activity*
- Wirral Borough Council: *Medium Activity*
- Copeland Borough Council and West Lancashire District Council: *Low Activity*

Of these, all, excluding West Lancashire District Council, were approached to participate in the Case Study One's semi-structured interview schedule; with three agreeing, *viz* Wyre Borough Council, Wirral Borough Council and Copeland Borough Council. A further eight authorities were identified and successfully approached, including all three Welsh sediment cell 11 authorities. The eleven surveyed North West Local Authorities can be seen in Figure 4.4.

Figure 4.4: Case Study One Surveyed North West Local Authorities
Source: Original

Examination of the staffing and levels of coastal defence activity within the Local Authority coastal engineering teams, identified a notable range of activity and in-house coastal defence capacity. At the higher end of activity included those authorities that, at the time of survey, were undertaking large coastal defence schemes and those that had done so in the past, such as, Wirral Metropolitan Borough Council, Wyre Borough Council and Lancaster City Council. Corresponding to this scale of activity, these authorities were found to have the largest in-house engineering teams with regards to Full Time Equivalent (FTE) staff working on coastal engineering and defence (11 FTE, 4.25 FTE and 4 FTE respectively). Authorities with more reduced levels of staffing included two authorities with 3 FTEs, one authority with 1 FTE and four authorities with a combination of staffing levels that equated to less than 1 FTE. The minimum dedicated coastal staffing level occurred within South Lakeland District Council. The officer responsible for coastal defence indicated this reflected low levels of coastal activity and profile of coastal issues within the authority. This officer's time on coastal defence averaged 0.05 FTE, with the majority of this time spent participating in coastal sediment cell (Coastal Group) meetings. Within one authority, Barrow-in-Furness Borough Council, it was discovered that the Highways section and all Local Authority engineering staff had been fully contracted out to a consulting engineering company in 2000, with no engineering staff present at the time of survey.

Local Authorities in England and Wales are encouraged but not required to prepare Coastal Defence Policy Statements under Defra's High Level Targets for Flood and Coastal Erosion Risk Management. These reiterate government policy on coastal defence and provide an assessment of flood and coastal erosion risk in the authority's area and report the authority's proposed actions for risk management (Defra, 2006a). As Local Authority policy, they are a public statement of the authority's interpretation of their coastal defence permissive powers and intentions as decision makers on matters of flood and coastal defence. In light of this, a review of Local Authority High Level Target 1 Coastal Defence Policy Statements in the North West was undertaken (Table 4.1; Figure 4.5).

Consistent structure and presentation of information within these documents was evident. An indicative example of statement content is presented in Table 4.2. Interviews with Local Authority engineers revealed that policy statements were based upon a template prepared by the North West Coastal Group. Engineer A indicated that when preparing their statement, coastal site visits were undertaken by authority engineers to inform the statement's content. As part of this process, the authority contacted all landowners with privately owned defences in place in order to make them aware of their responsibilities.

Table 4.1: Reviewed North West High Level Target Coastal Defence Policy Statements

Local Authority	High Level Target 1 Coastal Defence Policy Statement Status
Reviewed:	
Conwy County Borough Council	Adopted (date unknown)
Flintshire County Council	Adopted (April 2001)
Denbighshire County Council	Draft –not adopted (2008)
Wirral Metropolitan Borough Council	Adopted 2001, *under revision*
Sefton Borough Council	Adopted (April 2007)
Barrow Borough Council	Adopted (Second version April 2004)
Lancaster City Council	Adopted (Revised December 2004)
Allerdale Borough Council	Adopted (October 2001)
Wyre Borough Council	Draft -Not adopted (September 2000)
Not publicly available at time of survey (February 2007):	
South Lakeland District Council	Statement produced but not adopted or available
Copeland Borough Council	Statement produced but not adopted or available

Figure 4.5: Reviewed Local Authority High Level Target 1 Policy Statements

Source: Original

Table 4.2: Extract of a North West Local Authority Policy Statement of Flood and Coastal Defence

Sefton Borough Council Policy Statement of Flood and Coastal Defence (April, 2007):
"1.1 This revision of the 2004 policy statement has been prepared by the Technical Services Department in conjunction with the Planning Department Sefton Council to provide a public statement of the Council's approach to flood and coastal defence in its area. 4.1 Apart from certain obligations to protect internationally important habitats under the EU Habitats Directive, all flood and coastal defence works are undertaken under permissive powers. This means that Operating Authorities, such as Sefton Council, are not obliged to carry out flood and coastal defence works. 4.2 We are the relevant Operating Authority for: • flood defences on ordinary watercourses for which we have riparian responsibilities; • coast protection (i.e. measures against coastal erosion) on all frontages in our area; and • sea defences (i.e. measures against flooding from the sea) on the frontage between Weld Road and Harrogate Way, Southport. 4.10 The main means by which flood risks are managed is through the Environment Agency's flood warning dissemination plans for this area. Under these pans, Sefton receives both fluvial and tidal flood warnings; and following receipt of such warnings we take appropriate action... 4.11 We have in place a programme in place to inspect the state of tidal flood defences we are responsible for. 4.14 As identified in the Shoreline Management Plans (SMPs), of the 36km of shoreline in the Council's areas, 26.5km is defended against erosion. 13km is owned and maintained by the Council, of which 3.5km is stepped concrete revetment with wave wall, 1.8 km is protected by rubble armour and includes an 800m training wall, while the remainder is sand coastline. 4.15 Risks of erosion on the defended frontage at Crosby are variable, to the south there is accretion occurring along a short frontage, at Hall Road the structure is near the end of its life and the risk of erosion resulting from failure of this structure is increasing each year. The rubble armour is also eroding and provides limited protection to the coastline behind. The sand dunes are eroding across 7km frontage centred on Formby point at up to 5m per year (see SMP's for details). Historic coastal and climate change events have lead to this continuing erosion. Existing defences help reduce the rate of loss, but it many be that future climate change will increase the risk of flood and erosion to any coastal properties. 4.16 In addition to annual inspections of coastal defences, we are undertaking a long term Strategy Study for the frontages from Crosby Marine Lake to Formby Point and for the management of the sand dunes for coast protection from the River Alt to Weld Road. These studies will measure coastal processes such as wind, waves and tide as and the changes they make to beach condition over a longer timeframe. We also continue to be involved with studies of integrated coastal zone management and coastal change, climate and instability. 5.3 We intend to review this policy statement again in three years tine, when it will be revised and re-issued as necessary, taking account of the most recent Strategic Flood Risk Assessment carried out following the advice in Planning Policy Statement 25' Development and Flood Risk'."

Case Study investigations also identified private landowners as coastal decision makers. This was ascertained *via* Local Authority engineers who discussed the presence of privately owned defence structures along their frontages. A noteworthy finding concerns Network Rail who own and maintain many coastal engineering structures in the North West (Engineer F). These coastal works defend and protect prominent infrastructure assets. These include third party assets, for example, the defences constructed in the mid 19th century to protect the Chester to Holyhead railway line and the Furness railway. Such defences, first and foremost, deliver protection to these assets; they also provide *de facto* coastal defence for several Local Authorities and communities. As highlighted by one Local Authority Engineer, *"extremely grateful to them for defending most of the coast...lost without Railtrack, quite literally, would be washed away..."* (Engineer F).

With respect to coastal planning, Section 4.3 identified that this is primarily undertaken by Local Authorities and consists of two main aspects, development planning (also known as forward planning or planning policy) and development control (Rydin, 2003). Development control as a decision making process is guided by adopted development planning policies prepared by the Local Authority; in essence, development control is a processing system that implements local development policy. In light of the importance of planning policy to planning, the semi-structured interview schedule sought interviews with Local Authority planning policy officers as opposed to development control planning officers. Section 4.6.1 presents findings from these interviews and from the audit and review of North West planning documents (Table 4.5).

4.4.2 What is the context / sectoral domain of the decision being examined?

This EI refers to the decision contexts of coastal defence and coastal planning. As highlighted in Chapter One (Section 1.2), the coast is a highly congested and contested space; consequently decision making occurs within different sectors, some operating autonomously, others in a more integrated manner. The approach to the management of coastal risk relates to the latter, by taking a holistic perspective to assessing and managing coastal risk (Section 2.5.3). Coastal risk management concerns itself with a number of decision makers, most notably engineering and planning who have a shared responsibility for the protection of people and property from risk (Ballinger *et al.*, 2002). The literature highlights the limited interface between the statutory planning system and aspects of coastal defence, such as shoreline management planning MAFF, 2000; English Nature, 2005; Section 2.5.3). Consequently the thesis has focused its efforts upon identifying, where present, coastal engineering and coastal planning activities and sought to explore the decision making process internally within these areas and importantly the interface between them.

4.4.3 Are there discrete stages to the decision pathway and what stage is being examined?

In examining coastal risk decision making, a number of individual empirical decision pathways were investigated. A detailed critique of all stages associated with a specific decision pathway (and examination of the role natural coastal change evidence base) was undertaken and facilitated *via* the application of this particular EI and consideration of the RSM's hypothetical the decision making cycle (Figure 4.2). The selection of a decision pathway at the operational level of coastal planning complements other aspects of the research, in particular, the tactical coastal defence decision making pathway investigations associated with Shoreline Management Plans (Section 4.4.4).

The current decision making associated with the Ocean Plaza coastal planning application was brought to light through interview findings with Local Authority planning policy and engineering officers. Additionally, information was obtained *via* planning documents that included, *inter alia*, Denbighshire County Council's 2002 adopted Unitary Development Plan, Denbighshire County Council's Strategic Flood Consequence Assessment (SFCA) 2007 and WAG's planning policy 'Development and flood risk planning' guidance (TAN (W) 15).

The site of Ocean Plaza, as reported by the planning policy officer, is a 7.6 hectare mixed-use development site located at West Parade, Rhyl. The most notable factor concerning this site making it of particular interest and merit within the case study is the significant tidal flood risk. According to the authority's SFCA, "The Ocean Plaza site is at greatest risk and assessment of the risk to this site would need careful consideration in a site specific Flood Consequence Assessment to consider risk from waves, overtopping and breaching and the distribution of risk across the site" (JBA Consulting, 2007, pg. 33). The site can also be identified within WAG's Development Advice Maps in TAN(W) 15 'Development and Flood Risk', as a Zone C high flood risk area (equivalent to Flood Zone 3 in England). The proposed development encompasses a sixty-bedroom hotel, a seafront promenade including 10 vertical axis wind turbines, a new supermarket, 217 apartments, office and leisure units. The site is situated within an area referred to as Rhyl West, which the interviewed planner stated to be one of the top ten most deprived wards within Wales. In light of this, the decision maker, *i.e.* the Local Authority, allocated the site as a prospective redevelopment location. A review of the authority's Unitary Development Plan (UDP) identified, "The seafront is an integral part of the coastal planning zone and is important both for its tourism and recreational role...By way of general guidance, development proposals comprising tourism or recreational attractions...will be acceptable subject to certain conditions" (Denbighshire County Council, 2002, para. 8.91). Similarly, "The process of re-marketing, regenerating and remodelling the coastal resorts of Rhyl and Prestatyn has been taking place since the opening of the Sun Centre in Rhyl in 1980. This process of regeneration will continue...regeneration of the Seaside Resort industry, focussed on Rhyl and Prestatyn (Denbighshire County Council, 2002, para. 12.7 - 12.8).

The importance and prominence of the Ocean Plaza site within the authority's regeneration planning policies is, therefore, clear. In addition, the surveyed planner reported that economic development, specifically regeneration, was being strongly pursued by the authority's Chief Executive. This political / economic driver was accordingly impacting upon the Ocean Plaza planning application; this is indicative of the regional picture (Section 4.2). Thus, despite the recognised significant flood risk associated with the site reported in the authority's SFCA, the regeneration branding by the authority aligns the site to the authority's planning policies and aspirations. The consequences for the planning application are that it satisfies the justification criteria contained within WAG's TAN(W) 15 policy on Development and Flood Risk. As a previously developed brownfield site, it is not regarded within the authority's UDP as a

'new' allocation and, therefore, is in line with the authority's regeneration initiative. TAN(W) 15 states that "Development, including transport infrastructure, will only be justified if it can be demonstrated that...Its location in zone C is necessary to assist, or be part of, a local authority regeneration initiative...and...It concurs with the aims of the PPW and meets the definition of previously developed land" (WAG, 2004, pg. 8). Similarly, consideration of the authority's policy on development and flood risk identifies that as an existing development it may be permitted if it does not increase the need for additional coastal protection. The authority policy is as follows:
Policy CPZ4 – 'Coastal Defence and Flooding' states, "Development within the Coastal Planning Zone (CPZ) will only be permitted where it would:

- not increase or transfer the risk of flooding or coastal erosion through its impact on natural coastal processes;
- not prejudice the capacity of the coast to form a natural sea defence;
- not increase the need for additional coastal protection works except where necessary to protect existing investment or development.

New coastal defence works should not have an unacceptable impact on the character, appearance and natural processes of CPZ" (Denbighshire County Council, 2002). It is posited that were the site of Ocean Plaza undeveloped, it would be significantly unlikely under both the authorities' and WAG planning policies, to be granted planning permission.

The decision maker in this particular case can be seen as having significant control over the outcome of the decision pathway. This is evidenced by the authority's decision to redevelop the site using regeneration branding and applicable planning policies to award planning permission to HOW Planning LLP against the advice of the Environment Agency Wales who, as a statutory consultee with the development control process, objected on the grounds of flood risk. Discussions with the authority's engineer identified that his knowledge of flood risk at the site was being used to inform and facilitate flood risk mitigation. As opposed to this knowledge being used to prevent development of this location. As the authority's SFCA states, "To proceed with developing this site flood risk should be central to determining the site layout, e.g. locating highly vulnerable development in the areas at lower risk, and the Environment Agency and Emergency Planners should be closely involved in this process" (JBA Consulting, 2007, pg. 33).

In combination, this EI and the RSM can constructively be used to discern and analyse discrete stages of the Ocean Plaza decision pathway.

EI:

- *Are there discrete stages to the decision pathway and what stage is being examined?*

The five stages of the RSM Part A: Decision Pathway (Figure 3.3):

- Stage A: Problem Framing;
- Stage B: Scoping of Alternatives & Determination of the Course of Action;
- Stage C: Implementation;
- Stage D: Monitoring /Feedback; and
- Stage E: Refinement.

Stage A (Problem Framing) of the Ocean Plaza case is considered the regeneration of the site, in line with the authority's UDP and economic development / regeneration agenda of the authority's Chief Executive (the decision maker). The perceived extent and impact of this problem framing upon Stage B (Scoping of Alternatives & Determination of the Course of Action) is regarded as being significant in light of the strength of desire to redevelop the site in spite of flood risk concerns. Indeed, the problem framing is considered to be so strong in this particular instance, that the scoping of alternatives and possible of courses of action within Stage B consisted of a singular course of action, *i.e.* regeneration. This results in the decision maker taking forward a pre-determined decision choice to Stage C (Implementation), namely regeneration of the site for leisure and tourism purposes. The planning objection on flood risk grounds by Environment Agency Wales would have resulted in the decision to abandon the Ocean Plaza development, thereby allowing this historic sea-side resort area to continue suffering from economic decline. This, however, was not considered by the authority as a potential decision alternative during Stage B. The decision maker, in this case the Local Authority, was thus able to control the decision pathway from Stage A onwards. The role of natural coastal change information was found to be utilised by the authority to inform risk management at Stage C, thereby facilitating this coastal planning development. At the time of survey, the stages of D and E had yet to be undertaken, however, it is posited that in line with the other stages, the Local Authority will maintain its drive for regeneration / economic development at the site.

The Ocean Plaza case study clearly illustrated the applicability and relevance of the RSM's idealised pathway. The process of comparing and contrasting empirical decision pathways with those of the RSM, provides a structured framework for identifying and tracing discrete stages that may be missed through more discursive studies of decision making processes. Furthermore, it encourages explicit consideration of the connections between stages and aspects of decision framing upon specific stages, and associated 'knock on' implications for subsequent decision pathway stages.

4.4.4 Is the decision pathway connected to other decision pathways (past, present and future)?

This section considers inter-sector decision connections between findings from the coastal defence sector. These present interesting patterns concerning the distinguishable connections between historic, current and possible future coastal defence decision making.

As discussed previously (Sections 4.2.3 & 4.4.1), coastal defences exist in several localities along the North West coast, and some date back to 1793 when Rhuddlan Marsh Commissioners obtained powers *via* an Act of Parliament to drain the area around Towyn (Engineer K). It is noteworthy that this site in 1990 suffered a severe storm surge event with flooding affected approximately 2,800 properties (as discussed in Section 4.3.3). An important finding is the large number of structures installed during the Victorian period, for example the promenade and pier at Southport reportedly constructed in the 1850s (Engineer H).

In addition to the past coastal defence decisions, many authorities were observed to be undertaking coastal defence improvements and investing in new coastal works and large coast protection schemes. This was particularly the case along the Flyde coast of the North West, with Blackpool City Council involved in a £72 million coastal defence scheme, along with a £19 million scheme at Cleveleys (Wyre Borough Council).

Similarly, Conwy County and Wirral Borough Councils indicated they were undertaking schemes in Rhos-on-Sea and Kirby Marine Lake, respectively. An interviewed Coastal Group Chair reported, at the time of survey, central government grant aid of this coast protection represented the majority of Defra's flood and coastal defence budget for England and Wales for the period of 2007-2008. Furthermore, in addition to these current Local Authority-led hard engineering schemes, it was identified that one of the largest Managed Realignment schemes in England and Wales at Hesketh Marsh south of the Ribble Estuary was in early design stages (Engineer C). This scheme was reported as being undertaken by the Environment Agency, Natural England and the RSPB; Lancaster City Council were also indicated as being involved as part of Natura 2000 compensatory habitat programme (Statutory Agency B).

As contemporary operational coastal defence decision making is connected with more strategic coastal defence policies contained within Shoreline Management Plans (SMPs), this research reviewed adopted SMPs in the region. This was supported by data amalgamated from Local Authority engineering officers and coastal engineering consultants involved in the preparation of North West SMPs. From this it was ascertained that five SMPs were developed in 1999 for the sediment sub cells 11a, b, c, d and e (Figure 4.2). Following central government guidance, coastal defence policy options for SMPs were: Hold The Line (HTL); Do Nothing (DN); Advance the Line; and Retreat the Line (MR) (MAFF & WO, 1995). However, additional combinatory policy types were also devised to reflect existing local coastal defence strategies, such as, Natural Defence Management (NDM) (Consultancy B). Coastal defence policies were allocated to sub-divisions of the cell known as Management Units, with recommendations for both short term and long term planning horizons (Figure 4.6).

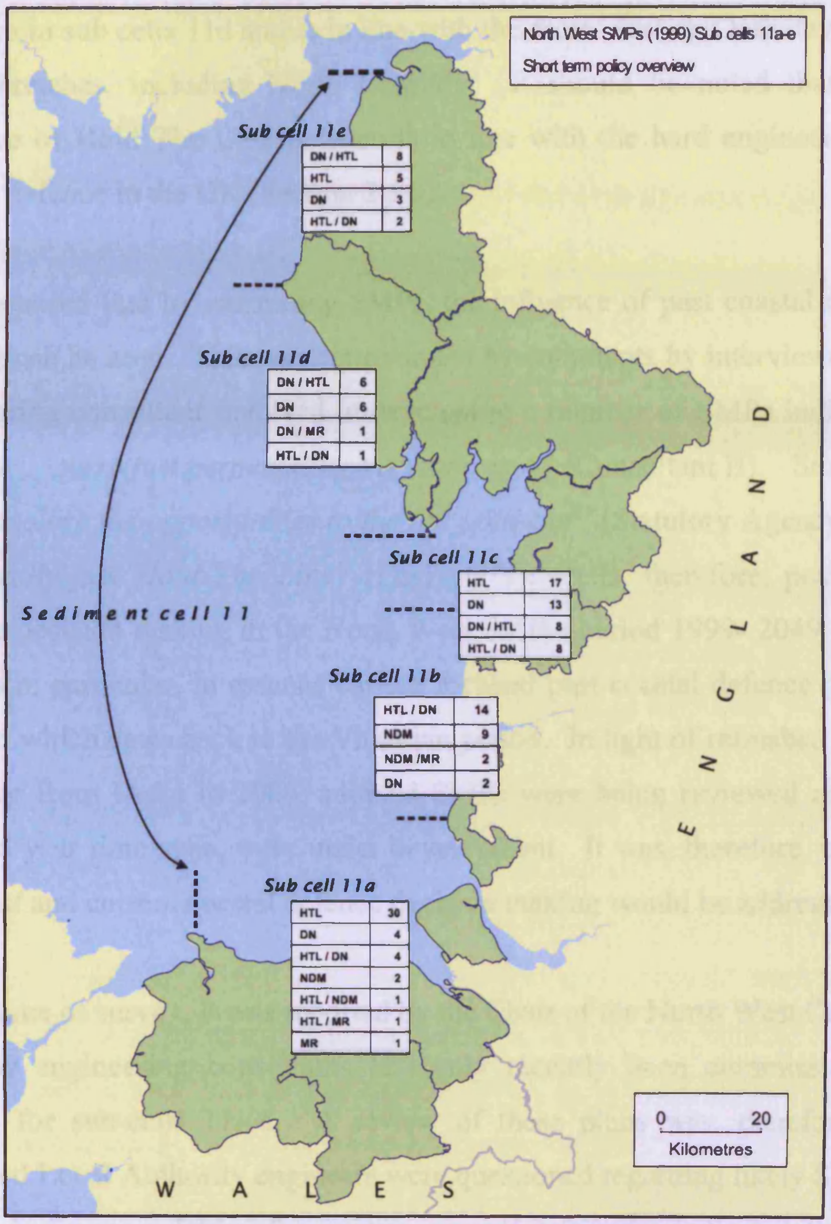


Figure 4.6: North West SMPs Sub-Cell Policy Content
Source: Original

Whilst a range of policy types can be seen in Figure 4.6, Hold The Line and Do Nothing policies predominate. Of the total 148 management units in plans 11a-e, 66 (44%) were Hold The Line and 28 (19%) Do Nothing. These two policy types therefore represent 63.5% of total policy types. The geographical locations of these reflect the characteristics of coastal areas (Section 4.2.2). Many Hold The Line policies were found within southerly sections of sediment cell 11 (sub cells 11a-c), thus corresponding with areas of static coast for example, sea-side resorts of Llandudno, Liverpool and Blackpool. Conversely, Do Nothing policies were found in greater numbers in sub cells 11d and e; in line with the more rural and less developed nature of these stretches, including North Cumbria. It should be noted that the significant presence of Hold The Line policies is in line with the hard engineering approach to coastal defence in the UK (Section 2.5.3).

It is proposed that by examining SMPs, the influence of past coastal defence decision making can be seen. This was corroborated by comments by interviewees. A surveyed engineering consultant involved in developing a number of SMPs indicated that many policies, *"were just perpetuating the status quo"* (Consultant B). Similarly, *"SMP1 didn't explore the opportunities to the full potential"* (Statutory Agency B) and *"SMP1 is basically just Hold The Line"* (Engineer J). It is, therefore, posited that coastal defence decision making in the North West for the period 1999- 2049, within the SMP process in particular, in essence carried forward past coastal defence decision making, some of which dates back to the Victorian period. In light of refreshed procedural SMP guidance from Defra in 2006, adopted SMPs were being reviewed and SMP2s, for a hundred year time span, were under development. It was, therefore, investigated as to how past and current coastal defence decision making would be addressed.

At the time of survey, it was reported by the Chair of the North West Coastal Group that Halcrow engineering consultants had only recently been commissioned to prepare SMP2s for sub-cells 11a-e. A review of these plans was, therefore, not possible. Surveyed Local Authority engineers were questioned regarding likely SMP2s issues and policy directions. From discussions, several engineers indicated that future policy content and direction was likely to carry forward previous past SMP policies. This is evidenced by the following quotations, *"...will go through the whole SMP process but there isn't going to be anything other than Hold The Line"* (Engineer A); *"A few policies might change, most of them are Hold the Line...no major change"* (Engineer C) and *"...SMP document is to support management of the coast and the way that Council does its job, it can hardly end up conflicting with Council policy...need to maintain defences for communities"* (Engineer F). This last quotation highlights significant issues concerning future coastal defence decision making processes.

The legacy of past coastal defence decision making into the first round of SMPs policies, maybe perpetuated within SMP2s. It is surmised that coastal defence decision making in the North West is in a cyclical pattern, involving a complex blend of decision pathways with strong connections between past, present and future decision epochs. Importantly, SMP decision making does not occur in isolation of existing management issues. Furthermore, where a strong regeneration driver exists, the rejuvenation of sea-side resorts impels and necessitates the maintenance and investment in coastal defence.

4.4.5 Is the decision pathway connected with those occurring within other decision contexts / sectoral domains?

This EI seeks to explore cross-sector decision connections. Whilst case study findings have so far been delineated between coastal defence and coastal planning, this section will now explore their interlinkages at a strategic level in the North West.

It is suggested that the presence of artificially defended coastlines along the North West coast is strongly connected with past coastal planning decision making. Much of the coastal development that has occurred can be considered a development control legacy; with many planning decisions made before dedicated coastal planning guidance was developed by government. When interviewed about contemporary coastal planning activities within their authority, Planner K raised an interesting consideration, *"future policies will steer new development away from the coast...this isn't the problem, it what we do with existing development... we have to deal with the situation just now ...historic legacy...the idea that we can retreat development from the coast is not going to happen... "* (Planner K). Similarly, Planner A stated, *"wouldn't start here in an ideal world"* (Planner A). Both authorities have large populations in areas of both significant flood risk and coastal erosion. In light of this, it is proposed that past coastal planning decision making in areas of flood and coastal erosion risk, gives rise to both present and future commitments and pressures upon Local Authorities to provide coastal defence for a large number of North West coastal communities. A clear relationship is, therefore, suggested between the decision contexts of coastal planning and coastal defence. This mirrors what was identified within the Literature Review (Section 2.5.3) as the 'development-defend cycle' predicament (Carter *et al.*, 1999; Figure 2.10). It is suggested that this contributes to understanding the external influences upon the SMP decision making process.

4.5 Findings: Decision Making Tiers

Decision making literature was found to propose the concept of decision making tiers (Section 2.4.1). Most notably the three tiers, Strategic, Tactical and Operational (for example: Gilligan *et al*, 1993). This section presents a combined discussion of findings associated with the Decision Making Tiers EI, namely:

- *What level or scale is being examined? and*
- *Can the three scales of decision, Strategic, Tactical and Operational, be identified within the context being examined?*

In light of absence in the literature of definitions for these tiers, findings interpreted their tiers as having pseudo- geographic boundaries framed by legislation and policy.

Table 4.3 presents the coastal defence-related legislative and policy framework (Section 4.3), and their implementation (Section 4.4.1) according to three decision making tiers. Whilst different policy instruments exist in England and Wales, Defra's 2005 'Making Space For Water' and WAG's 2006 Environment Strategy, both contain flood and coastal erosion risk management policies. Other similarities can be seen across the tactical and operational tiers in England and Wales, for example, the existence of SMPs, flood risk assessments and Coastal Groups. A similar picture emerges with regard to the coastal planning context, that also identified the three decision making tiers (Table 4.4). Interestingly, the geographical boundaries used to differentiate between the coastal defence tiers, do not correspond with the coastal planning tiers, specifically at the tactical tier. In coastal defence terms, this research has interpreted 'tactical' to mean coastal sediment cell. Within coastal planning, administrative boundaries for regional planning bodies, such as the North West Regional Assembly, are political (and more arbitrary) rather than geographical. Accordingly, regional planning at the tactical tier does not embrace the concept of sediment-cell based management (as used by SMPs and Coastal Groups). This creates issues and potential barriers to 'interfacing' activities between coastal defence and coastal planning.

Table 4.3: North West Case Study Coastal Defence Frameworks

Tier	Coastal Defence	
	England	**Wales**
Strategic	Legislation: Coast Protection Act 1949; Water Resources Act 1991; Land Drainage Act 1991 (as amended by Land Drainage Act 1994) Policy: Defra Making Space for Water (2005)	Legislation: Coast Protection Act 1949; Water Resources Act 1991; Land Drainage Act 1991 (as amended by Land Drainage 1994) Policy: WAG Environment Strategy (2006)
Tactical	Shoreline Management Plans; Regional Flood Risk Appraisals; Coastal Groups.	Shoreline Management Plans; Coastal Groups.
Operational	Coastal Defence Strategy Studies; Schemes; Strategic Flood Risk Assessments.	Coastal Defence Strategy Studies; Schemes; Strategic Flood Consequence Assessments.

Table 4.4: North West Case Study Coastal Planning Frameworks

Tier	Coastal Planning	
	England	**Wales**
Strategic	Legislation: Planning & Compulsory Purchase Act 2004 Policy: PPG 20 Coastal Planning (1992); PPS 25 Development & Flood Risk (2006)	Legislation: Planning Policy Wales 2002; Planning & Compulsory Purchase Act 2004 Part 6 (Inc Wales Spatial Plan) Policy: TAN(W) 14 Coastal Planning (1998); TAN(W) 15 Development & Flood Risk (2004)
Tactical	Regional Spatial Strategies	Regional Planning Guidance
Operational	Local Development Frameworks	Local Development Plans

4.6 Findings: Decision Structure

This section presents an examination of findings relating to forcing factors that may influence decision pathways. Specifically, the section addresses:

- *Is the decision pathway framed?*
- *What is the frequency of this type of decision?*

4.6.1 Is the decision pathway framed?

In light of the volume and extent of policies and documentation existing at all three RSM decision making tiers (Tables 4.3 and 4.4), it is proposed that there is significant framing of decision pathways within coastal defence and coastal planning.

The framing applicable within the coastal defence decision context is considered as occurring within a hierarchy aligned to the three decision making tiers, Strategic, Tactical and Operational. This will now be illustrated through consideration of the SMP process. As outlined in Section 4.4.4, the development of SMPs utilises central government's procedural guidance, that itself is in line with central government's coastal defence strategy and policy. SMPs and their policy recommendations are then adopted by Operating Authorities, for example, Barrow Borough Council reported that they had fully adopted the SMP for coastal sediment sub-cell 11e 'St Bees Head to River Sark, Scottish Border Shoreline Management Plan' in 1999 (Bullens, 1999). SMP policies are then often translated into smaller geographic –scale strategy studies that examine policies and engineering aspects in greater technical detail, *e.g.* Walney Island Coastal Management Strategy (Barrow Borough Council, 2000). At the operational level of coastal defence decision making, Local Authorities are steered and their coastal defence decisions explicitly framed by the content of the Coastal Defence Strategy Study, that stems directly from the adopted SMP, in line with national central policy.

Within case study investigations it is possible to trace individual operational schemes of work up to the tactical SMP level. This can be illustrated by Sefton Borough Council's coastal defence activities. The installation of the Marine Drive Floodwall in Southport was completed by Sefton Borough Council in 2002. This structure provides a 1 in 20 year return period standard of protection to the highway and the adjacent hinterland along this stretch of coast. This scheme of work directly corresponds to the Hold The Line policy within the adopted SMP 'Shoreline Management Plan 11b Formby Point to River Wyre' and the specific Coastal Process Unit 6, Management Unit 2 'Fairways to Weld Road' 3.2 km Management Unit length (Shoreline Management Partnership, 1999).

In coastal planning terms, the existence of decision framing was evidenced within the Ocean Plaza coastal planning case (Section 4.4.3). This discussion highlighted the range of coastal and flood risk-related planning policies that were applicable within this singular planning case. In particular, the authority's development plan policies were observed as strongly framing the decision making process. As the statutory documents to guide the land-use planning system, the coastal and flood policy content within development plans is paramount to coastal planning decision making. That is, whilst terrestrial planning is limited to land above the low water mark, coastal planning in England and Wales is governed principally and explicitly framed by Local Planning Authorities and their adopted development plan documents. These are the principal means of avoiding and reducing flood and coastal erosion risk to and from new development. To reflect this, and to inform the interviews conducted with Local Authority Planning Officers and Engineers, a review of planning documents for the eleven surveyed Local Authorities was undertaken.

The review of North West planning documents comprised fourteen Local Authority development plans (this included Structure Plans, Local Plans and Unitary Development Plans (UDPs)), along with regional level planning documents (Table 4.5). Due to aspects, such as, local government reorganisation and various changes to the planning system, plans of differing ages (the oldest developed in 1993 and the newest in 2006), at different scales and with varying geographical coverage exist (Figure 4.7). The term development plan will now be used to encompass Structure Plans, Local Plans and UDPs. The following discussion presents key findings from the review relevant to the framing of both coastal planning and coastal defence in the North West.

Table 4.5: North West Planning Documents

Local Authority	Document Title	Plan Status
Conwy County Borough Council	Gwynedd Structure Plan	Adopted 1993
	Colwyn Borough Local Plan	Adopted March 1999
	Conwy Unitary Development Plan Written Statement	Consultation Draft April 2001
Flintshire County Council	Flintshire Unitary Development Plan 2000-2015	Deposit Draft 2003
Denbighshire County Council	Denbighshire Unitary Development Plan	Adopted 2002
Wirral Borough Council	Wirral Unitary Development Plan	Adopted 2000
Sefton Borough Council	Sefton Unitary Development Plan 2006	Adopted 2006
Wyre Borough Council	Wyre Local Plan 1991-2006	Adopted 1999
Lancaster City Council	Lancaster District Local Plan 1996-2006	Adopted 2004
South Lakeland District Council	South Lakeland Local Plan	Adopted 1997
Barrow Borough Council	Barrow Local Plan Review 1996-2006	Adopted 2001
Copeland Borough Council	Copeland Local Plan 2001-2016	Adopted June 2006
Allerdale Borough Council	Allerdale Local Plan	Adopted 1999
	Allerdale Local Plan First Alteration	Adopted June 2006
North Wales Regional Planning Group	Regional Planning Guidance for North Wales	Adopted October 2002
Government Office for the North West	Regional Planning Guidance for the North West	March 2003
North West Regional Assembly	The North West Plan: Submitted Draft Regional Spatial Strategy for the North West of England	Submitted January 2006

Figure 4.7: North West Planning Documents

Source: Original

The review considered plan content with respect to coastal content and policies on flood risk, coastal erosion and coastal defence. Of the seventeen planning documents, only four contained a chapter dedicated to the coast (Denbighshire UDP, Wirral UDP, Sefton UDP and Regional Planning Guidance for the North West). Additionally, seven plans had a coastal section, these being two UDPs (Conwy and Flintshire), four Local Plans (South Lakeland, Barrow, Copeland and Allerdale) and the Regional Planning Guidance for North Wales. Within Authority J, the planner observed that the reason as to this authority having an explicit coastal chapter was, *"due to the great pressures and huge* *constraints"* on the authority's coastal area. The fact that eleven of the plans either contained a coastal section or chapter suggests a high significance attributed to the coast by those preparing these plans, reflecting a strong prominence of coastal issues within planning in the region.

All local plans referred to development and flood risk, as did all regional planning guidance. An exemplar flood risk policy content from the review, in line with current planning guidance on development and flood risk is as follows, "Policy WAT1 - Planning permission will only be granted for new development which would not be at risk from fluvial or tidal flooding, or which would not increase these risks to other developments" (Wirral Borough Council Unitary Development Plan, 2000, pg. 241). The requirement under PPS 25 and TAN(W) 15 that development plans address flood risk, explains the existence of flood risk policies. Additionally, this may indicate flood risk as being a strong driver of significance in the North West, necessitating explicit policies. This contention is supported by the history of flooding events (coastal and fluvial) that have occurred (Section 4.2.3).

In contrast to flood risk policies, only half of the reviewed plans contained policies on either coastal erosion or coastal defence. Excerpts of these policy statements are presented within Table 4.6. The majority state an explicit requirement that new development should not increase coastal erosion, impair the coasts' natural ability to provide coastal defence or increase the need for coast protection.

Table 4.6: Extracts of Coastal Defence-related policies in North West planning documents

Wirral Metropolitan Borough Council Unitary Development Plan (2000, pg. 253-255)
Policy CO4: "Proposals for new coastal protection and sea defence works will be permitted subject to the following criteria: ... (X) the works do not increase the risk of coastal erosion or flooding elsewhere". Policy CO5: "Within areas considered to be at risk from coastal flooding or erosion, development will only be permitted where this would not necessitate the construction of additional sea defence or coast protection works." Policy CO6: "Development proposed within areas likely to be affected by coastal erosion or land instability should comply with Policy PO7, but will only permitted where erosion or landslips are not likely to occur during the lifetime of the building."
Denbighshire County Council Unitary Development Plan (2002)
Policy CPZ4: "development within the coastal planning zone (cpz) will only be permitted where it would: i) not increase or transfer the risk of flooding or coastal erosion through its impact on natural coastal processes; ii) not prejudice the capacity of the coast to form a natural sea defence; iii) not increase the need for additional coastal protection works except where necessary to protect existing investment or development.
Barrow Borough Council Local Plan (2001, pg. 5_9)
Policy D7: "Development will not be permitted in the coastal zone which would be likely to: ...1. Increase the risk of flooding, coastal erosion or instability...2. Prejudice the capacity of the coast to form a natural sea defence...3. Increase the need for additional sea walls or other civil engineering works for coastal protection purposes except where necessary to protect existing investment"
Allerdale Borough Council Local Plan (1999, pg. 254)
Policy CZ4: "Coast Protection, sea defence, sewage disposal, highway improvement and other works requiring planning permission will only be approved where:... (iii) the carrying out of works will not lead to an increase in the risk of inundation, flooding or erosion elsewhere within the Coastal Zone".
Sefton Borough Council Unitary Development Plan (2006, pg.107)
Policy CPZ2: "Development within the Coastal Planning Zone will only permitted where it would: ...(a) increase the risk of tidal flooding or coastal erosion through its impact on coastal processes...". Policy CPZ2: "Development will not be permitted which would: ...(b) impair the capacity of the coast to form a natural sea defence...".

Flintshire County Council Unitary Development Plan (2003, pg. 36)
Policy L6: "Outside settlement boundaries and allocated sites development on the coast will be permitted only where: ...c. natural coastal defences are not adversely affected; d. extensive coast protection measures are not required...".
Copeland Borough Council Local Plan (2006, pg. 154)
Policy ENV 14: "Development will not be permitted in the coastal zone which would be likely to: ...1.increase the risk of flooding, coastal erosion or instability through it impact on natural coastal process...2.prejudice the capacity of the coast to form a natural sea defence...3.increase the need for additional sea walls or other civil engineering works for coast protection...".

The planning review sought to examine the interface between coastal defence and coastal planning. To facilitate this, the incorporation of SMP policies within development plans and regional planning guidance in the North West was analysed. As set out in Section 4.4.4, SMPs for the North West were adopted in 1999; the review, therefore, considered whether or not, development plans and planning guidance developed after 1999 made reference to SMPs, and if so, to what extent. It was determined that of the reviewed plans, eleven were developed and adopted after 1999. However, only eight of these refer to SMPs (five Local Authority plans and all three regional planning documents). Interestingly, the following quotation by a planner indicates the reasoning as to why their authority's adopted development plan did not refer to the SMP, *"LDP is not a management plan, it's a land use plan...can't really go into the same level of detail as an SMP...not the job of the LDP to take on board the content of CFMPs, RBMPs and SMPs"* (Planner K). In summary, SMP references asserted that the authority's land-use development policies should recognise, reflect and to be in accordance with the SMP and its contents. Despite only five Local Authority plans containing explicit references to SMPs (Flintshire UDP, Copeland Local Plan, Allerdale Local Plan, Barrow Local Plan and Sefton UDP), interviews with planning officers revealed all planners to be aware of the relevant SMP for their area and its adoption by their authority. This suggests that SMPs are important documents for land-use planning purposes. This is notable, in light of the non-statutory nature of SMPs and the perception of the limited interface between SMPs and the land-use planning system (English Nature, 2005). Of the five Local Authority plans that contained SMP references, four of these (Copeland Borough Council, Sefton Borough Council, Barrow Borough Council and Allerdale Borough Council) were identified in the review of High

Level Target Policy statements (Section 4.4.1)) as have notable coastal erosion risk. It can, therefore, be inferred that coast protection and shoreline management planning is an important activity undertaken by these authorities, thus providing a possible explanation as to their inclusion within the authority's development plan.

The findings of the planning review highlight the extent of framing that occurs within the coastal planning decision making context. Concomitantly, the interface that exists between the sectors of coastal planning and coastal defence is visible by erosion and flood risk-related policies and SMP references, that challenge literature propositions.

4.6.2 What is the frequency of this type of decision?

Case study findings identified that decision making frequency, in both studied decision contexts, was related to the particular decision tier being examined (Section 4.5). In light of this, a relationship between decision frequency and decision complexity is proposed.

Within the coastal defence sector, the plans and strategies observed at the three decision making tiers (Table 4.3), were found to have differing cycles of preparation and development. First Generation SMPs, for example, took on average three years, with adopted plans containing coastal defence policies for a fifty year planning horizon (Consultancy A). SMP2 development was underway in the region, eight-nine years after the adoption of SMP1s. In comparison, an authority may commission a site-specific Coastal Defence Strategy Study or Project Appraisal. This *ad hoc* form of documentation at the operational level can be prepared within a number of months, dependent on the detail of scheme design desired by the client and computer modelling of coastal processes required (Consultant B). This level was, therefore, found to be more frequent. For example, a large number of capital schemes and regular maintenance were being undertaken by several surveyed Local Authorities (Section 4.4.4).

The frequency of coastal planning decision making exhibited similar patterns, with regard to a discernable relationship between decision making tier and cycles of plan preparation. At the time of survey, in light of changes introduced by the Planning and

Compulsory Purchase Act 2004, the preparation of new spatial planning portfolios were underway. These included those at the operational level by Local Planning Authorities and similarly, those at the tactical level by Regional Planning Bodies (in England). A draft Regional Spatial Strategy for the North West of England was submitted to government in January 2006 to replace the adopted Regional Planning Guidance (North West Regional Assembly, 2006). English Local Authorities were also developing Local Development Frameworks (LDFs); the planning horizon associated with the Core Strategy documents of LDF reported as being 15 years (Planner A). The case study research did not incorporate surveys with development control officers. Accordingly, this form of operational coastal planning decision making and associated frequency cannot be commented upon. It is suggested, however, in light of the findings that the development control process within the coastal planning decision context would exhibit greater frequency of decision making due to it being the operational decision making tier.

A generalised picture from these findings, particularly within the coastal defence decision context, was therefore a recognised relationship between decision frequency and decision making tier, with greater decision frequency occurring at the operational level, in comparison to the tactical level of decision making. Furthermore, more time consuming and complex decision making cycles of plan preparation and decision making occur at the tactical level of decision making; with more frequent and routine decision making occurring at the operational level. The strategic tier of both decision making contexts corresponds to central government legislation and policy in England and National Assembly for Wales and WAG policies. Whilst the research did not examine this decision tier, it can be suggested that this would follow the patterns exhibited with the tactical and operational decision tiers; with less frequency and greater complexity. For example, the refreshing of central government policy in 2005 and 2006, by Defra and WAG, respectively, took place over ten years since the inaugural Flood and Coastal Defence Strategy issued in 1993.

4.7 Findings: Decision Support

Decision Support EIs examine the natural coastal change evidence base utilised within the Decision Pathway (Section 4.4), the Decision Making Tiers (Section 4.5) and the Decision Structure (Section 4.6).

RSM Decision Support EIs:

- *What is the nature/characteristics of the task information involved?*
- *What mechanisms (internal and external) were engaged to aid the retrieval and application of task information?*
- *Do different decision pathway stages and decision making tiers require different task information?*
- *Were aspects of the decision pathway aided by other sources in addition to task information?*
- *What is the level of certainty regarding decision outcome?*

4.7.1 What is the nature / characteristics of the information involved?

The Literature Review (Section 2.5.4) identified central to the sustainable management of the coast and its resources was natural coastal change information (Woodroffe, 2002). Consequently, natural coastal change information is considered central to the thesis (Section 2.6.2) and was focussed upon within the research.

The interview schedule with Local Authority engineers sought to determine the nature of their natural coastal change evidence base. Interesting findings supporting Kamphuis's (2006) assertion concerning natural coastal change uncertainty, emerged in discussions with Engineer H. This engineer reported that despite continued investment and concerted effort being taken towards understanding natural coastal change along their frontage, for example, coastal monitoring has been undertaken since the early 1920's, the authority's coastal defence team are still are not fully confident about the coastal processes at work. Furthermore, it emerged that whilst the authority has sufficient natural coastal change information to undertake broadscale mapping for the next 100 years, at the microscale there is a notable lack of detailed understanding particularly for aspects such as offshore conditions (*e.g.* sediment movement and direction). Concomitantly, this engineer observed uncertainty concerning natural coastal change also existing at the sediment cell 11-scale, where an absence of data and understanding concerning sediment movement and budget was noted. This was evidenced within the reviewed North West SMPs 11a, b and c, that contain recommendations for coastal studies and monitoring to address gaps and deficiencies in areas of natural coastal change understanding (Shoreline Management Partnership, 2001). Such findings suggest that uncertainty is inherent within the coastal defence operations undertaken by Operating Authorities; the implications of this last point will be addressed later (Section 4.7.5). Natural coastal change uncertainty will now be considered within the coastal planning decision context.

The planning review (Section 4.6.1) examined the use and presentation of natural coastal change information. Interestingly, only three of the seventeen reviewed plans contained visual natural coastal change information, such as, indicative flood maps or coastal erosion maps (Sefton Borough Council's UDP, Wirral's UDP and Regional Planning Guidance 13 for the North West). Emanating from the review's consideration of the use of natural coastal change information was an interesting case in which natural coastal change uncertainty was explicitly referred to within a reviewed UDP. Wirral Borough Council's adopted UDP (2000) contains a specific coastal defence policy 'Policy C04- Criteria for Coastal Protection and Sea Defence Works'. The policy justification states, "There is growing world-wide concern about the possible impact of seal level rises from global warming. In the Wirral context, the Flood Defence Division of the Ministry of Agriculture, Fisheries and Food, considers that the best estimate of sea level rise for the North West Region of the Environment Agency is 4.0 millimetres each year or 0.2 metres over 50 years; and for Welsh Region of the Environment Agency, 5.0 millimetres each year or 0.25 metres over 50 years" (Wirral Borough Council, 2000, pg. 254). In order to gain further insight into this, the subsequent interview with the authority planner sought greater detail and clarification. The planner explained that Wirral Borough Council's cross- border location meant that both English and Welsh sea level rise data were applicable, with no local-level sea level rise figures available for the Wirral coast. It was revealed that, during the preparation of the UDP, the authority had sought to obtain a definitive statement on sea level rise from the Environment Agency, but to no avail. In response, the authority chose instead to publicly present the sea level rise information provided by the two Environment Agency regions (*i.e.* 4mm and 5mm annual sea level rise). This predicament highlights points made earlier by Engineer H with regard to a lack of natural coastal change information certainty. Compounding this within the case of Wirral Borough Council was the complexity arising from the cross-border nature of sediment cell 11.

4.7.2 What mechanisms (internal and external) were engaged to aid the retrieval and application of task information?

This EI explores the mechanisms utilised by decision makers to access the task information outlined in the previous section. In light of this, this section presents detailed findings associated with Local Authority practices with respect to the retrieval and application of such information. These discussions explore the sources of information (internally and externally), highlighting a number of innovative systems, the patterns of usage associated with commissioning engineering consultancies and the sharing of this evidence base amongst decision makers.

Within the coastal defence decision context, interviews with Local Authority engineers examined in depth natural coastal change information sourcing activities, such as, monitoring efforts, inspections, commissioned research. These investigations produced an overview of the information types involved undertaken by the authority and on behalf of the authority. Thus, it was possible to review the technical skills and capacity of the surveyed authorities. Information types can be grouped into two main categories, and subtypes, namely:

- Forcing Factors:
    - Wind;
    - Wave;
    - Tidal; and
    - Currents.
- Topographic:
    - Profiles (*e.g.* dune)
    - Extent lines (*e.g.* saltmarsh)

The most frequent and commonly cited regular in-house Local Authority information sourcing activities were identified as being:

- beach surveys and topographic profiles;
- beach monitoring;
- maintenance inspections;
- annual survey / inspections of assets and
- annual monitoring reports.

Several authorities reported having extensive historical monitoring datasets. For example, in the case of Sefton Metropolitan Borough Council, foreshore profiles have been monitored between Ainsdale and Southport since 1914. Similarly, Wirral Metropolitan Borough Council has datasets dating back to the 1930s. Lancaster City Council reported they have an environmental monitoring station at the head of Stone Jetty, Morecambe, recording temperature, wind direction, barometric pressure, tide height (telemetrically liked via computers to the Engineering Division within the Town Hall). Further funding had been secured to increase the capability of the station to include measuring full surge depth. It was explained that this monitoring forms part of the authority's tidal flood surge warning system implemented in response to past flooding events that has occurred, for example, the flood event in 1983 that affected over 200 properties in Morecambe (Zong and Tooley, 2003).

Regular and re-occurring activities, such as annual coastal inspections, were often being supplemented by other types of information for operational coastal defence decision making. For example, the development of coastal strategies (*e,g.* Walney Island Strategy by Barrow-in-Furness Borough Council), detailed topographic surveys (*e.g.* on the Sefton sand dunes by Sefton Borough Council) and studies of erosion rates at hot spots (*e.g.* Allonby Bay and Bootle, Cumbria by Allerdale Borough Council). However, these were generally undertaken on *ad hoc* basis in response to site-specific issues and short-term operational decision making. Interviewees were not able to indicate if such studies were utilised in other forms of decision making, such as, SMP development.

In addition to the range of activities undertaken by Local Authorities in the collection and sourcing in-house of natural coastal change data, several innovative mechanisms to the sourcing and application of information to support coastal decision making were identified. Most notably were those by Lancaster City Council and Wyre Borough Council. Lancaster City Council, who were found to be have one of the larger engineering teams and high levels of coastal defence activity (related to their coastal resort heritage), reported pioneering work trialling satellite imagery of Morecambe Bay to investigate channel movements. This research, as stated by the engineer, was being undertaken with a view to see whether or not it could be utilised to inform decision making by the authority in, and around, Morecambe Bay. It was explained that satellite data are purchased by the authority from the British National Space Centre in a digital format. This is analysed in-house using computer software to produce images in order to identify new positions of the channel within Morecambe Bay. Prior to this, they had utilised orthorectified aerial photography to examine the coastal processes of area. It was reported that the authority was one of the first in Europe to use this form of data at this geographic scale. In the case of Wyre Borough Council, it was identified that they had established a real time video (Argus) to record a section of the foreshore. This novel system, operated by Delph and owned by Oregon State University, is being used to assess the impact of a new seawall on the adjacent coastline at Cleveleys. The system, at the time of the survey, had been in place for approximately two years. The authority had been successful in gaining initial grant aid funding from Defra, with on-going funding provided by the authority.

The activities so far discussed can be regarded as being internally sourced and undertaken natural coastal change information activities. All surveyed Local Authorities indicated that, to differing levels, they source additional information from external sources and mechanisms. This was categorised into information commissioned specifically by the authority and information that was undertaken by others, but, of interest to the authority's coastal defence work, for example, conservation information compiled by statutory agencies. The following list compiled from interview data from Authority H, seeks to demonstrate the vast range and diversity of externals sources and mechanisms that can be accessed by an authority to support their internal sources:

- Natural England
    - Nature conservation *e.g.* boundary designations
- Environment Agency
    - LiDAR data
    - Vegetation surveys

- Hydrological data
- Proudman Oceanographic Laboratory
  - Wind, wave, tidal currents
- Coastal Group
  - Aerial photography
- Higher Educations Institutions (Liverpool University, Liverpool Hope University, Edge Hill University)
  - Collaborative research between engineering staff and academics
  - PhD, Masters and Undergraduate projects
- Local Research Office and Civic Societies
  - Historic documents and records (hard copy, visual and audio)
- Ordnance Survey data
- Commercial companies
  - Dredging companies, ports

However, of most interest within this category was the predominant usage of engineering consultancy firms as a mechanism for sourcing information.

All surveyed Local Authority engineers, were found (to some degree) to engage external consultancy firms to undertake coastal work. The level of usage varied significantly across the region, from *ad hoc* usage through to annual and regular usage. An emerging trend involved authorities with engineering teams of 3 or less FTE staff members being identified as regularly using consultants. Reasons conveyed by these authorities related predominantly to institutional capacity, with a lack of in-house skills, expertise and time being common. For example, *"...haven't got the technical capacity, skills or importantly the time to be doing it"* (Engineer J). Other authorities had *ad hoc* patterns of consultancy usage, for example, *"anything out of the ordinary"* (Engineer F). Regular commissioning of consultants was facilitated by working relationships, for example, *"good working relationship with a number of consultants"* (Engineer A), and trust and familiarity, *"they know the problems...and our stretch of coast"* (Engineer F). As indicated, most authorities utilised consultants, the rationale behind this varied. In one instance, an authority reported they make a conscious effort to try and do as much in-house coastal work as possible, *"always feels we have more ownership of the schemes that way"* (Engineer D). Similarly, Engineer A reported that whilst they try to do the majority of their coastal work in-house, for example, scheme development, they will bring in consultants for final design work. Consultants are, therefore, often used for their specialist services, knowledge and expertise, including services related to computer modelling and simulation of flood overtopping. An additional reason offered was that this form of scientific evidence, *"...comes with more a guarantee...we can't indemnify themselves"* (Engineer A). In the case of Authority C, the engineer indicated that their usage of consultants related specifically to aspects of quality control and assurance, as indicated by the following quote, *"preferable to have third party assessment...speaks volumes"* (Engineer C).

Patterns of usage (frequency and type of services sought) by the surveyed authorities were examined, with discernable correlations between the coastal defence capacity of the authority and the level of consultancy service required. Authorities with small-scale in-house coastal defence capacity, *i.e.* small teams of staff and limited resources (Authorities B, E, F, G, J and I) were found to require consulting services that included both technical and procedural assistance. For example, guidance on technical aspects (coastal processes knowledge and expertise), and assistance with the procedural aspects of coastal defence including, understanding the process by which the authority can access funding and grant aid for coastal defence from central government. In contrast, those authorities with large coastal defence teams (Authorities A, C, D and K), are knowledgeable and experienced and, as such, do not require input from consultants on either low-level technical issues or procurement aspects.

Further consideration of consultancy usage established that two coastal consultancy firms were providing regular coastal-consultancy services to several Local Authorities in the region; and have been doing so, in some cases, for over fifteen years. In order to gain further insight into this, interviews were conducted with three consultancy firms in the region. Long-standing working relationships between certain consultants and numerous coastal Local Authorities were identified. For example, Shoreline Management Partnership Consultancy provides resident consultancy services to Lancaster City Council. The range of coastal work undertaken was reported as including, monitoring, annual coastal defence inspections, design work, strategy development and SMP development. Contractual work is also carried out on behalf of North West Coastal Groups, including the North West Coastal Group, Tidal Dee Users Group and Cell 11 Working Party.

Potts (1999a), in his work examining Coastal Group policies and practices for coastal information management identified external consultants as an important means of information collection for Coastal Groups in England and Wales. For example, this author observed an emerging trend for "tendering out" (1999a, pg. 242). Case study research found this practice to be common place within the surveyed authorities and other statutory agencies, and supported by the following quotation, *"follow the lead that the Environment Agency take, we hire in a consultant to do it"* (Engineer C).

The case study research also sought to identify instances of information sharing between authorities. Emerging from these investigations was the involvement of many authorities within a sediment cell-wide monitoring initiative, Cell 11 North West Regional Monitoring Strategy (CERMS). This initiative, promoted by the North West Coastal Group and led by Sefton Borough Council, had secured central government funding from Defra from 2008 until 2011. It was reported that this initiative would collate existing monitoring data in the North West and establish a strategy for the North West for future coastal data collection and monitoring activities (Engineer H). Several interviewees regarded this development as strengthening the regions coastal defence capacity, addressing natural coastal change gaps and facilitate access to existing sediment cell 11 natural coastal change data.

In light of these findings, the retrieval and application of natural coastal change information by Local Authority engineers and coastal defence teams can be considered to be a mosaic of various datasets of varying temporal and spatial scales. The mechanisms engaged to do so were found to be a combination of internal in-house sourcing activities, in conjunction with externally commissioned coastal work; with the latter of these becoming increasingly more prevalent.

4.7.3 Do different decision tiers require different task information?

This EI explores the application of task information within decision making. With respect to coastal defence operations, the information needs within the development of SMP were explored. The development of SMPs does not involve the undertaking of new coastal research. Instead, those developing these documents draw together and collate existing and available information on a number of areas. First Generation SMPs, utilising the 1995 procedural guidance, collated and assimilated information on the following areas:

- Coastal Processes;
- Coastal Defences;
- Land Use and the Human & Built Environment and
- Natural Environment

(MAFF *et al.*, 1995). Accordingly, these plans operate within the existing state of the knowledge. Where gaps and deficiencies were found, plans made recommendations for future studies to be undertaken. This can be contrasted with the natural coastal change information requirements at the operational level of decision making. At the site-level, the natural coastal change information required by decision makers differs. It was reported that to inform particular schemes of work, authorities will commission consulting engineers to prepare studies and undertake computer modelling and simulations to allow much greater understanding of site conditions (Engineer K). This work can then be used to inform technical engineering scheme design work, as reported by one engineer, *"the costs of collecting the data are far outweighed by the benefits in increasing confidence and certainty, for example in scheme design"* (Engineer H). This level of information sourcing is seen as being both appropriate and proportional to the information needs at this operational level of decision making. An interesting finding with respect to this point was the reporting by an authority concerning the range of information from different sources and spatial scales, brought together in a 'layer-cake' style of combination for operational-level decision making. For example, in order to provide a detailed picture of site conditions, the engineer was able to obtain large-scale strategic coastal process understanding contained within the Futurecoast coastal evolution study. This could then be scaled down to the SMP-level of understanding, followed by information within the coastal strategy, enhanced by site investigations and local knowledge (Engineer G). This layering of natural coastal change information demonstrates that information needs vary according to both the geographic scale and decision making tier.

4.7.4 Were aspects of the decision pathway aided by other sources in addition to task information?

To address this EI, this section explores if decision makers utilised other sources, in addition to task information, to support decision making pathways.

Emanating from interviews with Local Authority planning officers were findings concerning the role of expert advice and knowledge within coastal planning decision making. All planning interviewees reported that the main internal source of natural coastal change information was the Engineering Division or engineering officers within the authority. In light of this, the role of Engineering in relation to the natural coastal change information transfer and provision was examined. Several planners emphasised that they regarded the key role of the authority's Engineering Division as being to translate and interpret technical information for Planning. This they suggested, can, as and when needed, be disseminated into planning decision pathways, *e.g.* the development of coastal policies for the UDP, or a development control planning application. This is reflected within the following comments by planners, *"...engineering provides an interpretation of technical information...including implications...relying on them to tell us of urgent issues if they are aware of them"* (Planner D); *"...essential that they provide the technical side of coastal defence"* (Planner B). These findings are explained by research by Stojanovic (2002). This author states that due to the complexity of coastal information, information exchange through personal interactions (in this case between planners and engineers) allows for the knowledge of the engineer to be transferred to the planner in an interpreted and relevant fashion.

There was a strong consensus amongst surveyed engineers concerning the valuable role of Coastal Groups in sharing best practice and lessons learnt, as well as the contribution of these Groups to decision making. These voluntary groupings of coastal defence practitioners in the North West were reported as being the primary mechanism for maintaining an engineer's awareness of emerging policy and guidance developments, the sharing of recommendations concerning the usage of consulting engineers and facilitating strategic and joined up thinking. In some cases, Local Authority engineers indicated that whilst their authority had internal weaknesses, *e.g.* small teams, with limited financial resources, they considered this compensated for, and counterbalanced by their engagement with the Coastal Group. It was reported that due to this, the associated support that this membership provides to support and inform their coastal defence activities (Authorities E, F and G). This form of professional engagement and participation can, therefore, be seen as supplementing and supporting decision making pathways.

4.7.5 What is the level of certainty regarding decision outcome?

Decision certainty is considered within this EI. This includes the confidence of the decision maker in the outcome of the decision pathway. The term 'certainty' is un-related to previous discussions pertaining to task information uncertainty (Section 4.7.1). This section presents findings from both examined decision contexts, including the role of the Precautionary Principle within coastal planning and the certainty of decision outcome in relation to the planning horizons associated with SMPs is also considered.

As documented within the Literature Review (Section 2.3), the Precautionary Principle may be utilised as to deal with uncertainty (Gonzalez-Laxe, 2005). Consideration was paid to the usage of the Principle within coastal planning, both within planning review (Section 4.6.1), and the interviews with planners. The incorporation of the Precautionary Principle and Approach was observed in only five reviewed plans, all of which were Local Authority Plans; extracts of these are contained in Table 4.7.

Table 4.7: Review of North West Planning Documents: Extracts of statements concerning the Precautionary Principle

Allerdale Borough Council Local Plan (1999, pg. 23)
"The Council will support the Precautionary Principle where there are significant risks of damage to the environment but scientific knowledge does not conclusively prove this. In such cases, the principle dictated that such development should not go ahead…"
Flintshire County Council Unitary Development Plan (2003, pg. 96)
"…where there are considered to be unacceptable risks, proposals will be refused in accordance with the Precautionary Principe as embodied in Planning Policy Wales".
Sefton Borough Council Unitary Development Plan (2006)
"A precautionary approach will be applied to manage environmental risk".
Denbighshire County Council Unitary Development Plan (2006, para. 2.6)
"…to adopt the precautionary principle (i.e. assume the activity might be damaging unless it can proved otherwise) in respect of development proposals where significant environmental implications are involved".
Copeland Borough Council Local Plan (2006, pg. 44)
"A precautionary approach will be adopted in relation to new development proposals where all flooding implications must be assessed".

The findings from the review were mirrored within interviews with Policy Planners concerning their usage and awareness of this principle in the development of coastal policies. It was identified that the principle was neither regularly applied nor used in development policy, as it was ascertained that whilst the majority of planners were familiar with the principle, its role within their work was negligible. This is highlighted by the following comments made by two planners, *"the theory is there…used for risk…more related to contaminated land issues rather than the risks associated with flooding or significant coastal issues"* (Planner H) and *"…it's paid lip service to by the Council"* (Planner C). In the case of Authority J, whilst this authority's development plan states that principle should be adopted for development planning, the interviewed planner stated, *"I'm not sure about this Precautionary Principle although I've heard other Officers talk about it…wasn't used for one of our big coastal resort* *developments because of the push for regeneration and didn't have the data at the time"* (Planner J). This suggests a possible a lack of awareness and implementation of the principle, despite its presence in the UDP. Due to observed low profile of the Precautionary Principle within the review of planning documents and interview findings, a correlation cannot be made between uncertainty in the natural coastal change evidence base within the coastal planning sector and the literature proposition that the Precautionary Principle may be utilised as a tool to deal with uncertainty.

Discussions with Local Authority engineers concerning the development of SMP2s, particularly the introduction of the 100 year planning horizons, brought to light Local Authority concerns with regard to the adequacy of the coastal defence evidence base. In the majority of instances, engineers regarded the 100 year planning timescales, as either, not feasible, or possible due to the uncertainties of their natural coastal change information and understanding. This is highlighted by Engineer F, *"little bit puzzled about this 100 year planning...I don't think its an achievable target...far far too long...looks good on a wish list...not feasible...planning on 100 year timescale is totally unrealistic...too many variables".* This engineer indicated that they would only be able give a vague response when forecasting local natural coastal change, with a more detailed response available in the future, as and when the problem arose. Engineer I similarly stated that they had greater confidence when operating on a shorter planning horizon. Interestingly, Engineer C felt that the hundred year planning horizon was *"an opportunity to stargaze, anybody that feels they can say with any degree of certainty that they know precisely what is going to happen is kidding themselves as well as trying to kid others".* In contrast, Engineer G indicated that their authority's natural coastal change information was, *"fairly good", "at least for the 50 years can get a reasonable idea, once past the 50 years it's putting your finger in the air and guessing".* This engineer indicated that a lot would depend on future studies. Engineer E stated that they were *"not confident at all...doing reactive management...not sure what is going to crop up, don't know where the main issues or concerns are going to be, just waiting for the phone to ring...feel a little bit vulnerable".*

An additional area of uncertainty was observed at the interface between coastal planning and coastal defence due to development control legacies. This is evidenced by the following quotations, *"... we have to deal with the situation just now ...historic* *legacy...the idea that we can retreat development from the coast is not going to happen...*" (Planner K); similarly, "*wouldn't start here in an ideal world*" (Planner A).). As demonstrated in Section 4.6.1, the coastal planning decision context in the North West is considered as being framed by a raft of planning policy at strategic, tactical and operational levels. The consequence of this framing for future coastal planning decision making is indicated by the quote, "*future policies will steer new development away from the coast...this isn't the problem, it what we do with existing development*" (Planner K). The ramifications, however, of past coastal planning decision making for the present and future coastal defence decision context were considered within Section 4.4.5. North West coastal communities are vulnerable to coastal hazards and, as such, are reliant upon coastal defences. As observed by a Local Authority engineer, whilst there has been considerable investment in new coastal defence, and maintenance of existing ones, there are urbanised areas at flood risk. Furthermore, "*it's not a case of if a flood event will happen, but more when*" (Engineer A). This authority indicated that in response to the level of flood risk within the authority and the communities at risk, the authority was investing £12 million a year in total on coastal defence activities (including staffing), with £400,000 on maintenance (2007-2008). Similar situations were found within authorities: A, C, D, H and K. However, as Engineer H reported, whilst the authority provides a number of defence structures along the authority's frontage, they work with a level of uncertainty concerning the integrity of their coastal defences. This is illustrated with the case of a seawall and embankment structure that authority is responsible for. When built it was designed to provide 1 in 20 year level of flood defence and engineered to withstand a storm event. However, the residual life and engineering integrity of the structure is uncertain due to it being near the end of its design life, with the risk of erosion resulting from failure of this structure increasing annually (Engineer H). This form of risk management necessitates regular coastal inspections and monitoring activities (Section 7.2). This was indicated as being fairly indicative of other authorities; therefore, the uncertain nature of coastal risk-related decision making is regarded as a dominant characteristic.

4.8 Discussion and Conclusion

This section will now integrate and synthesis the findings presented in Sections 4.4 - 4.7.

Given the findings in Sections 4.4.1 and 4.4.2 it can be surmised that coastal risk decision making in the North West is extremely complex. The artificial distinction between coast protection and sea defence and border issues, cumulatively create fragmented and divided administrative arrangements. Furthermore, the range of decision makers (Section 4.4.1), from central government to private landowners, results in an intricate web of coastal defence decision making agendas.

Section 4.5 presented the strategic, tactical and operational hierarchy of decision making tiers. These are considered to be extensively framed by central government, regional government (in England) and local government policies on both coastal defence and coastal planning matters, thus, creating boundaries and constraints within which coastal risk decision makers operate. The Decision Making Tiers aspect of the RSM allowed the relationship between the different tiers of decision making to be clearly established.

Adding significantly to the complex coastal risk-related operating landscape, the research revealed that practices of past coastal planning and coastal defence decision makers (Sections 4.4.3- 4.5.5) were influencing present day decision making. Tied relationships between contemporary decision making in both decision contexts is regarded as a significant finding. Historical planning decisions have created legacies for coastal communities in areas of high flood risk and erosion. For example, several sea-side resort communities were found to be suffering from socio-economic decline and protected by aging inherited coastal defences. Decision making pathways at different decision making tiers reflected these community issues, for example SMPs at the tactical level and development control by Local Authorities at the operational level. These investigations elicited instances of inter-linkages between these contexts, suggesting an interface between the decision contexts of coastal planning and coastal defence; as evidenced within the documentary planning review (Section 4.6.1) and interviews between Local Authority engineers and planning policy officers.

The above discussion clearly reflects key decision making characteristics of coastal risk-related decision making and management in the North West. These research findings fulfil the first four stated case study data requirements as contained in Section 4.1, whilst importantly addressing the first thesis objective, '*To identify the salient decision making characteristics particular to coastal risk*'. Decision Support Empirical Indicators (Section 4.7) established a number of key findings with regard to the second objective of the thesis, '*To evaluate the application of natural coastal change science as evidence used within coastal risk assessment and its associated decision making procedures*'.

The nature of this information used by Local Authorities was identified, in addition, the range of natural coastal change information sources utilised and importantly the mechanisms available to them for doing so were ascertained. Through these investigations, the matter of uncertainty within the natural coastal change evidence base was highlighted in a number of areas. Most notably, the absence of data and understanding concerning sediment movement and budget at the micro-scale of coastal processes, and sediment cell-wide results gaps, creates a lack of decision making certainty. This situation was considered to necessitate on-going investment in coastal monitoring and inspections to inform risk-based management by local government Operating Authorities. Whilst diversity of coastal monitoring effort by the eleven authorities was observed, commonalities were noted. This was with regard to low-level monitoring of the coastal frontages, for example, beach surveys, coastal monitoring and annual coastal inspections. Extensive temporal and spatial data sets were found within various authorities. Mechanisms for sourcing information were reported as often including a substantial mix of in-house and external sources used in combination together to inform their coastal work (Section 4.7.2). Innovative approaches to the sourcing of natural coastal information were observed, for example, the utilisation of satellite imagery by Lancaster City Council to increase scientific understanding of channel movements within Morecambe Bay, the UK. The ability of authorities to develop state-of-the-art approaches to coastal research (in-house) indicates a strong technical capacity within some authorities. As reported above, the CERMS Cell 11 North West Regional Monitoring Strategy initiative was cited by a number of surveyed engineers as strengthening existing local-level coastal monitoring efforts through the assimilation of existing data into one central depository.

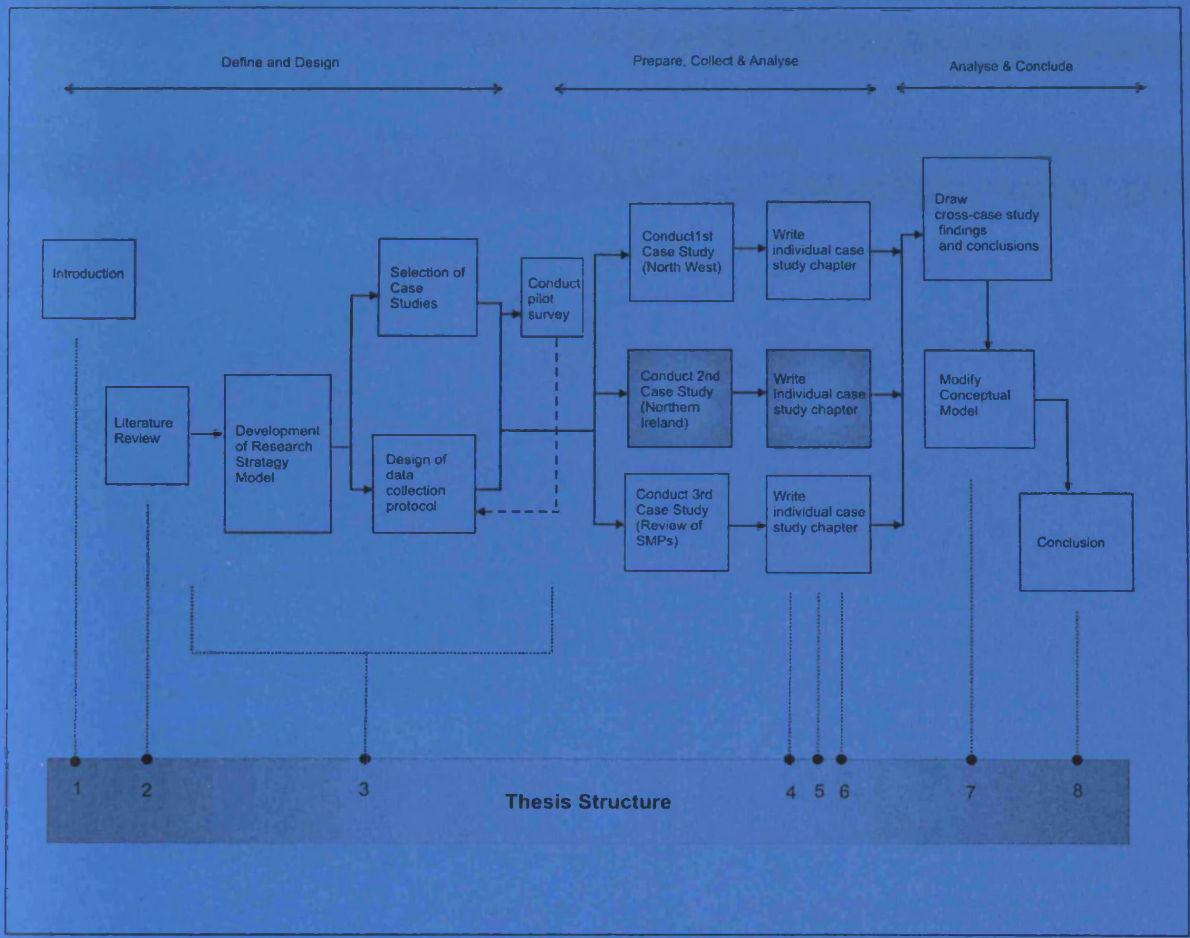
Section 4.7.2 proposed a relationship between past and present levels of coastal defence and the staffing resources within these Local Authorities. Authorities located in heavily urbanised areas with considerable lengths of defended frontages and significant flood risk were found to have the largest teams of engineers dedicated to coastal defence, *i.e.* three or more FTEs. It was identified that, historically, resorts tended to have significant technical capacity with in-house Chartered Civil Engineers to undertake and manage coastal defence activities, such as, large frontages with sea-walls and groynes. The engineering teams currently present in these authorities therefore reflects these past activities; however, the scale of these teams was now notably smaller despite present and future drivers to maintain, and in some cases increase, coastal defence activities within these areas. Local government restructuring was identified as having a significant impact on staffing and resourcing more generally within Technical Services and Engineering divisions of Local Authorities. In those localities with less areas of defended coastline and more variable levels of risk, both flooding and coastal erosion, technical teams were found to be smaller with more duality with respect to their staffing. Staff within these authorities tend to deal with coast defence alongside other responsibilities on behalf of the authority, most commonly land drainage. These patterns were linked to the use of consulting engineering firms to provide a range of client services to Local Authorities. An inversely proportional relationship was suggested between smaller coastal defence teams and their considerable usage and engagement practices with engineering consultants.

The planning review (Section 4.6.1) examined the use of natural coastal change. Interestingly, only three of the seventeen reviewed plans were found to present natural coastal change information in a visual format and so the wealth of natural coastal change information held by authorities was therefore not present or visible within the plans. Similarly, only eight plans referred to the relevant SMPs. The low frequency possibly reflects a low level of application and possible suitability of technical natural coastal data and information within this form of decision making, *i.e.* planning policy. The study of the application of natural coastal change within other decision making (Section 4.7.2) showed that differing task information was required by decision makers according to the different decision making tiers. This was evidenced within task information requirements of SMPs compared with local level decision making.

The last Decision Support EI (Section 4.7.5) is regarded as eliciting a strong picture concerning the application of natural coastal change information within coastal risk-related decision making. Strong consensus emerged amongst engineers concerning the complexities and uncertainties associated with the natural coastal change scientific evidence base. This translated into, for example, low confidence concerning the hundred year planning timeframe of SMP2s. Interrelated within this was decision maker's confidence concerning the integrity of coastal defence structures and the uncertain nature of coastal risk management. Several coastal communities can, therefore, be considered at both coastal erosion and tidal flood risk. Coastal risk decision makers are continually balancing the probabilities of events, such as storm surges and overtopping, with maintaining hard engineering structures and investing in on-going coastal inspections and monitoring. These activities are intended to manage and mitigate coastal risks that cannot be fully eliminated, despite engineering efforts.

With respect to the provision of coastal defence in the North West, it can not be easily discerned what function many of the coastal works serve, for example sea defence or coast protection, the level of protection they provide (*e.g.* 1 in 20 year or 1 in 50 year) and importantly, who is responsible for inspecting and maintaining them. Ultimately, this creates a lack of transparency and understanding of coastal risk by those communities the defences are intended to protect. Whilst investment into coastal defence continues by Local Authorities and others, a significant element of risk remains. Climate change predictions are only likely to exacerbate such risks.

In summary, the selection and undertaking of the North West Case Study as one of two geographical case studies, utilising a hypothesised based aproach, delivered an in-depth empirical investigation. The utilisation of the thesis RSM and its associated EIs concerning Decision Pathway, Decision Making Tiers and Decision Support (Sections 4.5 - 4.7), served well the process of examining the decision making processes associated with the coastal defence and coastal planning decision contexts in the North West. Furthermore, the Decision Support EIs (Section 4.8) allowed many aspects of the natural coastal change scientific evidence to be considered. A number of pertinent findings and observations emerged from these investigations; including the nature of the natural coastal change task information utilised by coastal risk-related decision makers, the sourcing and application of this form of scientific information by local government authorities to inform their coastal defence and coastal planning decision making activities. In light of the range of authorities contained within the case study, findings present a reliable picture of the current coastal defence arrangements in the region. The integration of the four discrete findings sections according to the two thesis objectives facilitated multi-dimensional analysis and discussions that explicitly addressed both the thesis objectives and case study data requirements.



Define and Design
Prepare, Collect & Analyse
Analyse & Conclude
Introduction
Literature Review
Development of Research Strategy Model
Selection of Case Studies
Design of data collection protocol
Conduct pilot survey
Conduct1st Case Study (North West)
Conduct 2nd Case Study (Northern Ireland)
Conduct 3rd Case Study (Review of SMPs)
Write individual case study chapter
Write individual case study chapter
Write individual case study chapter
Draw cross-case study findings and conclusions
Modify Conceptual Model
Conclusion
1
2
3
Thesis Structure
4
5
6
7
8

5 Chapter Five 'The Northern Ireland Case Study'

5.1 Introduction

This chapter presents the results of the Northern Ireland case study. Utilising the Research Strategy Model (RSM), the research examines aspects of coastal risk decision making. The decision making sectors of coastal defence and coastal planning, and importantly the interface between the two, are used as a lens for the case study. Furthermore, the underpinning natural coastal change evidence base is critically reviewed. Through the application of RSM Empirical Indicators (EIs), the aim and objectives of the thesis are addressed and the case study data requirements fulfilled.

The chapter commences by considering the methodology associated with this study. This is followed by contextual information and an outline of the legislative and policy frameworks (Sections 5.2 & 5.3). The subsequent four sections apply the RSM EIs to the findings, detailing the Decision Process Tracing (Section 5.4) and Decision Making Tiers (Section 5.5), followed by Decision Making Aid (Sections 5.6 - 5.7). An integrated discussion then syntheses the findings in relation to the thesis aim and objectives, with a short conclusion (Section 5.8).

As presented in the Methodology Chapter (Chapter Three, Section 3.4), case study research instruments included a semi-structured interview schedule and audits and reviews of strategic and regional planning documents. The semi-structured interview schedule included sixteen interviews with officers from nine Local Authorities, five government departments and several academics (Figure 5.1; interview questions are contained in Appendix A2). The planning review survey proforma is contained in Appendix A3. Due to the sensitivity of the interview content and in line with the methodological approach taken within Case Study One 'the North West' (Chapter Four), interview data are presented via non-attributable quotations that indicate interviewee organisational or professional sources. Sections 5.3 onwards contain a blend of both primary and secondary data sources, with clear signage of source origin provided.

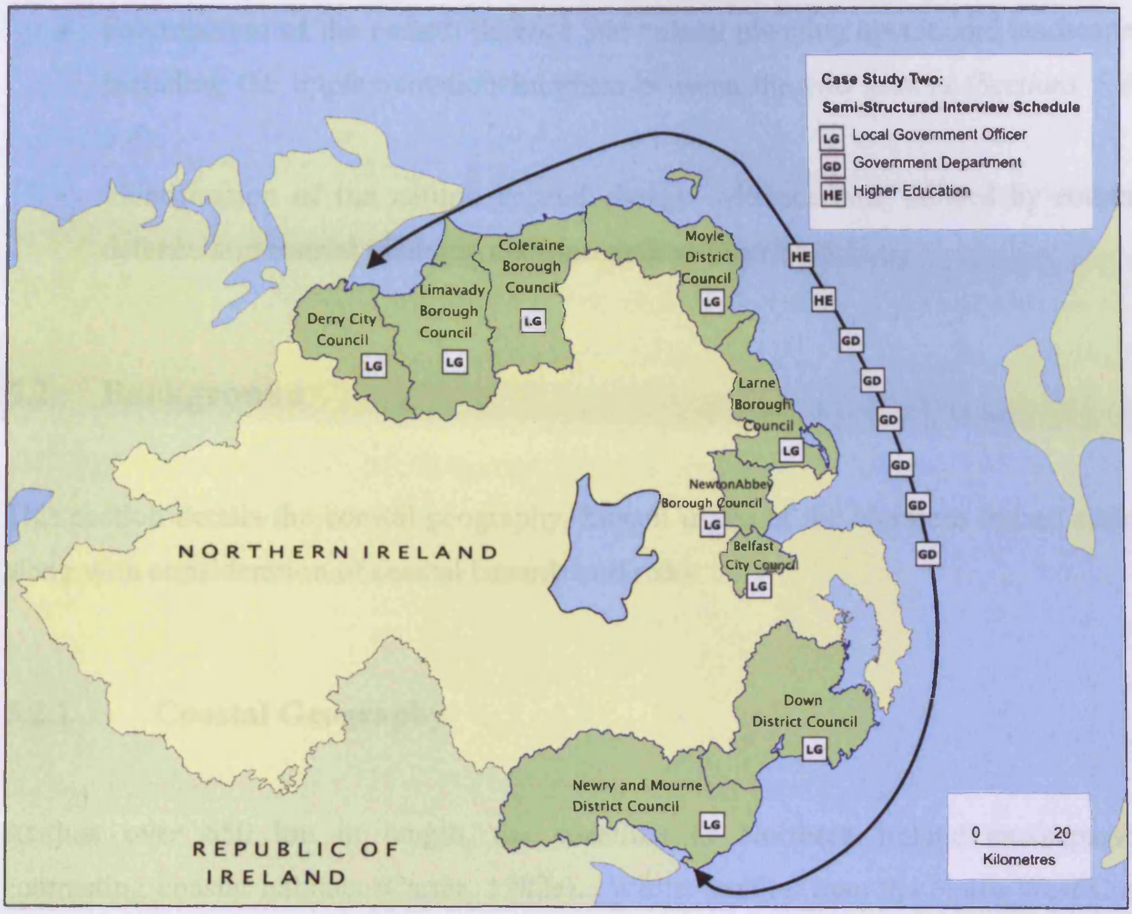


Figure 5.1: Case Study Two Distribution of Semi-Structured Interviews
Source: Original

The chapter structure mirrors that of Case Study One with the presentation of case study findings aligned according to the RSM EIs (Table 3.1). This process firstly traces the investigated coastal risk decision processes (Part A EIs), followed by the associated evidence base utilised within the observed decision making (Part B EIs). In doing so, there is concurrence with both the aim and objectives of the thesis and case study data requirements.

Case Study Data Requirements:

- Identification of the coastal defence and coastal planning legislative and policy frameworks (*Section 5.3*);
- Detailed review of documentation relating to coastal planning and coastal defence (*Sections 5.4-5.7*);
- Assessment of coastal defence and coastal planning decision making (legacies, drivers and policy directions; past, present and future) (*Section 5.4.4 & 5.4.5*);

- Examination of the coastal defence and coastal planning operational landscape, including the implementation interface between the two sectors (*Sections 5.4-5.6*);
- Identification of the natural coastal change evidence base utilised by coastal defence and coastal planning decision makers (*Section 5.7*).

5.2 Background

This section details the coastal geography, human usage of the Northern Ireland coast, along with consideration of coastal hazards and risks.

5.2.1 Coastal Geography

At just over 650 km in length, the coastline of Northern Ireland encompasses contrasting coastal habitats (Carter, 1982a). Whilst smaller than the North West Case Study, many similar coastal features occur in both localities. From the large, enclosed and highly diverse sea lough of the Strangford Lough Marine Nature Reserve (Bann, 2002) to The Giant's Causeway World Heritage Site, the coast is a strategic natural resource and national asset. Within the literature the coastal environments of Northern Ireland have been divided into two types: those found along the, "high energy north coast where storm deposits and erosion forms dominate" and those of the, "moderate to low marine and estuarine" east and south-eastern coasts (Carter, 1982a, pg. 10). The north coast comprises several sandy beaches, such as Magilligan Point, one of the UK's largest coastal sand dunes (Cooper and Gault, 2002), as well as several estuaries, for example, the Bann Estuary and Lough Foyle that support scarce saltmarsh habitats (Cooper, 2002). The east and south-eastern coasts are noted for their softer topography with moderate wave energy (*ibid*). This coastline features the Loughs of Belfast, Strangford and Carlingford, along with sandy beaches and fringing marshes (Atkins, 2004; Carter 1982b).

Due its high scenic value, almost three quarters of the coast is covered by some form of conservation designation (McLaughlin and Bann, 2002). The legislative framework covering nature conservation in Northern Ireland replicates that found in Great Britain *e.g.* Areas of Special Scientific Interest (ASSIs) (equivalent to SSSI's present in England and Wales), Marine Nature Reserves (MNRs), Ramsar sites, SACs and World Heritage Sites. In Northern Ireland sites are protected under various acts, most notably the Amenity Lands Act (Northern Ireland) 1965, Nature Conservation and Amenity Lands (Northern Ireland) Order 1985, as amended (DofE, 2006). Whilst many environmental designations are in place, the introduction and implementation of this legislation has, "...lagged many years behind Great Britain..." (McLaughlin and Bann, 2002, p.18). The rural farming community in Northern Ireland has been extremely powerful lobbying group, delaying environmental legislation between 1949 and 1965 (Mitchell, 1999). A case in point is the delay in the declaration of National Parks, which came sixteen years after those in England.

5.2.2 Coastal Usage

The coastline of Northern Ireland, like much of the coast around the United Kingdom, is vulnerable to continued pressures from substantial commercial and recreational activity. The agricultural sector has had a strong influence on the historical usage, including land reclamation and the removal of beach material (MaLaughlin and Bann, 2002). The practice of sediment removal (sand and gravel) from several beaches continues. However, its impacts are more severe due to larger quantities being extracted via large mechanical equipment, such as, bulldozers and tractors, with sites such as Castlerock, Portstewart, White Park Bay, and Cushedun suffering as a result (McLaughlin and Bann, 2002; Carter, 1982b). In the case of White Park Bay, Carter (1982b) estimated that since 1960, approximately 56,000 tonnes (2% of the total available sand) had been extracted, increasing vulnerability to coastal erosion. More recently, illegal sand extraction has been occurring at Ballintoy Harbour on the north coast (Coastal and Marine Forum, 2007).

Coastal access in Northern Ireland is considered within the literature as being good, facilitated by the existence of many coastal roads, with car parking facilities (including foreshore parking) (Carter, 1991). This pro-access culture stems from socialist attitudes after World War II that promoted the "people's right" to access the coast and countryside (Mitchell, 1999). The Antrim Coast Road, for example, built between 1832 and 1842, is regarded an important regional route (McCauley, 1997 cited in

McLaughlin and Bann, 2002). In addition, there are many coastal footpaths; with rambling and walking routes promoted by various tourism partnerships (DofE, 2006).

The Victorian era saw the establishment of several sea-side resorts similar to those in the North West of England and Wales. The construction of promenades and other amenities, such as, boarding houses and the establishment of railway lines to the coast facilitated the growth of coastal tourism, (Hanna, 2002). During 'The Troubles', domestic tourism strengthened, with resorts, such as, Portrush becoming extremely popular destinations in peak tourism seasons (Carter, 1982b).

The issue of second home ownership along the coast is evident in much of the literature (see Carter 1982a, 1982b, 1983 and 1991). More recently, this issue is considered within Northern Ireland's Integrated Coastal Zone Management Strategy, which states that, "On parts of the north coast second home development has reached levels that are causing concern both to residents and planners" (DofE, 2006, pg. 31). Human settlements within rural coastal areas have, in the past, sought this form of development to boost the local rural economy (Planning Service, 2005). Portballintrae, on the north coast, is estimated to have fifty percent secondary home ownership (DofE, 2006). The growing population of Northern Ireland, along with the prospering coastal tourism industry are the key drivers behind this demand (McLaughlin and Bann, 2002; DofE, 2006).

5.2.3 Coastal Hazards and Risks

It is understood that the Northern Ireland coastline is a, "delicately-balanced, physical system" (Carter, 1982, pg. 121). There is little sediment movement or transfer along the coast as sediment is contained within enclosed embayments that act as 'closed' cells (*ibid*). Orford and McFadden (2002, pg. 68) note that, "Coastal erosion as a means of supplying sediment to the beach has been important for NI"; with sediment supply also coming from landward-derived sediment transported via rivers.

In the 1990s Carter (1982b) stated that few sites were exhibiting natural progressive erosion or deposition. Mount Sandy on Magilligan Foreland experiences amongst the highest levels of coastal erosion in Northern Ireland; recorded at 3 cm yr^{-1} by Carter

(1991). Human activities and interventions have modified natural coastal processes resulting in both erosion and accretion (Cooper and Jackson, 2002). Where extensive sand extraction activities have occurred, the 'closed' sediment systems have been unable to replenish sediments lost; in some cases, resulting in notable erosion (McLaughlin and Bann, 2002; Carter, 1982b). Several sites experience the adverse effects of coastal erosion in response to coast protection features, such as, sea walls and rock armouring (Cooper, 2002; Carter, 1991). Research carried out by Rea (1981, pg. 2) in the early 1980's identified many sites, "suffering from the effects of 'erosion' processes, or at some time during the last two decades have suffered from the same".

The interim National Flood Risk Assessment for Northern Ireland (2007) estimated that 63,000 properties were within the indicative flood plain (Sayers and Calvert, 2007). The Foresight Future Flooding documents state that the tidal flood risk inventory for Northern Ireland lists 12,715 properties within the coastal zone and below the 5 m contour line; this document also notes that there are no estimates of flood frequency, making flood risk assessments difficult (Evans *et al.*, 2004). Large scale flooding in Northern Ireland is, however, considered rare, with coastal flood risk being, "significantly below elsewhere in the UK" (Evans *et al.*, 2004, pg. 203). It is estimated that 1 in 10 properties are at risk, with only 1 in 5 properties receiving protection (RPS, 2006). Coastal flooding is defined by Northern Ireland's planning body as, "the inundation of low lying coastal areas by the sea, or the overtopping or breaching of sea defences. It is an infrequent event..." (Planning Service, 2006a, pg. 26). Lowland areas and areas around the Loughs of Foyle, Belfast and Strangford are susceptible, with all major rivers also having stretches vulnerable to flooding following heavy precipitation (Smyth *et al.*, 2002; Betts, 2002). The risks associated with this are greater than that of river flooding due to the more rapid flows of water (Planning Service, 2006a; RPS, 2006). Whilst infrequent, partly due to Northern Ireland's high topography and large sections of hard rock coast, there is potential for greater localised flooding. In recent years there has been a higher incidence of flooding (Planning Service, 2006a; Chatterton & Suter, 2007). The most recent flood (fluvial) events occurred in August 2008. Prior to this, the Strabane Flood in October 1987 is regarded as being one of the most severe flooding events recorded and raised many issues regarding the adequacy of flood protection measures (Betts, 1990; Betts 2002). Recent fluvial flooding events have raised many issues regarding the adequacy of flood protection; flood warning measures and the availability of flood risk mapping.

5.3 Legislative and Policy Context

It is worth briefly considering the unique political nature of Northern Ireland as this influences the nature of decision making relevant to coastal matters. As a devolved administration of the United Kingdom (UK), it is defined under the Government of Ireland Act 1920. Ruled under the Stormont Government from 1921-1972, civil unrest ensued with the most severe period of unrest occurred during 1968 and 1994, known as 'The Troubles' (Kinnaird, 1993). The National Assembly of Northern Ireland was established under the Northern Ireland Act 1998. However, since October 2002 there have six periods of devolution in between several states of suspension. These periods have been ruled from Whitehall by the Secretary of State for Northern Ireland (Knox and Carmichael, 2006). This civil conflict has critically influenced nearly all matters of government and governance in Northern Ireland and will be discussed in greater depth within the chapter.

Coastal matters concerning the decision contexts of coastal planning and coastal defence in Northern Ireland are complex, with numerous decision makers involved. Before detailing these, an appreciation of the legislative and policy associated with environmental management is required. This has been predominantly informed by extensive desk-based documentary audits and reviews, supported by interview data as applicable.

The public sector can be best described as a kaleidoscope of fragmented administrations and divisions. The Departments (Northern Ireland) Order 1999 established eleven government departments that joined numerous government agencies, Local Authorities, boards, trusts and quasi-autonomous non-governmental organisations (Quangos). In light of this, Northern Ireland's governance system is regarded as, "...'over-governed and 'over-administered'..." (Knox and Carmicheal, 2006, pg .942). The plethora of administrative systems and structures presents challenges to environmental policy making and its associated implementation, especially with regard to coastal issues. Table 5.1 summarises the range of government departments and their responsibilities.

Table 5.1: Key Northern Ireland government departments, amended from Macrory (2004).

Northern Ireland government department	Indication of the range of responsibilities
Department for the Environment (DofE)	Land-use planning, development control, pollution control, nature conversation, biodiversity, marine environment, road licensing
Department for Regional Development (DRD)	Strategic land use planning, roads, ports and harbours, provision of water and sewerage services
Department for Social Development (DSD)	Urban regeneration and housing
Department of Agriculture and Rural Development (DARD)	Flood defence, agriculture, inshore fisheries regulation
Department of Culture, Arts and Leisure	Fishery protection
Department of Enterprise, Trade and Investment	Tourism, energy, mineral development
Department of Health, Social Services & Public Safety	Air quality and noise pollution

Coastal defence is defined in the Literature Review (Section 2.5.3) as a composite term for both the protection of the coastline against coastal erosion and instability (coast protection), and flooding (inundation) by the sea (sea defence; flood defence refers to flooding by seas and rivers). Case Study investigations revealed a sparse amount of legislation in pertaining to coastal defence. The Coast Protection Act 1949, the principal and solitary piece of coast protection-related legislation in England, Wales and Scotland, excludes Northern Ireland. Discussions held during the development of the act regarded coastal erosion issues in Northern Ireland as being of such small scale, as to not warrant it covering Northern Ireland within its statutory remit (Rea, 1981). In 1967 an administrative arrangement, the 'Bateman Formula', was established. This arrangement sees each government Department taking responsibility for the provision of coast protection works related to the infrastructure assets threatened by coastal erosion (Government Agency 3). A full overview of organisations involved in aspects of coastal defence in Northern Ireland, either through statutory legislation or government agreements can be seen in Figure 5.2 and Table 5.2. Whilst indirect legislation addressing aspect of coastal erosion and coast protection works exists, this is done only in a secondary or incidental manner, with coastal erosion not being the central focus of the legislation. As there is a little literature detailing these arrangements, Figure 5.2 has predominantly been based on discussions with interviewees from government departments and agencies. This research identified that previous studies in the early 1980s (largely by Rea (1981) and Carter (1981)) are still accurate, as there remains a legislative and policy vacuum for dealing with coastal erosion in Northern Ireland.

For tide-related flooding of low-lying coastal areas, the Drainage (Northern Ireland) Order 1973 places discretionary powers on DARD to maintain designated sea defences and watercourses, construct and maintain drainage and flood defence structures and to administer advisory and enforcement procedures to protect the integrity of the drainage infrastructure of all watercourses (Rivers Agency 2008; RPS, 2006). All statutory functions arising from the Drainage Order are undertaken by an Executive Agency of the Department of Agriculture and Rural Development, the Rivers Agency. This agency is tasked with reducing risks to life and property from flooding and preserves the productive potential of agricultural land. It should be noted that the Environment and Heritage Service (EHS) does not have a statutory responsibility for addressing flooding and coastal erosion. However, it is concerned where erosion impacts on statutorily protected sites *e.g.* SACs (Government Department 2).

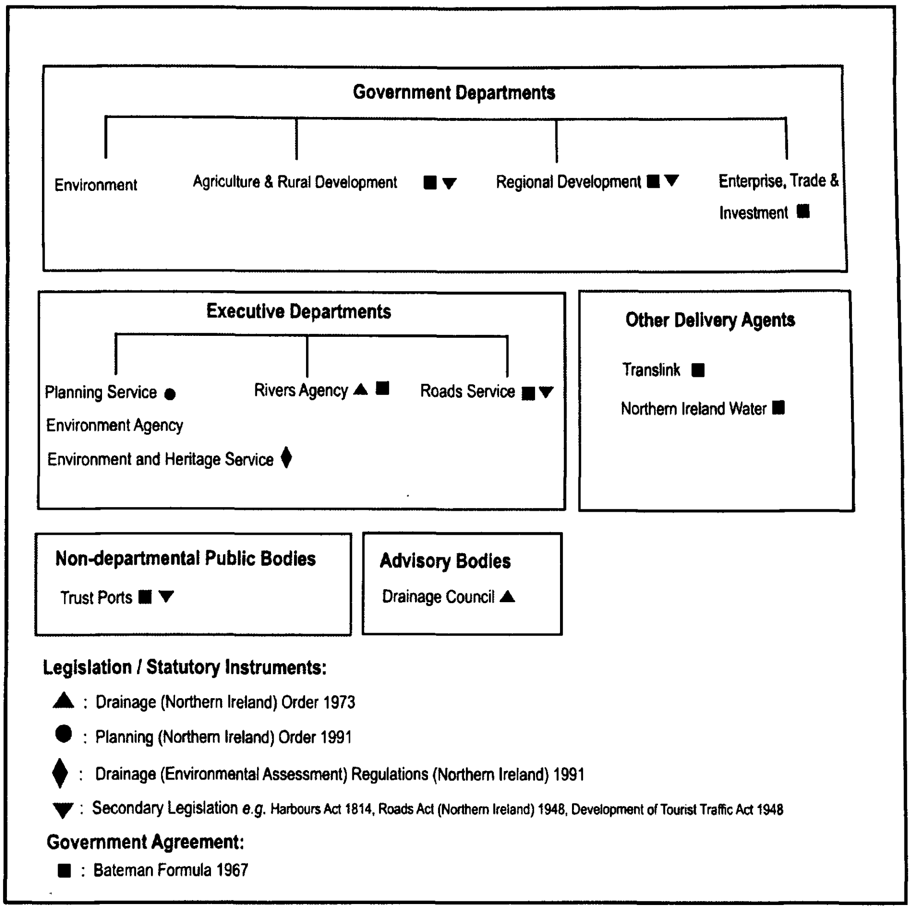


Figure 5.2: Government organisations involved in aspects of Coastal Defence

Source: Original

Table 5.2: Northern Ireland's Bateman Formula for essential coastal protection works

Northern Ireland government department	Indication of responsibility
Department of Enterprise, Trade and Investment (DETI)	Schemes related to tourism or harbours
Department for Regional Development (DRD)	Schemes with a road or promenade interest (for which DETI would have no responsibility)
Department of Agriculture and Rural Development (DARD)	Any essential schemes not falling to DETI or DRD which satisfy cost-benefit criteria

Source: Information supplied by the Environment Heritage Service, Northern Ireland.

In light of the information contained in Figure 5.2 and Table 5.2, it is asserted that the current system for dealing with coastal defence in Northern Ireland is piecemeal with several government departments engaged. Similarly with respect to coastal planning, it was ascertained that three government departments have planning roles and responsibilities (Table 5.3).

Table 5.3: Northern Ireland government departments dealing with planning matters

Northern Ireland government department	**Planning involvement:**
Department of Regional Development (DRD)	Strategic planning; development and implementation of Regional Development Strategy
Department of the Environment (DofE)	Development Planning: development and implementation of Area Plans. Development Control
Department of Social Development (DSD)	Development initiatives and various action plans

The Town and Country Planning system in Northern Ireland was established in 1931 to regulate the development of land for the benefit of society as a whole (Planning Service, 2008). Since the first piece of planning legislation, Planning and Housing Act (Northern Ireland) 1931, several amendments to the legislation have occurred. Presently, the Planning (Northern Ireland) Order 1991 (as amended) and Planning Reform (Northern Ireland) Order 2006 are the primary pieces of legislation. This legislation is designed to influence the nature of development of land to ensure that it is appropriate, of the right scale for the location and is aesthetically apposite (Planning Service, 2008). The Town and Country Planning Service was established in 1973 creating a singular planning body that sought to address claims of sectarian discrimination (Ellis, 2001; Kinnaird, 1993). This body became an Executive Agency of the DofE in 1996, therefore becoming semi-autonomous (Planning Service, 2008). It's creation is regarded as being the formal establishment of a development planning process in Northern Ireland (McEldowney and Sterrett, 2001). The Planning Reform (Northern Ireland) Order 2006 introduced a number of changes to the planning system that included, *inter alia*, moves to modernise the Development Control process and improving consultation arrangements between the Planning Service and Local Authorities (Planning Service, 2003). The majority of these came into force in May as the result of 'Modernising Planning Processes Implementation Plan' that noted, "The Planning process in Northern Ireland has not fundamentally changed in nearly 30 years" (Planning Service, 2003, pg. 11; Planning Service, 2008).

5.4 Findings: Decision Pathway

As indicated in Section 5.1 findings in Sections 5.4 through to 5.7 are aligned to the thesis RSM EIs (Table 3.1). The first section presents here EIs which address decision making processes associated with coastal risk. These are:

- *Who is the decision maker being examined?*
- *What is the context / sectoral domain of the decision being examined?*
- *Are there discrete stages to the decision pathway and what stage is being examined?*
- *Is the decision pathway connected to other decision pathways (past, present and future)?*
- *Is the decision cycle connected with decision pathway occurring within other decision contexts?*

The term 'decision pathway' refers to the complete cycle of decision stages that a decision maker may undertake. For example, the RSM's hypothetical decision pathway contains five stages (Figure 3.3). Decision pathways may occur at various levels or scales, for example Strategic, Tactical and Operational (Figure 3.3). Signage within the following sections establishes the level of decision making and sector being referred to. Even following intensive documentation review and an extensive interview programme, research identified only a limited number of complete decision pathways that could be investigated, reflecting the *ad hoc*, parochial and fragmented decision making frameworks (Section 5.3). Consequently, a substantive aspect of this case study involves the detailed investigation of the coastal defence decision pathway associated with a coastal bay on the north west coast of Northern Ireland. This example, Portballintrae, is initially presented in Section 5.4.3, with further references in subsequent sections.

5.4.1 Who is the decision maker being examined?

Case study investigations examined implementation of the regulatory and governance frameworks associated with coastal defence and coastal planning (Section 5.3). Research identified several decision makers; these being government (central and local) and private landowners within the coastal defence sector and central government within coastal planning. The following discussions detail various aspects related to these decision makers, including the legislation or discretionary powers governing their operations and the extent of their coastal defence and coastal planning activities.

The operational landscape with respect to coastal defence decision makers is extremely fragmented and sectoral. This, as noted in Section 5.3, is substantially due to the absence of specific legislation on coastal erosion and the nature of government arrangements. For example, there is a lack of a single authority responsible for coastal defence and the provision of coast protection works by central government. The Rivers Agency is responsible for maintaining 26 km of designated coastal flood protection defences under the Drainage (Northern Ireland) Order 1973 (Roberts *et al.*, 2002). Designated defences include 20 km of embankment structures along Lough Foyle, with smaller structures on Belfast Lough, Strangford Lough and on the coast of Down District Council (Government Department 3). Watercourses are designated by the Drainage Council, a non-departmental public body established under the Drainage Order (Northern Ireland) 1973. In addition, this body has a general scrutiny role over the Rivers Agency's drainage functions. Whilst predominantly focussed upon fluvial urban flooding, it is worth noting that Northern Ireland has an Inter-Agency Flood Group, established in 1999 following floods in the Greater Belfast Area. This group consists of the Rivers Agency (fluvial flooding and coastal defences), the Water Services (with storm and foul sewers) and the Roads Service (gulleys and road drainage) (Chatterton and Suter, 2007; Government Department 3). It was identified that Translink, responsible for running the railway service in Northern Ireland, provide 'third party' coastal defence at numerous locations totalling 23 km of sea-defences over their 336 km railway network (Government Department 4). The Roads Service that has responsibility for maintaining the integrity of the road network in areas of flood risk or coastal erosion, were unable (at the time of survey) to provide data regarding the extent of their coastal protection works (Government Department 5).

The absence of any shoreline management planning practices was identified by the desk study and interviews (Government Departments 4 & 5). This highlights a significant void at the strategic level in Northern Ireland for considering and managing coastal defence. At an operational level, a piecemeal modus operandi exists in the form of the previously discussed Bateman Formula (Table 5.2), *i.e.* infrastructure asset-based approach to the provision of coast protection works by government agencies. Mechanisms to assist and address issues of integration between government bodies undertaking coast protection work (for example, Coastal Groups in England and Wales; Section 4.7.2) do not exist in Northern Ireland.

In relation to flood management practices, the Rivers Agency (as the statutory drainage and flood protection authority) have been described within a recent government commissioned consultancy report as being, "reactionary, responding to flood events whilst staying within fixed budgetary constraints" (RPS, 2006, pg. 9). Furthermore, Betts (2002, pg. 43) highlights, "Traditionally, management of flooding problems in Northern Ireland has focused upon capital works rather than flood warning schemes". The activities of the Rivers Agency are regarded as being strongly influenced by a historical protectionist strategy towards agricultural land in Northern Ireland aimed at facilitating good agricultural productivity. The previously referred to consultancy report regards this public body as acting more as a Drainage Authority than as a flood management authority (RPS, 2006). Interestingly, interviews with Rivers Agency personnel did not concur with this finding. For example, it was reported that they considered their role, from a flood management perspective, as being similar in many respects to the Environment Agency. This agency has recently refreshed its policies towards flood risk management and in 2008 launched a revised policy vision on these matters; "To manage flood risk to facilitate the social, economic and environment development of Northern Ireland" (Rivers Agency, 2008, pg. 9).

As highlighted in Section 5.3, Northern Ireland's Local Authorities have no duties or responsibilities for coastal defence. This is determined under the Bateman Formula and as such, is regarded as a central government responsibility. However, as in many parts of the UK where coast protection functions are permissive, case study investigations revealed that authorities do undertake coast protection and coastal defence measures (at some sites), in an autonomous and parochial manner. From interviews with the nine authorities, research ascertained that only four authorities had undertaken coastal-defence related activities. Concomitantly, the research also revealed a significant lack of transparency, awareness and coastal management-understanding within a number of authorities that hampered further investigations into coastal defence activities. Interviews with Local Authority officers provided limited data and so it is acknowledged that the information provided here is not exhaustive, and as such, should be seen as illustrative. Only four authorities reported having sea walls, harbours, promenades and coastal paths (Authorities 3, 5, 7 & 9), however no further information was available regarding the management of these coastal works, for example, relating to inspection, maintenance and monitoring efforts. The next paragraph presents illustrative examples of identified coastal defence activities with Local Authorities as the overall decision maker.

In the case of Down District Council, the authority has been involved in attempts to manage beach erosion at Newcastle (which is part of the Dundrum beach system on the east coast) for a number of years. The interviewee indicated that there had been severe disruption of this beach system since the installation of a pier and seawall. These are believed to have increased long shore drift of sand to the northern section of the beach, away from the town centre, where the council would like the sediment for amenity purposes. Groynes and rock armouring were installed by the council in an effort to address the erosion. However, whilst the council recognises that the groynes are causing a negative impact and wishes to remove them, EHS requires them to carry out an Article 6 assessment in concordance with the site's protected status. This assessment would determine whether or not a project to remove the groynes would have a significant impact on the conservation value of the site. This has currently not been undertaken due to a lack of resources and, therefore, the erosion issues remain (Authority 2; Academic 1). Limavady Borough Council was also identified as being active in coastal management for the Benone Beach system. This site received intense visitor pressure due to the attraction of the dune system, the presence of a caravan park and the ability to park on the foreshore. Erosion of the dune system was highlighted as a concern for the authority, with efforts made to introduce visitor management techniques, such as, fencing. However, it was reported that these had to be removed when objections were received from the EHS who felt that they were disrupting the natural dune processes of the dune system (Authority 4). Moyle District Council reported they were working in partnership with the EHS on a soft engineering scheme at Waterfoot to provide protection to a designated dune system. This scheme is considered by the authority to be successful in management terms (Authority 5).

Adding to the complexity of the coastal defence arrangements so far discussed within central and local government, is the role of the individual as a decision maker. As in England and Wales, it is the responsibility of the landowner to protect or defend property from coastal erosion or flood risk. Private landowners represent a significant proportion of landownership, for example, the National Trust owns up to a third of the coast (200 km) (DofE, 2006). The activities of these landowners, and therefore decision makers, most notably Golf Clubs, have been discussed within the literature relating to coastal erosion in Northern Ireland. Several documented cases exist of golf clubs and coast protection schemes resulting in negative impacts on natural coastal processes, and instances of exacerbated coastal erosion (Carter, 1991). This aspect is highlighted by the activities of the Royal Country Down Golf Club. It is purported that this landowner has been responsible for impacting upon the western end of the Murlough dune system, County Down (*ibid*; Academic 1). The literature states since the 1930s this golf club, has installed a large number of timber groynes (over 3000 railway sleepers) and several installations of rock armouring (planning permission was granted despite an ASSI designation) to trap sediment and maintain the integrity of the course. As a result of these activities, the natural processes of the Murlough dune system have, been significantly interrupted (Hanna, 2002). This case can be seen as indicative of the types of coastal defence decisions undertaken by private rather than public bodies.

It is suggested that cumulative impacts of activities by these multiple decision makers (government departments, Local Authorities and private landowners) have yet to be fully considered, for example, due to the absence of any strategic coastal defence-related management and the lack of a reporting requirement and strategic monitoring. Also, it is questioned as to whether or not private landowners are undertaking activities in light of government inaction on this matter where coastal erosion issues are not directly impacting upon, for example, government infrastructure assets.

As reported in Section 5.3, there are three central government departments with coastal planning decision making powers (Table 5.3). However, the majority of the coastal planning decision making remit belongs to the DofE's Planning Service. The role of Local Authorities in the planning process is extremely limited due to their a consultative status / role (Ellis, 2001; Kinnaird, 1993). The remit of Local Authorities is summarised by Carter (1982b, pg. 123) as, "small or uncontentious matters are dealt with by District Councils". Whilst Local Authorities are involved in the consultation process, for example, for the development of Area Plans and planning applications, they do not have executive planning powers and cannot overturn planning decisions. Instead they are able to only refer a decision; the final decision for planning approval rests solely with the Planning Service (Planning Service, 2008). In light of this, one Local Authority interviewee regarded their involvement within the planning system as being token-like, as the de facto process sees Local Authorities merely being informed of the Planning Service's planned decision (Authority 2). It must be noted, however, that this has not always been the modus operandi. Prior to local government review, namely the 'Macrory Commission Report,' and subsequent government reorganisation in the early 1970's, planning powers were the responsibility of Local Government areas. These included County Borough Councils, County Councils and Urban District Councils (Planning Service, 2008; Kinnaird, 1993). The Local Government (Boundaries) Act (Northern Ireland) 1971 and the Local Government (Northern Ireland) Act 1972 abolished the 73 two-tier Local Authorities and created the current 26 single-tier local government (Kinnaird, 1993).

5.4.2 What is the context / sectoral domain of the decision being examined?

In order to provide an examination of coastal risk-related decision making, the decision contexts of coastal defence and coastal planning were used as a lens for the research. Section 5.3 has already outlined the legislative and policy frameworks of these. Additionally, Section 5.4.1 presented the range of decision makers within these sectors and responsibilities. These discussions highlighted the interesting and disjointed administrative arrangements that coastal risk decision making operates within, for example, an absence of coastal erosion legislation and the low profile of coastal defence within government. Furthermore, due to the importance of the planning system in controlling new development in areas of coastal risk and the shared responsibility with coastal defence for safeguarding communities and property at risk, it is interesting that local government does not have planning powers or coastal defence duties. To examine the interface between the coastal defence and coastal planning sectors, a review of coastal-related planning policy in Northern Ireland was undertaken and will be presented in the next section (Section 5.5.3).

5.4.3 Are there discrete stages to the decision pathway and what stage is being examined?

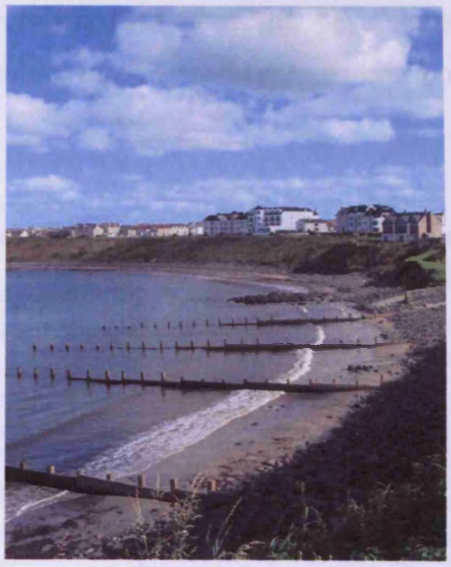
Investigations examined a range of decision making scales, from strategic considerations of coastal defence and coastal planning actions by central government decision makers, through to more detailed examinations, at the operational level by local government and private landowners. In light of the current lack of strategic system for coastal defence, the majority of coastal defence decisions are made at the operational level. Using the thesis RSM's hypothetical decision cycle (Stages A through to E) (Figure 3.2), a critique of an individual operational level of decision making was undertaken. As part of this, the role of natural coastal change information within the decision making process was critically examined. This process was facilitated by interview discussions with academics at the University of Ulster (Academic 1 & 2). The site of Portballintrae is regularly cited in the literature due its notoriety concerning a disagreement regarding the cause behind the loss of the wide sandy beach within the bay (Carter *et al.*, 1983; Rea, 1981; Carter, 1991; McLaughlin and Bann, 2002). Indeed, Cooper and Jackson (2002, pg. 168) state that Portballintrae is regarded as, "…one of the most celebrated examples of beach loss in Northern Ireland". This decision pathway example is, therefore, regarded as being of particular interest. As no other equivalent decision making examples of this scale were brought to light, the case of Portballintrae seeks to highlight the situation that can evolve with regard to short-term coastal defence decision making, based upon differing natural coastal change information and fluctuating political will.

Portballintrae is a seaside village on the north coast that has been used as a landing and mooring site for hundreds of years (Authority 8). The horseshoe embayment is a popular tourism destination due to its close proximity to several centres of population, for example Coleraine, Portstewart and Portrush. Additionally, two hotels close to the seafront service a strong tourist trade that attracts visitors who are also drawn to this stretch of coast's tourist attractions, notably Giant's Causeway and the Royal Portrush Golf Club. At present, there is a publicly owned harbour at the eastern side of the bay owned and maintained by Coleraine Borough Council (Figure 5.3). On the north western corner is a small pier, known locally as Leslie's Pier, which was originally constructed in 1895. This pier and a section of the land adjacent to the shore along the north- west corner of the bay (Seaport Lodge and Seaport Avenue) is currently in private ownership (Carter, 1991; Authority 8). The council has, over time, taken on responsibility for the foreshore at Portballintrae as a public amenity shore (Authority 8).

Leslie's Pier (north western section of bay)

Portballintrae Harbour (eastern section of bay)

Retaining wall (western section of bay)



Groynes (south western section of bay)

Figure 5.3: Portballintrae, Northern Ireland
Source: Original

The popularity of Portballintrae is linked to its wide sandy beach (Authority 8; Carter *et al.,* 1983). There was however, a loss of the sand within the bay between 1932 and 1979, with sediment changing to a mixture of gravel and boulders in the late 1990's (Kirk *et al.*, 1992; Authority 8). Based upon historical evidence, it is clear that a sandy beach (of varying volumes) existed from at least 1830 to around 1970 (Kirk *et al.*, 1992). However, the cause of the sand loss, along with collapse of cliff sections along the western section of the bay, remains undetermined. Over several decades, numerous intervention efforts have been undertaken to address the coastal erosion problems. However, these have been undertaken by different government agencies and private individuals based upon differing understandings of the coastal geomorphology within the bay.

Table 5.4 presents for the first time a chronology of coastal works undertaken at the site. This has been based upon a range of published literature, along with interview discussions and reports supplied by Coleraine Borough Council. The existing and available documentation, and local knowledge does not, however, facilitate a transparent and comprehensive consideration of all works, particularly with respect to the individuals carrying out the work and accurate dates. Despite this, it is can still be remarked that erosion problems have occurred at various times, with schemes of work, such as, the introduction of groynes at various locations within the bay, slope stabilisation and beach nourishment interventions taken to address perceived erosion problems.

Table 5.4: Chronology of coastal works pertaining to coastal erosion at Portballintrae, Northern Ireland (indicative rather than exhaustive).

Year	Works undertaken	Information Source
Circa 1760-1790	Leslie's Pier constructed at Seaport Lodge	Kirk *et al.* (1992) Carter *et al.* (1983)
1830	Pier destroyed by storm	Carter *et al.* (1983)
1890	Wooden groynes put in response to erosion	Kirk *et al.* (1992)
1895	Reconstruction and extension of Leslie's Pier	Carter *et al.* (1983)
1905	Wooden groynes erected on the north west side of bay	Carter *et al.* (1983)
1950's	Sediment removal for agricultural purposes (sand and gravel)	Carter (1991)
1950's	Deterioration of groynes	Rea (1981)
1950's and	Dredging of the channel for the public	Kirk *et al.* (1992)

onwards	harbour	
1960 & 1970's	Replacement of wooden groynes in the north west side of by including the introduction of gabions	Carter *et al.* (1983)
1965 – 1975's	Mud flow and backshore cliff slippage sporadic dumping of materials at base of cliff slope	Carter *et al.* (1983)
By 1970	Loss of sand (80,000 cubic metres)	Carter (1991)
Early 1970s	Introduction of gabions in the eastern side of the bay	Rea (1981)
1979/ 1980	Concrete toe wall put in to stabilise cliff slope thereby protecting integrity of road Rock armouring of pier wall (Department of Agriculture and Department of Environment)	Rea (1981)
1980	Cliff slope stabilisation	Carter *et al.* (1983)
1997	New groynes and beach nourishment by Coleraine Borough Council	Authority 8
Early 2000	Retaining wall put in at toe of eastern cliffs by Roads Service	Authority 8
2004	Survey commissioned by Coleraine Borough Council to examine 1997 coast protection works	Authority 8
2007	Future coast protection works planned by Coleraine Borough Council	Authority 8

Extensive research on Portballintrae by the late Dr RWG Carter and other academics at the University of Ulster has been conducted over several decades. Additionally, an independent study by consultants Kirk, McClure and Morton was commissioned by Coleraine Borough Council in 1992 to investigate the bay's coastal regime. This made recommendations concerning future schemes of work (Kirk *et al.*, 1992). Case study research identified that few records exist prior to the 1830s.

The study by Kirk *et al.* (1992) utilised the following sources of information:

- Topographic survey (1985, 1992);
- Ordnance Survey maps (1832, 1859, 1904, 1932, 1965, 1979) (all 1:2500);
- Admiralty chart (1979 1:75,000);
- Aerial Photography (1963,1975);
- Postcards and photographs;
- Historical private correspondence and
- Local informal information regarding historical beach sediment patterns.

Whilst a notable volume of natural coastal change information, there remains disagreement regarding the cause of beach sand loss, including the effects of groynes at different locations within the bay and drivers behind cliff slippage. The greatest debate, however, concerns the reported explanations regarding the loss of the sandy. The aerial photography in Figure 5.4 shows the reduction of the sandy beach over time.

Figure 5.4: Beach changes at Portballintrae, Northern Ireland.

Source: Photography reproduced with kind permission of CCMR, University of Ulster, Coleraine.

As highlighted by Carter (1991, pg. 23), "Experts have come and gone, mostly without solving the problem". Several authors have cited the reconstruction of Leslie's pier in 1895 as the predominant reason behind the sand loss (*e.g.* McLaughlin and Bann, 2002). Carter *et al.* (1983, pg. 35) established that, "Rea notes that the cause of the shoreline erosion was generally ascribed to drainage impedance leading to saturation of the beach and cliff. However it seems more likely that the troubles stem from the extension of Leslie's fishing pier in 1895". This claim is underpinned by a simulation model, the results of which modelling showed that, "The pier destablizes the beach plan, and erosion progressively envelopes the embayment" (Carter *et al.*, 1983, pg. 37). More recently Carter (1991, pg. 22-23) reiterates this, "22. The small pier near Seaport Lodge, the prime cause of erosion at Portballintrae...when this pier was reconstructed... it acted to upset, or perturb the wave pattern within the bay...the sediment that initially accumulated in the centre of the bay later tended to be flushed offshore, passing over a submarine scarp into deep water". Figure 5.5 illustrates Carter's (1991) asserted impact of the pier upon the sediment grading within the bay. With larger sediments accumulating closer to Leslie's Pier and finer sediments being drawn towards the eastern sections of the bay.

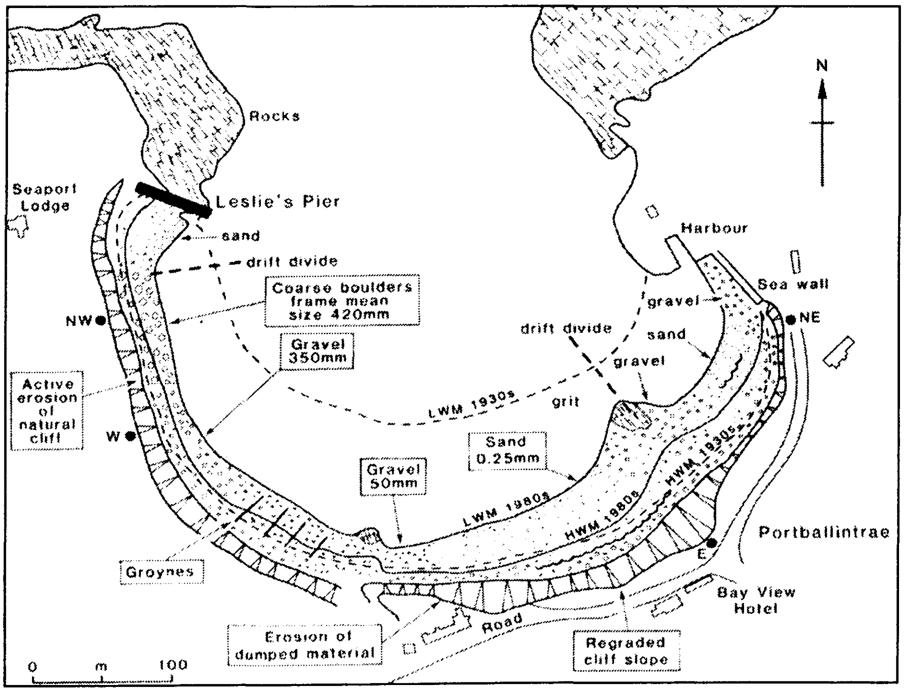


Figure 5.5: Proposed coastal regime, Portballintrae, Northern Ireland.

Source: Image (Carter, 1991) reproduced with kind permission of CCMR, University of Ulster, Coleraine.

McLaughlin and Bann (2002, pg. 16) cite the work of Carter (1991) and Carter and Bartlett (1988) and re-state the pier-based explanation of sand loss, "the construction of a new concrete jetty at Portballintrae (to replace an older wooden structure), caused the beach sediment to move offshore to deeper water where it was lost to the system". Cooper and Jackson (2002) state that sand and gravel sediment removal for agricultural purposes to be partially attributable to the erosion, whilst reiterating the role of the pier as being the predominant driving force.

Interestingly, Rea's (1981, pg. 107) discussion of erosion issues in Portballintrae do not discuss the pier in relation to, "the severe loss of beach sand". The positive role of first groynes in facilitating the build up on sand is implied and the deterioration of these is thought to aid the scouring and loss of sandy sediments from the bay. Similarly, the investigation undertaken by consultants Kirk McClure and Morton, reports that whilst localised effects such as Leslie's Pier exacerbated the erosion in the west of the bay, the groynes are the determining factor. They explain that the sand (which made up the large platform beach) was contained below the low water mark and the introduction of groynes in 1890 encouraged sediment shorewards and then deposited between the groynes. The construction of Leslie's pier, they consider as only having caused localised erosion. They argue that the sediment transport towards the intertidal zone (caused by the presence of the groynes) deepened the centre of the bay thus permitting greater wave energy to enter the bay and increase the return current velocity. This increased wave action most likely introduced significant quantities of sand into suspension and the increase in return flows transported this material seawards and ultimately lost offshore (Kirk *et al.*, 1992). In stark contrast, Carter (1991, pg. 21) states, "the presence or absence of groynes played very little part in the process".

As illustrated, different theories exist regarding the drivers behind changes within the coastal regime of Portballintrae; in parallel, various approaches to the erosion issues have been undertaken (Table 5.4). The reinstatement of a sandy beach has been the prevailing public concern, along with ensuring the integrity of the cliff slope due to the road and properties located behind it. During the late 1980s and early 1990s the local community began to, *"rumble and grumble about the ongoing loss of the beach"*, the loss of groynes and sediment was raised with the Council, due to the fears of loss of tourism revenue caused by a loss of the once sandy beach (Authority 8). As coastal defence is not a requirement of local government in Northern Ireland, it was ascertained that the council was keen not to be drawn into the matter (Authority 8). This was similarly the case for Roads Service, for example, cliff slippage has not always threatened the integrity of the road; this stance is in line with the Bateman Formula (Section 5.3; Table 5.2).

Strong community pressure, utilising elected member representation, saw the matter discussed at length by the Council. This resulted in site surveys and investigations commissioned by Coleraine Borough Council. It was during this time, that the theory of Dr RWG Carter concerning the role of pier became publicly known. The report by Kirk *et al.* (1992, para. A.6) makes reference to this work only in the appendix, that states, "Numerous reports and theories have been forwarded. Extensive research has been carried out by Dr. W. Carter in association with his colleagues, Bartlett, Lowry and Shaw". The community, thoroughly rejected Carter's idea and pressed for the re-instatement of the groynes (with the perception that they would attract and trap sediment). It has been proposed that the council were forced to be seen to be taking action and secured funds to undertake coast protection work (Authority 8). Protection of the western cliff face was undertaken first to address the illegal dumping of materials by locals at the base of the cliffs (often construction waste) to possibly antagonise the authorities. In 1997 news groynes were installed by the council, along with beach nourishment, (Figure 5.3) as recommended by Kirk *et al.* (1992). More recently the Roads Service put in a retaining wall at the toe of the eastern cliffs to protect the public road (Authority 8). There has since been redistribution of the imported sediment that was placed amongst the groynes, with a visible reduction in the sediment on the foreshore in recent years. In 2004, consultants were commissioned to examine the success of the 1997 works. However, this report was not available from the council at the time of survey. In light of the 1992 and 2004 reports, a number of phased works in the future, including, breakwaters, are to be undertaken by the Council (Authority 8).

It is suggested here that the coastal engineering interventions, rather than responding to the erosion issues themselves, have been provided to avert public concerns. The case study reveals the ability of the local community to influence and compel the local council to act upon matters that it is not legally required to do. For decades there has been no clear ownership of the coastal erosion issues; it is suggested that this is attributable to the modus operandi for coastal defence matters in Northern Ireland. The Area Development Plan, 'Northern Area Plan 2016', was reviewed and found to contain no coastal defence related policies. Furthermore, no local coastal management plan exists (Planning Service, 2005). Whilst the Planning Strategy for Rural Northern Ireland 1993 (PSRNI) contains a number of coastal policies, these had not been applied due to strong economic (tourism) pressure outweighing concerns over coastal risk and conservation (Authority 8). In the absence of the application of these, the Bateman Formula has been incited, along with the council undertaken discretionary works.

The management situation has been aggravated by and decisions made in spite of uncertainty regarding the natural coastal change evidence base. Whilst a range of information exists, there has been absence of systematic and prolonged coastal monitoring efforts, specifically regarding the role of groynes at various locations in the bay over time. The literature notes limitations concerning modelling studies of natural coastal change within the bay. For example, Carter *et al.* (1983, pg. 37) states briefly that the parameters used within the simulation model, such as wave conditions, do not, "exist in nature". However, these authors still regard their findings (based on the models) as corresponding with the available empirical knowledge of the site. Literature, such as Carter *et al.* (1991) and Kirk *et al.* (1992) use photography to examine changes in sediment volumes within the bay. They do not, however, provide information, such as whether the aerial photography is orthorectified, adding to concerns regarding the certainty the natural coastal change utilised to inform the scientific theories regarding the bay. Accordingly, the accuracy and levels of certainty regarding the use of maps and photography over such lengths of time, due, for example to changing cartographic techniques, can be questioned.

An interesting aspect to this case study is the capacity of the council to be able to respond to the perceived coastal erosion issues. Whilst there are technical officers with the capacity to make certain judgements within the council, assessments and decisions (in line with many Local Authorities in England and Wales) the engineering capacity of this council for dealing with coastal engineering issues is minimal. Accordingly, they are reliant upon external consultants to undertake technical coastal work, such as surveys and other site investigations. Furthermore, they are dependent upon external experts to advise on site management (including coastal engineering decisions). As indicated by a council officer, *"The science has been employed through the engineers, that's what they were brought in to do, to bring the science into it"*; additionally, *"we learnt from Portballintrae that science has a definite role to play in our understanding and our response to erosion issues"*. On the rationale behind using consultants and the absence in-house of engineering expertise, they indicated that the council, *"buy it in"* (Authority 8). As noted in Section 5.4.1, there are currently no scientific forums or mechanisms for example, Coastal Groups, that could facilitate coastal research, such as that undertaken by the University of Ulster, to be accessed by public bodies to support coastal decision making. The council therefore is dependent upon engaging consultancies to undertake research and work. However, it is discretionary for these firms to engage other research bodies, such as, academia (due to confidentiality of data and costs).

When the decision cycle of Portballintrae is considered against the thesis' theoretical RSM hypothetical decision pathway below (Figure 3.3), specific stages can be discerned.

RSM Part A: Decision Pathway:

Stage A: Problem Framing;

Stage B: Scoping of Alternatives & Determination of the Course of Action;

Stage C: Implementation;

Stage D: Monitoring /Feedback and

Stage E: Refinement.

The decision maker in this particular instance is the Local Authority, Coleraine Borough Council (influenced by community pressures). Stage A (Problem Framing) within the Portballintrae decision cycle can be considered as being strongly framed by concern over the perceived loss of beach material and community demands for action by the Local Authority. Leaving Stage B in effect pre-determined, as the desired course of action sought by the community was the re-instatement of the groynes. The potential scoping of alternatives contained in the RSM's Stage B, was cosmetically undertaken within the 1992 consultant's report. However, their recommendation for groyne installation (along with beach nourishment) was made in line with authority and community wishes (Authority 8). The framing of the problem at Stage A was not steered or governed by any relevant coastal planning policies within the applicable development plan for the area, *i.e.* the Northern Area Plan 2016. The policies contained in the PSRNI concerning the undeveloped coast were not applied by the Planning Service. Stage C (Implementation) has been reviewed within Table 5.4 that catalogues the number of works undertaken at the site. This implementation has been phased and connected with Stage D (Monitoring and Feedback). For example, surveys have been undertaken by the Local Authority to inform the ongoing coast protection works, *i.e.* maintenance of groynes and retaining wall (2004 and 2007), with a view to further beach nourishment that is regarded as being aligned to Stage E (Refinement). Whilst this particular coastal defence decision cycle could be considered haphazard and ad hoc, that has been sensitive to locally-based political will, when compared with the thesis RSM clear stages can be seen in the decision cycle and seen within a decision making framework of connected stages. This Empirical Indicator and aspect of the RSM, therefore, provides a process for exploring discrete stages within the process of decision tracing.

5.4.4 Is the decision pathway connected to other decision pathways (past, present and future)?

This section considers connections between decisions within their respective decision contexts, for example, inter-sectoral decision connections occurring within the coastal planning sector. This is undertaken to identify temporal relationships and sector connections (past, present and future). Operational coastal defence decision connections are considered first, followed by coastal planning.

It is evident from the literature and interviews, that coastal defence decision making at several sites has been taken at a micro-scale perspective to facilitate local benefits and to address, reactively, perceived coastal erosion issues. As discussed in Section 5.4.1, Local Authorities undertake *ad hoc* coastal defence-related works, with no long-term planning undertaken. Whilst the single sector (asset) management approach of government departments in accordance with the Bateman Formula achieves short-term objectives, it does not entertain cross-cutting strategic goals for coastal risk management. Local Authorities, central government departments and private landowners undertake works in isolation of each other, with no central reporting required. These forms of historic and contemporary decision making patterns by both public and private bodies have been fostered by an absence of specific legislation pertaining to coastal erosion and a lack of a strategic government policy or overview of coastal defence-related activities in Northern Ireland. Despite in depth case study research, the full extent of defended coastal frontages remains unclear.

Northern Ireland does not have in place a historic legacy of defences, for example, local and central government in England and Wales have permissive powers to oversee the maintenance of substantial amounts of coastal defences installed during the Victorian period (Academic 2; Government Agency 5). This situation clearly influences future decision making, as the absence of past decisions regarding the provision of defences does not tie decision makers to past coastal defence commitments. Without strategic shoreline management planning, and with a central policy void on coastal defence, it is unclear as to how coastal defence decision making will be guided in the future.

In the case of coastal planning, whilst it was found that development and urbanisation, has to date, not significantly encroached upon Northern Ireland's flood plains (Chatterton and Suter, 2004), the 250,000 dwellings to be built by 2025 may impact upon this (DRD, 2001). Indeed, Chatterton and Suter (2007) indicate that development within the areas of Portrush, the Outer Ards peninsula, Rostrevor and Newtonwards are likely to be at risk from coastal erosion. This situation is exacerbated by pressures for second homes, as developers seek prime coastal sites for development (Authority 8, Government Department 2; McLaughlin and Bann, 2002). Furthermore, climate change impacts, that include, *inter alia*, mean sea level rise of between 13cm to 74cm by 2050, will have implications for coastal risk decision making (Betts, 2002). Accordingly, it is suggested that future coastal planning decision making will potentially occur in areas of coastal risk. When this issue was presented to the Rivers Agency, who provide statutory development control advice to the Planning Service, they noted their policy of, "*... first and foremost risk avoidance and then risk management*" (Government Department 3). With only a limited coastal area, it is clear that contemporary coastal planning allocations will have implications upon future coastal planning decisions.

5.4.5 Is the decision pathway connected with those occurring within other decision contexts / sectoral domains?

This section considers the interface between the two decision contexts of coastal planning and coastal defence. As noted above, contemporary and projected future decision making within the coastal planning sector (Section 5.5.4), is likely to see development in areas of flood risk and coastal erosion. The implications of this for coastal defence decision cycle is clear due to tied relationship between development, demand for defence and the provision of defence works (LGACSIG, 2004; Figure 2.10). Whilst the full extent of future development in areas of coastal risk is unknown, pressure for coastal defence to protect coastal communities at risk is to be expected. Case study research could not identify where these commitments and pressures for the provision of coastal defence would potentially go to, for example developers, the Planning Service, other central government departments, for example Department of Regional Development, or Local Authorities. Whilst not in the remit of the case study research, connections between other sectors, such as, conservation and tourism, will likely impact and influence the sectors of coastal defence and coastal planning. This will detected within the Portballintrae case study, in which the amenity value of the beach saw tourism as a primary driver behind coastal defence decision making.

5.5 Findings: Decision Making Tiers

This section comprises two Empirical Indicators concerning Decision Making Tiers, *viz*:

- *What level or scale is being examined?;*
- *Can the three scales of decision, Strategic, Tactical and Operational, be identified within the context being examined.*

The following discussion integrates these two respective EIs, presenting a combined discussion of the associated findings within the coastal defence and coastal planning sectors.

As reported previously, case study investigations examined the full range of potential decision making with respect to coastal defence decision makers and detailed the legislative and policy frameworks. Table 5.5 aligns these arrangements in relation to the three decision making tiers: Strategic, Tactical and Operational. Most noteworthy are the legislative and policy gaps at the strategic level far, and those at the tactical tier. It is suggested that in light of the length of coast, this tier is not required and would be considered duplication of effort.

Table 5.5: Northern Ireland Case Study Coastal Defence Framework

Tier	Coastal Defence
Strategic	Legislation: EU Floods Directive adopted 2007; Drainage (Northern Ireland) Order 1973; Policy: "*Living with Rivers and the Sea*: Government's Response to the Independent Flood Management Policy Review" (2008)
Tactical	
Operational	Bateman Formula 1967

The same exercise was undertaken for the coastal planning sector (Table 5.6). In comparison to Table 5.5, gaps can be seen at the operational level. Development plans that in England and Wales exist at the operational level, in Northern Ireland exist at the tactical tier. Research into the hierarchy of planning documents (Figure 5.6), did identify a tiered approach similar to England and Wales, with strategic regional level documents existing (Regional Development Strategy) and at the Tactical (Area Development Plans). The Planning Service's 'Modernising Planning Processes' Implementation Plan reports, "There is a general uncertainty about the interrelationship between the precedence of policies, plans, supplementary guidance and other material considerations, which are relied upon when making decisions on planning applications" (Planning Service, 2003, pg. 49). This may be to an inability to decipher or align the range of plans (Figure 5.6) to geographical scales. In Case Study One (Section 4.5) geographical interpretations of the coastal planning decision making tiers were possible.

Table 5.6: Northern Ireland Case Study Coastal Planning Framework

Tier	Planning
Strategic	Legislation: Planning (Northern Ireland) Order 1991 Policy: Regional Development Strategy (2001); Planning Policy Statement (PPS 15): Planning and Flood Risk (2006)
Tactical	Development Plans (Area Plans)
Operational	

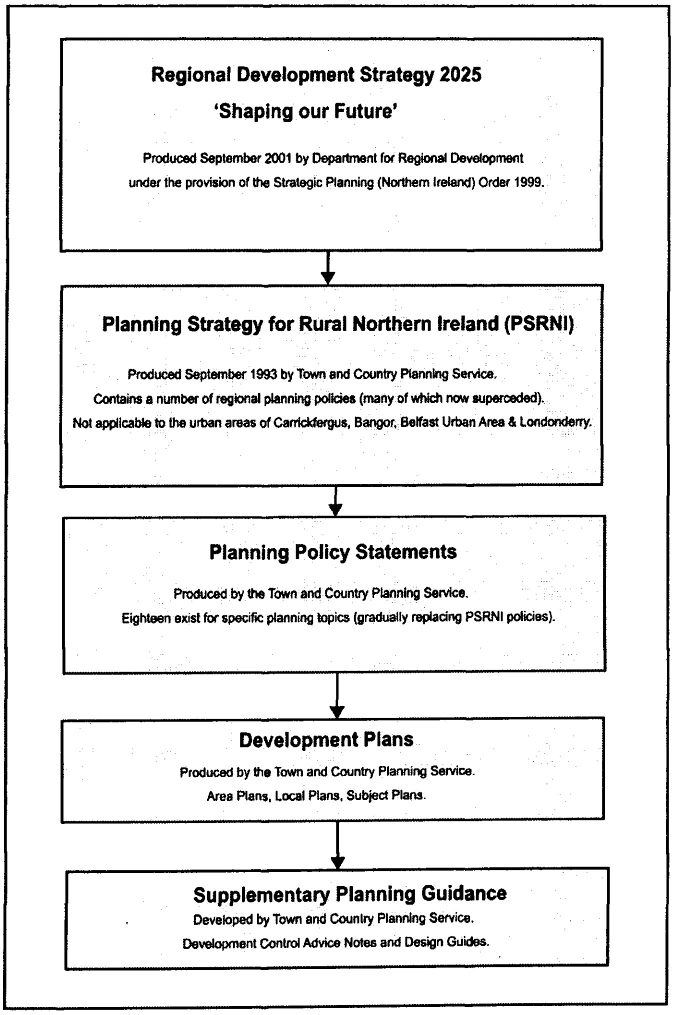


Figure 5.6: Key Planning Policy Documents

Source: Original

In summary, findings concerning decision making tiers highlighted specific attributes of the Northern Ireland case study. For example, the low profile of coastal erosion issues creating an absence of legislation or policy at the strategic level, and the central governance of planning by the Planning Service at the Strategic and Tactical levels, as opposed to the operational level by Local Authorities (as identified in Case Study One Section 4.3 & 4.5).

5.6 Findings: Decision Structure

This section presents an examination of findings in relation to forcing factors that may have an influence upon the decision pathways, namely, pathway framing and decision frequency. This translates into the following two RSM EIs:

- *Is the decision pathway framed?*
- *What is the frequency of this type of decision?*

5.6.1 Is the decision pathway framed?

The previous section presented the policies and documents that exist at various decision tiers with respect to coastal planning (Table 5.6; Figure 5.6). These are considered as framing the decision making pathway. In contrast, the coastal defence sector was observed as having notably less policy (Table 5.5). This section will examine these issues and implications.

A notable absence of strategic policy or procedural guidance materials on coastal defence in Northern Ireland was found. In contrast, for example in England and Wales, Defra and its predecessor, have produced various iterations of guidance, such as, Flood and Coastal Defence Project Appraisal Guidance series for Operating Authorities (Section 4.6.1). An interviewee indicated that whilst formally there are no Northern Ireland-based documents, there is an informal culture of transferring knowledge and working practices from England and Wales relating to coastal defence (Government Department 3). However, as the current framework is reactive and parochial, it does not facilitate adaptive management. The sharing of best practice and lessons learnt is achieved via individuals electing to engage with their English and Welsh counterparts.

For example, with regard to climate change, the Rivers Agency reported the use of Defra figures and supporting documentation (*ibid*). At the local level, it was revealed that only one Local Authority, Down District Council, was involved within a European Regional Development Funded research project, Copranet. This involvement, examining coastal erosion and sustainable beach management practices was fostered by links between the council and academics at the University of Ulster (Authority 2). No other similar activities were observed.

There are eighteen Planning Policy Statements (PPS) (Figure 5.6) covering a range of land-use planning in Northern Ireland, including wind energy, telecommunications and nature conservation. As part of this the Planning Service developed a PPS on Planning and Flood Risk in 2006. Prior to this, the PSRNI (that excludes the urbanised areas of Londonderry, Carrickfergus, Bangor and the Belfast Urban Area) was applicable. The PSRNI document contains an explicit policy dealing with development at risk from flooding, coastal erosion and land instability (Policy PSU 10). This states a general presumption against development at risk of flooding or where engineering works would be required to protect development on land subject to erosion by the sea, or to defend land at risk from coastal flooding or where coastal erosion is likely to occur during the lifetime of the building. As the PSRNI is applicable to the defined rural areas of Northern Ireland, this document has limited applicability, with planning applications near large centres of population at risk of flooding, for example the Lough areas, such as, Londonderry adjacent to Lough Foyle and the Greater Belfast Area, being exempt.

PPS 15 Planning and Flood Risk was found to be consistent with the Regional Development Strategy for Northern Ireland 'Shaping our Future' (2001). This advocates a precautionary approach to minimise development in areas considered to be at risk from flooding, coastal erosion and land instability (Planning Service, 2006a; DRD, 2001). It contains four policies dealing with planning and flood risk, viz, Development and Flood Plains (Policy FLD1), Protection of Existing Flood Defences (Policy FLD2), Development Beyond Flood Plains (Policy FLD3) and Flooding and Land Drainage (Policy FLD4). It was ascertained that there has been inertia by central government regarding the development of a PPS on Coastal Planning (Academic 1; Coastal and Marine Forum, 2008). An interviewee reported in late 2006 that this PPS was being developed by the DRD, as opposed to the Planning Service who developed the other PPSs, due to the strategic approach being taken by government in recognition of the implications of this document on Northern Ireland's economic development (Government Department 2). However, it then identified in March 2008 that there was to be a transfer of responsibility of Planning Policy Statements being prepared by the DRD to the DofE (Coastal and Marine Forum, 2008). This has resulted in the preparation of the document arguably falling into abeyance. It was suggested that the absence of a PPS on Coastal Planning is due to the increasing pressures and conflicts on the coast (Government Department 2). The value of this form of planning document in integrating policies, such as, tourism, flooding, erosion, land instability, countryside etc., is noted within the planning system in England and Wales (Taussik, 1996). However, this guidance (PPG 20: Coastal Planning) has not been updated since it was issued in 1992, and is considered outdated in light of current coastal developments and moves towards marine spatial planning. A number of planning documents in Northern Ireland do, however, deal with aspects of coastal planning, most notably the Regional Development Strategy and the PSRNI. In addition to the flood policies, the previously referred Regional Development Strategy, 2001, contains a sub-section on protecting and managing the coastline of Northern Ireland (SPG- ENV2). (DRD, 2001; DRD, 2008). Additionally, the PSRNI contains several coast-related policies:

- Policy CO1: The Undeveloped Coast;
- Policy CO2: The Developed Coast;
- Policy CO3: Areas of Amenity of Conservation in the Coast;
- Policy CO4: Access to the Coastline;
- Policy CO5: Tourist and Recreation Schemes.

(Planning Service, 1993).

The Review of Planning Documents, which will now be presented, sought to identify the level of framing that occurs at the tactical tier. The review concentrated upon Area Development Plans prepared by the Planning Service under the provisions of the Part III of the Planning (Northern Ireland) Order 1991 (Planning Service, 2000). Figure 5.7 illustrates the geographical coverage of these (as of November 2006). Of the twenty-six Local Authorities, twelve were found to have a coastal boundary, with two, Derry City Council and Newry and Mourne District Council, having a shared coastal boundary with the Republic of Ireland. Table 5.7 presents a list of the six reviewed documents (Figure 5.8).

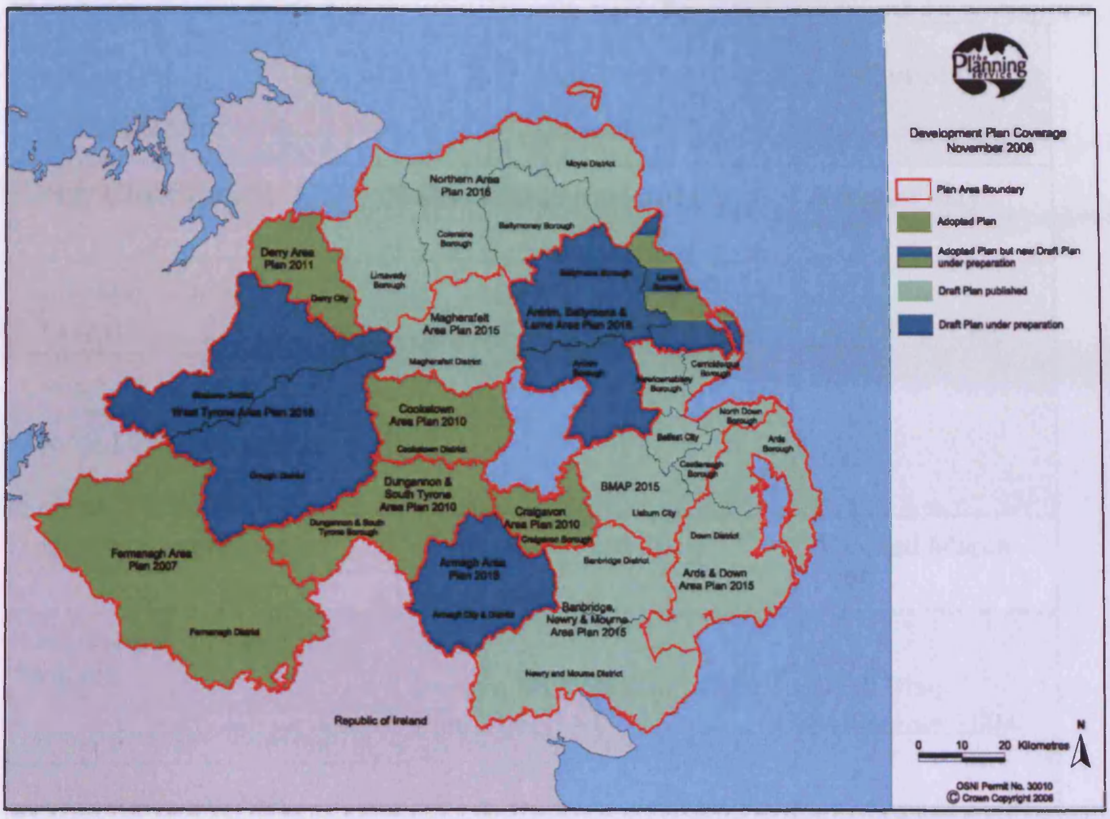


Figure 5.7: Area Development Plan coverage in Northern Ireland

Source: (Planning Service, 2006)

Table 5.7: Reviewed Northern Ireland Planning Documents

Coastal Local Authorities	Document Title	Plan Status
Derry City Council	Derry Area Plan 2011	Adopted May 2000
Limavady Borough Council	Northern Area Plan 2016	Draft Plan May 2005
Coleraine Borough Council		
Moyle District Council		
Larne Borough Council	Larne Area Plan 2010	Adopted March 1998
Carrickfergus Borough Council	Belfast Metropolitan Area Plan 2015	Draft Plan November 2004
Newtownabbey Borough		
Belfast City Council		
North Down Borough Council		
Ards Borough Council	Ards and Down Area Plan 2015	Draft Plan December 2002
Down District Council		
Newry & Mourne Council	Banbridge / Newry and Mourne Area Plan 2015	Draft Plan August 2006

Figure 5.8: Reviewed Planning Documents in Northern Ireland
Source: Original

The following sections present key findings from the review, including, reviewed plan content with respect to coastal-related planning policies, coastal defence and flood risk. The term development plan will now be used when referring to the reviewed Area Development Plans.

The review revealed that three of the six plans contained flood risk-related policy statements. Extracts of these can be seen in Table 5.8. This is regarded as consistent with national policy, including PPS 15, in that there is strong conveyance of directing development away from the flood plain and areas at risk from flooding. Whilst these policies were identified, the location of these policies within the document is worth considering. For example, in the case of the Ards and Down Area Plan, several flood-related policies were located within the Housing section of the development plan. These policies were site-level design considerations, for example, "…a small portion of the site at the southern boundary…lies below the present high watermark…potential developers would be advised to seek advice with regard to the effect of storm surges and potential climate change..." (Planning Service, 2002, p.136). Similarly, within the Villages section, several "low lying lands liable to flooding to be kept free from development" (Planning Service, 2002, p.178). Due to the nature and location of these policies within the Ards and Down plan, *i.e.* being situated within Housing policies as opposed to strategic polices for the whole of the development plan boundary, it may be implied that flood-related issues are not of a high priority within the scope or consideration of the development plan. Alternatively, it may be argued that they their locations within Housing, gives developers clear guidance and direction on flood risk prevention and mitigation.

Table 5.8: Extracts of flood risk policy statements from reviewed plans

Derry Area Plan (Planning Service, 2000, pg. 97)
Policy PU2: "Development will not normally be permitted in areas known to be at serious risk from flooding".
Larne Plan Area Plan (Planning Service, 1998, pg. 38)
Policy DR1: "Development will not normally be permitted in areas known to be at serious risk from flooding, coastal erosion or land instability".
Ards and Down Area Plan 2015 (Planning Service, 2002, pg.178)
Policy HPA3: "low lying lands liable to flooding to be kept free from development".

The finding that only a half of reviewed development plans had flood risk- related policies was found to be in stark contrast to the observation that the majority, five out of the six plans, cite areas within the plans boundary coverage of areas that have known localised flooding problems (Table 5.9). The majority were noted for stating that locations cited in the plan were indicative rather than exhaustive. This information alludes to aspects of the natural coastal change knowledge base available within the Planning Service and the Rivers Agency; this will be examined in Section 5.7.

Table 5.9: Extracts of geographical information on flood risk areas

Ards and Down Area Plan 2015 (Planning Service, 2002, pg. 74)
"Major areas of flooding affecting the larger settlements within the Plan area lie to the north west and areas alongside the Engler River in Comber, to the west and south west of Downpatrick originating from the Quoile River and its tributaries, along the Ballynahinch River to the west of Sastlewellan Road in Newcastle and along Carrigs River to the north of the town".
Larne Plan Area Plan 2010 (Planning Service, 1998, pg. 38)
"Within Larne Borough there are no extensive areas of land subject to flooding from a major watercourse. However there are a number of localised flooding problems of varying significance, in particular at Drains Bay, Ballygalley, Millbrook and Ballcarry".
Banbridge / Newry and Mourne Area Plan 2015 (Planning Service, 2006b, pg. 58)
"Rivers Agency has advised the Department there area number of recorded flooded areas that significantly affect particular settlements within the Plan Area. The main areas at risj from flooding include: • The Bann river valley at Banbridge, Gilford and Lawrencetown; • The Lagan river valley at Dromore; • The Newry and Clanrye river valleys to the north and east of Newry; • The Camlough river and • The Ghann river Rostrevor This list is not exhaustive. Prospective developers are advised to contact Rivers Agency, at an early stage in the formulation of their proposals to clarify flooding or floodplain issues that may affect particular sites".
Derry Area Plan 2011 (Planning Service, 2000, pg. 97)
An area of land straddling the Buncrana Road between Coshquin Road and the Glengalliagh Hall estate lies below the level of the Skeoge flood plain...Development at areas of risk from flooding outside the city limit will be controlled in accordance with the Department's rural policies".

Belfast Metropolitan Area Plan 2015 (Planning Service, 2004, pg. 161)
"The Department has been advised by River's Agency, DARD, that there are a number of recorded flooded areas that significantly affect particular settlements within the District. Major areas of flooding identified include: • The River Lagan towards Lisburn; • The River Enler; • The Loop River; • The Forthriver; • The Three Mile Water; • The Six Mile Water; • The Ravarnet River and • The Ballymartin River This list is not exhaustive nor is it intended to include the floodplain of every watercourse in the Metropolitan Area. Prospective developers are advised to liaise early in the formulation of their proposals with Water Service, DRD and Rivers Agency, DARD to clarify flooding or flood plain issues that may affect particular sites. Planning policy with respect to development within floodplains is contained within the Rural Strategy. Policy is being reviewed and developers should take account of draft PPS15 Planning and Flooding when published. "

The review noted that all plans contained information pertaining to statutory government responsibility of the Rivers Agency in relation to flood and drainage issues. This finding contrasts with the limited flood risk-related policies identified within the review.

In addition to seeking flood-related policies, the review also sought to identify coastal erosion-related policies with the reviewed development plans. Only one plan, Larne Area Plan, was found to make reference to coastal erosion in conjunction with the plan's overall policy on flooding and land instability (Table 5.8). As no other coastal defence or shoreline management planning-related policies were found within the review, the Larne Area Plan policy is considered to be anomalous. However, this finding is consistent with the government view concerning coastal erosion matters to be minor, and as such, not a government priority.

The findings of the review of Northern Ireland planning documents presented here highlights the limited amount of framing that exists tactically with respect to flood risk, with coastal erosion and coast protection given little regard within this tier. The strategic level provides the majority of coastal planning framing via the PPS 15 Planning and Flood Risk along with the coastal-related policies of the Regional Development Strategy.

5.6.2 What is the frequency of this type of decision

Decision making frequency is considered as being a function of decision complexity within the literature (Gilligan *et al.*, 1993). Accordingly, the frequency, or regularity of decision making was examined within case study findings.

With respect to coastal planning, an interview with a government planning official reported that coastal planning applications of a coastal nature were predominantly infrequent. Applications for small-scale second home developments were most common. Within the coastal defence sector, data from Local Authorities concerning their coastal defence activities strongly suggest that coastal defence decision making is ad hoc and infrequent, and as highlighted in the Portballintrae case, conducted intermittently depending on political will and levels of community concern. Translink and the Roads Service both indicated that they undertake coast protection works reactively, 'as and when' required in light of maintenance requirements and storm events. The Rivers Agency reported that their flood defence works were small in number, for example, on average four to five a year. Reflecting this agency's historic remit as a drainage authority, the majority of these works are flood alleviation schemes such as, river channel and culvert maintenance. Despite case study findings, there is not enough detail to adequately assess potential relationships between decision frequency and decision complexity. However, the low frequency observed within both decision contexts is considered a valuable finding and provides support for the literature propositions reported in Section 5.3.

5.7 Findings: Decision Support

The RSM Empirical Indicators associated with Decision Support primarily deal with the associated natural coastal change evidence base of the examined coastal risk decision making.

The RSM Decision Support EIs that will now be considered in turn are as follows:
What is the nature/characteristics of the task information involved?

- *What mechanisms (internal and external) were engaged to aid the retrieval and application of task information?*
- *Do different decision pathway stages and decision making tiers require different task information?*
- *Were aspects of the decision pathway aided by other sources in addition to task information?*
- *What is the level of certainty regarding decision outcome?*

5.7.1 What is the nature / characteristics of the task information involved?

As reported in the Literature Review (Section 2.5.4) the need to understand and explain 'natural coastal change', is central to the sustainable management of the coast and its resources (Woodroffe, 2002). Consequently, natural coastal change information is central to the thesis aim and objectives. Accordingly, this form of scientific information was focussed upon within the coastal defence and coastal planning decision contexts. An additional pertinent finding from the Literature Review concerned the associated uncertainty of natural coastal change science (Section 2.3). In light of this of this, case study investigations sought to explore characteristics of the natural coastal change information utilised by coastal risk decision makers in Northern Ireland; thereby addressing this EI.

An important finding was that the historical development of the natural coastal change evidence base in Northern Ireland has not seen the same level of investment as elsewhere in the UK. Carter (1982b) notes that whilst a number of coastal studies and surveys were carried out in Great Britain during the 1930s and 1940s these excluded the Northern Ireland coast. More recently, the innovative work of Motyka and Brampton (1995) identifying coastal sediment cells did not consider Northern Ireland; this is considered a significant lacuna in the Northern Irish natural coastal change evidence base. Other notable differences between Northern Ireland and its counterparts in England and Wales, included the absence of a future coastal evolution study, such as, Futurecoast. In 1981 Rea reported that few records pertaining to coastal erosion exist in Northern Ireland, with reliance upon seasonal observations and recollections being prevalent (Rea, 1981). This was found to still be accurate. Interviews with the Rivers Agency supported this, and will be examined further in Sections 5.7.2 and 5.7.4. In summary, it is considered that natural coastal change evidence base with regards to coastal defence is limited in its extent with divergences from that in England and Wales

The Regional Development Strategy states with regard to flooding, "...predictions of climate change and impacts still lack certainty, and a precautionary approach to potential development problems such as flooding is desirable where scientific evidence cannot offer clear direction" (DRD, 2001, pg. 18). Similarly, PPS 15 states, "As part of the Department's precautionary approach to dealing with flood risk, measures such as flood compensation storage works or new hard-engineered flood defences will not be acceptable as justification for development in a flood plain" (Planning Service, 2006a, pg. 16). This planning document also goes on to state, "Development plans will therefore adopt a precautionary approach to development in areas that may be subject to flood risk" (Planning Service, 2006a, pg. 11). This requirement was not visible within the reviewed Area Plans (Section 5.6.1). However, due to the general conformity requirement of development with regard to the Regional Development Strategy and PPS's, it is suggested here that this aspect, *i.e.* the Precautionary Principle, may be implicit with the Development Control process. It is postulated that issues of uncertainty with respect to flooding and climate change impacts (as contained in the above quotations) are regarded as part of the evidence base and decision making process in coastal planning.

5.7.2 What mechanisms (internal and external) were engaged to aid the retrieval and application of task information?

Case Study investigations identified a natural coastal change-related evidence base underpinned by various forms of coastal research. This section presents an overview of mechanisms, including strategic level investment by government, academic contributions, followed by activities at the operational level by Local Authorities and the Planning Service. These findings are considered aligned to this Empirical Indicator, which seeks information on the mechanisms (internal and external) employed by decision makers for the retrieval and application of natural coastal change information.

An interesting aspect of government research investment can be seen with the introduction of the EU Floods Directive, to be shortly transposed into Northern Ireland legislation (Rivers Agency, 2008). This legislation has driven rapid and substantial investment in flood risk mapping. For example, the 'National Flood Risk Assessment for Northern Ireland: Flood Mapping Strategy (Interim)' produced by consultants HR Wallingford in 2007, was the first ever structured programme of fluvial and coastal flood risk mapping in Northern Ireland (Sayers and Calvert, 2007). The 'Strategic Flood Map (NI) Rivers and Sea' has quickly followed this (Rivers Agency, 2008). The 'Strategic Flood Map (NI) Rivers and Sea' notes inherent characteristics of the flood modelling techniques and data used; indeed the document states that there is insufficient accuracy to determine flood risk of individual properties of specific point locations. This confirms previous statements concerning the uncertainty of the coastal defence and coastal planning evidence base (Section 5.7.1) (Rivers Agency, 2008).

Government investment in strategic research and development has occurred in wider areas, such as climate change. A climate change scoping study was commissioned by the DofE in 2002, entitled 'Implications of climate change for Northern Ireland: informing strategy development' (Smyth *et al.*, 2002). The document has since been updated using the UK Climate Change Impacts Programme 2002 data and a report entitled 'Preparing for a Changing Climate in Northern Ireland' published in 2007 (Arkell *et al.*, 2007). These documents examine the impacts of climate change in relation to flood and coastal defence making them valuable. Other important additions to the coastal defence evidence base include the Government's Foresight Future Flooding report (Evans *et al.*, 2004).

It was ascertained that coastal research and data collection is undertaken related to the day-to-day operational side of coastal defence. Most applicable here is that by the Rivers Agency. This body has extensive database of ground investigations of its stock of sea defences (Roberts *et al.,* 2002). Flow records have been gathered since 1970, and an archive of previous flooding events is held (Government Department 6; RPS, 2006). With respect to latter, it has been reported that some aspects of these records are incomplete with varying levels of quality (RPS, 2007). It was also reported that Rivers Agency collects tide gauge information. However, this is merely recorded, with currently no analysis undertaken (Government Department 6). A monitoring regime and asset management system for designated sea defences was undertaken by consultants WS Atkins on behalf of the Rivers Agency (Roberts *et al.*, 2002). Interestingly, it was reported that on the matter of climate change this government department takes their lead from Environment Agency in England and Wales as the Rivers Agency has, "*…no expertise in climate change*" (Government Department 3).

Translink, as indicated previously, are responsible for 23 km of sea defences that provide protection of Northern Ireland's railway. It was identified from interviews that this organisation carries out both formal and informal monitoring of their hard engineering sea defences that consists, in the majority, of rock armouring and reinforced concrete structures. Formal monitoring conducted in both in-house and externally by consultant engineers, aims to alert Translink to areas of maintenance needed to ensure the structural adequacy of defences (Government Department 4). Roads Service, at the time of survey were unable to comment on their monitoring of coastal defence assets (Government Department 5).

Under PPS 15 Planning and Flood Risk, it is the responsibility of the applicant to carry out a flood risk assessment (Planning Service, 2006a). The Rivers Agency reported they provide information, such as predicted flood levels. It does not, however, have resources to undertake the assessment on behalf of the applicant (Government Department 3). The Review of Planning Documents also identified that natural coastal change information in the form of statements regarding land subject to flooding was provided within a number of Area Development Plans (Table 5.8). Furthermore, the majority of plans were found to advise developers to contact the Rivers Agency regarding development proposals. For example, one Area Development Plan states, "Prospective developers are advised to contact Rivers Agency at an early stage in the formulation of their proposals to clarify flooding or floodplain issues that may affect particular sites" (Planning Service, 2006b). The applicant must demonstrate that they have actively considered all flood risk aspects. The Rivers Agency must then determine the adequacy of these flood risk assessments and inform the Planning Service. In-house expertise is required by the Rivers Agency to assess these flood risk assessments. This Development Control process is similar to England and Wales, in which the Environment Agency provides advice to Development Control officers (this advice is not mandatory and planning permission may still be granted in spite of flood risk and Environment Agency objections). However, the lack of publicly available flood risk maps prior to 2008 was a notable area of divergence. The Centre for Ecology and Hydrology developed Indicative Floodplain Maps for the Rivers Agency in the early 1990's, these however are not publicly available (Chatterton and Suter, 2007). The 'Strategic Flood Map (NI) –Rivers and Sea' is designed to support PPS15 and the Planning Service in planning and managing flood risk by identifying if flooding is likely to be an important consideration (Rivers Agency, 2008).

In addition to government affiliated coastal research and data, there is a notable amount of academic literature on coastal aspects of Northern Ireland as noted earlier (Section 5.3). Several key pieces of research have been carried out by the late Dr R.W.G. Carter and other academics at the Centre for Coastal and Marine Research, University of Ulster. The "Shifting Sands" study on the north coast of Northern Ireland is a particularly valuable resource representing the amalgamation of 25 years worth of coastal research (Carter, 1991). This pool of knowledge is still being expanded by academics at this institution and others, such as, the 'Field Guide to the coastal environments of Northern Ireland' (2002), and numerous journal articles and conference papers.

Although these documents are valuable, their accessibility is a key issue. A notable finding within this research revealed that no central depository, platform or mechanism for natural coastal change information exists that allows this form of information to be fed into. However, some initiatives were found to be underway to improve information and data management efforts in Northern Ireland. For example, The Centre for Environmental Data and Recording (CEDaR) database held at by the Ulster Museum is coordinating the collation of datasets from a wide range of agencies and bodies that hold marine and coastal data (DofE, 2006). Similarly, the Marine Irish Digital Atlas project (MIDA) is bringing together a wide range of datasets on the marine and coastal environment (DofE, 1996). Recent efforts in flood risk mapping and the development of policies to address flood risk management by government that are occurring do not, however, include coastal erosion or coastal defence considerations. It is unclear whether this aspect will eventually occur through government investment, or whether research into this area will remain an academic endeavour.

As stated, Local Authorities' functions do not involve planning or any responsibilities for coast protection or coastal defence. Consequently, all surveyed authorities reported that they did not have in-house engineers with coastal expertise, with a practice of consultant engineering firms being engaged as and when needed to support the technical capacity of the authority. The undertaking of coastal defence activities was not found to include coastal monitoring or inspection activities by the majority of authorities, with seasonal observations (empirical) being a common source of information. Overall, there was found to be little or no production, processing, storage, exchange or dissemination of natural coastal change information by Local Authorities. Authorities, when required to do so, are able to commission external consultant to carry out research to underpin coastal decision making. However, whilst this mechanism exists, it is questionable as to whether this is always done due to limited resources of Local Authorities and the low profile of coastal defence. It is therefore proposed that a weak natural coastal change evidence base underpins the technical capacity and reactive approach to coastal defence by Local Authorities. As such, this situation is vulnerable to short-sighted and even misinformed coastal decision making. Furthermore, the Portballintrae case serves to highlight that decision making can be greatly influenced by drivers, such as community pressure for action to be taken without clear scientific underpinning.

5.7.3 Do different decision tiers require different task information?

The decision tiers for both coastal defence and coastal planning were presented in Section 5.5. However, it was not possible within case study investigations to examine the information requirements of different tiers of decision making, as necessitated by this EI:

- *Do different decision tiers require different task information?*

At the time of survey it was ascertained that no Area Plans were being developed and that no coastal planning applications were being processed by the Planning Service. Furthermore, the infrequent nature of decision making by Local Authorities also meant that no 'live' examples could be studied for their evidence base needs. The detailed Portballintrae study (Section 5.4.3) closely scrutinized the limited natural coastal change information utilised by the Local Authority, as compiled in Table 5.4. However, it is not suggested here that this particular case of decision is indicative of all operational coastal defence decision making in Northern Ireland. Further research into more decision pathways would address this particular Empirical Indicator.

5.7.4 Were aspects of the decision pathway aided by other sources in addition to task information?

Section 5.7.2 considered the range of mechanisms and sources of natural coastal change utilised by coastal planning and coastal defence decision makers. This EI seeks to identify other possible contributions to the decision making pathway, in addition to the natural coastal change information sources so far discussed.

The planning process as previously indicated (Section 5.3) is undertaken by the Planning Service and informed by the Rivers Agency. The Planning Advisory Unit of the latter provides strategic policy advice to the Planning Service during the development stage of development plans (*i.e.* Area Plans) (Government Department 3). In addition, it acts as a consultee during the planning application process, with development control advice representing 7% of the core business (Government

Department 3; RPS, 2006). Whilst it was reported that this agency does not hold vast amounts of datasets, excellent local knowledge and high levels of expertise were reported by interviewees (Government Departments 2 & 3). Accordingly, an important element of the decision making process is the expert knowledge base of personnel within the Rivers Agency and Planning Service. This was evidenced by the knowledge of flooding events within five out of the six reviewed Area Development Plans (Table 5.8, Section 5.6.1).

Under the present planning system and central government coast protection arrangements, Local Authorities are unable to partake in the sharing of best practice and lessons learnt regarding their coastal activities. This includes beach management and shoreline management planning that are the consequence of no mechanisms or requirements for cross-authority engagement. The case of Down District Council being engaged with a European research project was considered anomalous. It was not reported that the outputs of the research project had been disseminated to other Local Authorities in Northern Ireland (Authority 6). Furthermore, a preference for local decisions and judgements to be to based predominately upon empirical based sources was observed. The results point to local knowledge (contextual) and colloquial sources of information having great prominence, with the consequence that this system could be vulnerable to mis-information and abuse (Local Authorities 3 & 5).

Lastly, it was reported that the Centre for Coastal and Marine Research, University of Ulster, has provided both formal and informal advice to local and regional government on matters related to coastal geomorphology, coastal erosion and management over many years. This was confirmed by Local Authorities 3 and 5 who conveyed that the knowledge and contribution of Northern Ireland academics to coastal management is extremely valuable, but under-recognised by central government.

5.7.5 What is the level of certainty regarding decision outcome?

This Empirical Indicator is designed to explore the certainty of decision outcome. As reported previously, restrictions and limitations of case study investigations did not allow for data to be gathered concerning this indicator. This included only limited understanding and awareness of coastal risk decision making by interviewees.

Investigation into a greater number of decision pathways, from both sectors, at all decision tiers, Strategic, Tactical and Operational, would in theory provide data that could be analysed in relation to this indicator.

5.8 Discussion and Conclusion

The previous four sections (Sections 5.4- 5.7) utilised the thesis RSM and associated EIs to present the findings of the Northern Ireland Case Study. These sections addressed:

- Decision Pathway;
- Decision Making Tiers;
- Decision Structure and
- Decision Support

This process facilitated the examination and tracing of decision making processes associated with the coastal defence and coastal planning decision contexts. Importantly, this addressed the decision making interface between these two sectors representing aspects of coastal risk. Furthermore, Decision Support EIs (Section 5.7) enabled explicit consideration of the supporting natural coastal change evidence base. Key findings of these areas will now be synthesised in relation to the aim and objectives of the thesis. The first of the objectives will now be addressed:
'To investigate the salient decision making characteristics particular to coastal risk'

In light of the findings presented in Sections 5.3 and 5.4.1, it is postulated that the three main groups of coastal defence decision makers identified in Northern Ireland (central government, local government and private landowners), whilst given some degree of structure via the Bateman Formula (Table 5.2) and flood risk policies within PPS 15, do not operate within a transparent or integrated system for the management of coastal risk. Coastal erosion has historically been and remains a minor concern; associated coast protection works are undertaken reactively by all decision makers in the absence of statutory provisions or strategic shoreline management planning. The small site of Portballintrae (Section 5.4.3), highlights how this gives rise to short-term decision making, based upon differing natural coastal change evidence and fluctuating political will. Research in Sections 5.4.4 and 5.4.5 found that historical coastal planning decision making has not resulted in significant levels of flood plain encroachment or legacies of hard engineering coastal works. However, this is forecast to change with increasing demand for homes, and second homes on the coast. The future interface between the sectors of coastal planning and coastal defence is likely to see a greater dependency by the coastal planning sector upon the coastal defence sector. Due to the need to provide and manage coastal and flood risks for coastal communities, thus creating a tied relationship between them.

Government agencies, through an asset-focused sector based approach to coast protection works, were found to often provide coastal defence by default. Local government were observed as having notable level of 'on-off' involvement, and several reports of landowners carrying out coastal works 'as and when' desired were noted. This creates a haphazard system for coastal defence that is predominantly fragmented and parochial. The Bateman Formula and lack of government policy on coastal erosion, does not encourage inter-agency cooperation, with no 'joined-up thinking' observed by involved parties. A key finding within respect to coastal planning was that the planning system does not cater for coastal erosion or coast protection, with a PPS on coastal planning in abeyance. With respect to flood risk, the work of the Rivers Agency and the Planning System has become more clearly framed in the light of statutory provisions and recent strategic government flood risk management vision. Serious flooding events in 2007 and the EU Floods Directive have undoubtedly driven these actions, making flood risk management a government priority, unlike coastal erosion. Whilst management efforts should be proportional to risk, is it posited here that within Northern Ireland there is an underestimation of coastal erosion risk. Furthermore, the disparate approach to matters of coastal erosion and flood risk, in light of climate change, and in particular sea level rise and increased storminess, will likely put pressure on these current arrangements that do not recognise the cross-cutting nature of coastal hazards. In contrast within England and Wales, an integrated risk-based approach to flood and coastal erosion risk has recently come into place.

The suite of RSM EIs associated with Decision Support gave rise to a number of key findings associated with the second objective of the thesis:

'To evaluate the application of natural coastal change science as evidence used within coastal risk assessment and its associated decision making procedures'

An important finding with respect to this was that whilst a natural coastal change evidence base was identified, currently no mechanisms or infrastructure are available for those disparate research bodies to feed their science into. Consequently, much of the existing evidence base does not make its way into coastal-related decision making. There exists a limited institutional and technical capacity for this form of information to be harmonised and centralised. The establishment of a voluntary grouping, similar to Coastal Groups that operate in England and Wales, for those involved in aspects of coastal defence in Northern Ireland could provide a central depository for natural coastal change information, a forum for discussion, allow the sharing of knowledge and expertise and encourage consistency in approach. Furthermore, evidence from the case study research identified that informal advice to local and regional government by academics on matters related to coastal geomorphology and management occurs.

At a strategic level, the natural coastal change evidence base in Northern Ireland was found to be extremely fragmented. The contribution to the natural coastal change evidence base made by the Foresight Future Flooding reports and technical documentation (Evans *et al.*, 2004), and the recent strategic-level flood risk mapping (Rivers Agency, 2008) are notable and should be seen as valuable components of the evidence base. It is proposed here that greater detail of micro-scale shoreline processes and their interactions with human activities occurring at the coast is required. Additionally, the delineation of sediment cells along the Northern Ireland coast would bring the evidence base in line with other parts of the UK. For example in England and Wales this is considered the cornerstone of shoreline management planning. Within a recent European study of coastal erosion, sediment cell-based management was noted as becoming increasingly regarded as best practice (NICMMN, 2004). Recent rapid government investment was seen in flood risk mapping. However, it is still recognised that this mapping is of varying quality and only exists at a very coarse strategic scale.

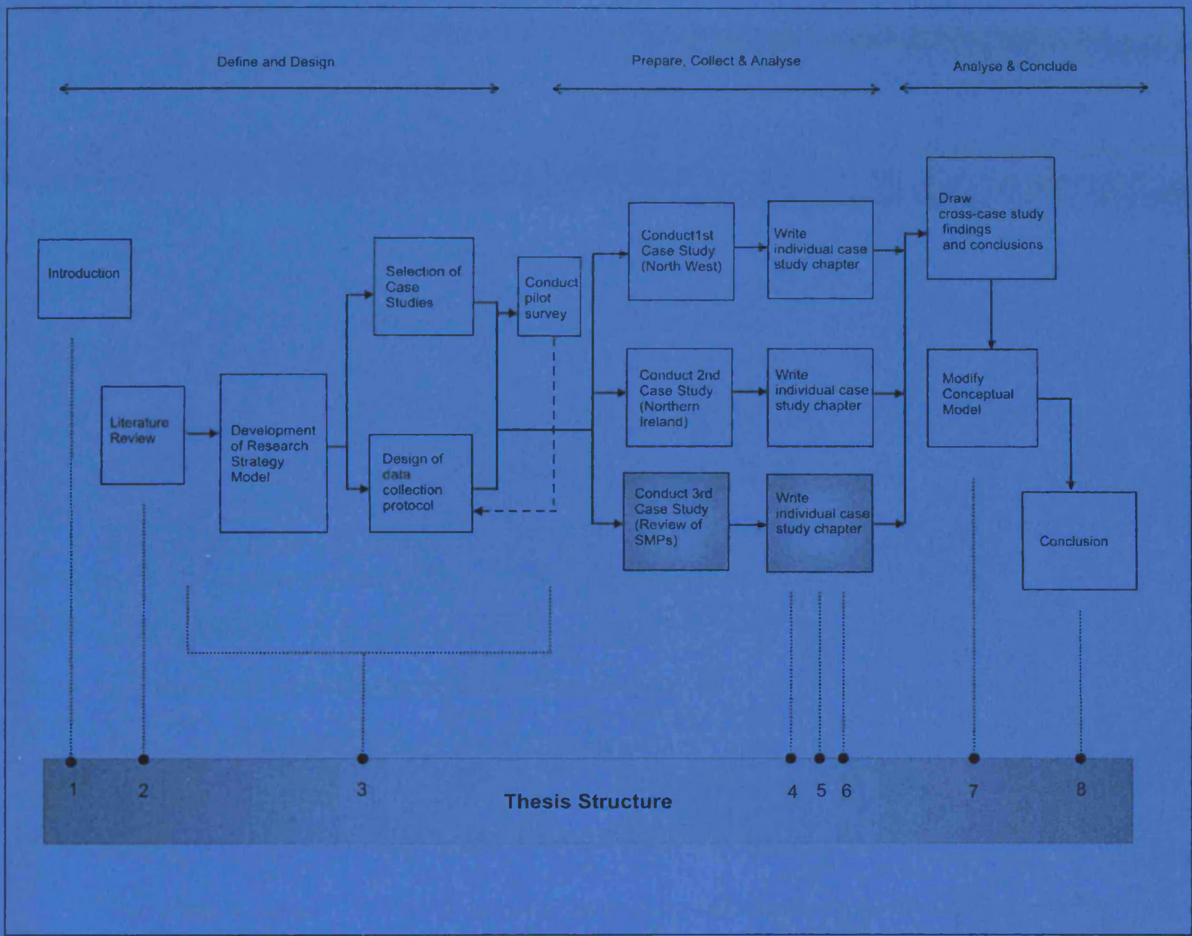
The current arrangements with respect to Local Authorities and their lack of coast protection statutory powers and observed intermittent coastal defence activities, results in no in-house coastal engineering capacity being found at this tier. In light of this, engineering consultancies were found to be engaged for coastal defence-related purposes. Additionally, research found preference for local decisions and judgements to be to based predominately upon empirical sources, with local knowledge (contextual) and colloquial sources of information having great prominence. The Portballintrae case serves to highlight this point, and illustrates that coastal risk decision making can be greatly influenced by other drivers, such as, community pressure for action to be taken without clear scientific underpinning.

The case study research instruments employed for data collation, namely a semi-structured interview schedule comprising sixteen interviewees and documentary audits and associated reviews of planning documents, provided in-depth information concerning coastal risk-related decision making. The application of the thesis RSM and associated suite of EIs as a lens for the interpretation of the gathered data provided the ability to explain and understand research findings within a structured framework. Furthermore, the integration of four discrete sections of the chapter (Sections 5.4 - 5.7) within Section 5.8, according to the two objectives of the thesis, facilitated multi-dimensional analysis and discussions. The value of this approach as identified in the Methodology Chapter (Chapter Three), is that this case study can be coherently compared and contrasted with the other geographical case study of the thesis, *i.e.* the North West (Chapter Four). This will be undertaken in the Discussion Chapter (Chapter Seven).

In summary, case study research observed that the coastline of Northern Ireland that has a large number of coastal landscapes, habitats and species, is an important economic and environmental resource. Furthermore, it identified that coastal hazards *e.g.* coastal erosion and tidal flood risk, are present at various locations and climate change impacts are expected to amplify these. It was identified that these hazards are not managed in an integrated or strategic manner. Central government departments, such as, Roads Service, Tranlink and Rivers Agency, were found to partake in coastal defence decision making under an informal and dated government agreement, *i.e.* the 1967 Bateman

Formula. As responsibility to defend property from flood risk and coastal erosion remains with the individual landowner, land ownership practices on the coast are undertaken without strategic coordination, thus presenting a barrier to effective coastal defence, sustainable coastal planning and ultimately coastal risk management. A lack of legislation, government policy, strategic planning and operational guidance on coast protection perpetuates an un-structured decision making environment, characterised as parochial, reactive, short-term and extremely fragmented. In contrast, flood risk management has rapidly become a central government priority in light of EU Floods Directive and a number of recent storm events; accordingly government policy exists on flood risk management.

The identified natural coastal change evidence base faces a number of barriers to its application within coastal risk decision making, namely a lack of a centralised depository, limited technical and institutional capacity relating to matters of coastal defence and considerable historic practices of parochially-based reactive management undertaken in the absence of scientific information.


Define and Design
Prepare, Collect & Analyse
Analyse & Conclude
Introduction
Literature Review
Development of Research Strategy Model
Selection of Case Studies
Design of data collection protocol
Conduct pilot survey
Conduct1st Case Study (North West)
Conduct 2nd Case Study (Northern Ireland)
Conduct 3rd Case Study (Review of SMPs)
Write individual case study chapter
Write individual case study chapter
Write individual case study chapter
Draw cross-case study findings and conclusions
Modify Conceptual Model
Conclusion
1
2
3
Thesis Structure
4
5
6
7
8

6 Chapter Six 'Review of SMPs'

6.1 Introduction

Shoreline Management Plans (SMPs) are an integral component of the government's current coastal defence delivery framework in England and Wales. Due to their distinctive nature, they are only mechanism of their kind to deliver strategic shoreline management over significant planning timeframes, based on a natural coastal change scientific evidence base. Their absence in Northern Ireland represents a major point of divergence between the two geographical case studies of the thesis. Due to their purported scientific evidence base, distinctive decision making characteristics, Tactical tier of operation and evolving nature, SMPs provide an interesting focal point upon which to consider the aim and objectives of the thesis. Using a different approach to that taken in the geographical case studies, this case study has reviewed the decision making processes associated with SMPs and examined their natural coastal change evidence base. The review presented here investigates the role and relationship between science within this coastal risk decision making process for the first time. In doing so, it offers a unique approach and framework to facilitate these considerations, thereby directly addressing the aim and objectives.

The chapter is divided into several sections, the first (Section 6.2) examines in greater detail than in the Literature Review, the evolving nature of, and approach to coastal defence in England and Wales, particularly shoreline management planning. Section 6.3 introduces the Review of SMPs and its methodology. Section 6.4 presents the analysis and results of the review. Section 6.5 discusses findings in relation to the aim and objectives of the thesis, considers strategic case study findings and details the limitations of the research process. The chapter concludes with wider considerations, most notably, issues associated with the use of natural coastal change within the evidence base for coastal risk decision making.

The methods devised for the review presented in the Methodology Chapter (Chapter Three, Section 3.5) (*i.e.* two survey proformas) should be regarded as being distinctive and innovative for a number of reasons. Firstly, at the time of survey, no similar assessment had been undertaken with regards to SMPs. Secondly, and importantly for the thesis, no other assessment framework to examine the role of science within such documents was found to exist within the literature. As such, the devised survey instruments are considered innovative and experimental in nature.

6.2 Shoreline Management Plans: The Approach to Coastal Defence in England and Wales

As discussed in the Literature Review (Section 2.5.3), coastal erosion is occurring worldwide and in 2004 approximately 20% of Europe's coastline was considered to be experiencing serious impacts due to coastal erosion (Kamphuis, 2006; Doody *et al.*, 2004). Whilst coastal erosion is a naturally occurring phenomenon, it has been, and continues to be, considered a problem in light of the associated and perceived risks it poses coastal communities and assets (Doody *et al.*, 2004). As the coastline of England and Wales has become increasingly developed over the 19^{th} and 20^{th} century, settlements have seen ever more risk and accordingly there is a desire to protect these communities and assets (Pettit, 1999). Traditional management actions can best described as mirroring the classic development-defence cycle (Carter *et al.*, 1999; Figure 2.10). Structural engineering responses therefore predominate, with other supporting measures for example, flood warning systems and the discouragement of inappropriate development in at areas at risk from flood or coastal erosion (Potts, 1999). The underpinning natural coastal change science of coastal defence and coastal risk management was discussed in the Literature Review (Section 2.5.4), in particular it discussed notable natural coastal change attributes including, uncertainty and limitations, *e.g.* long-term morphological prediction (Nicholls *et al.*, 2007; Woodroffe, 2002).

The introduction in 1993 of a Flood and Coastal Defence Strategy for England and Wales by Ministry of Fisheries and Food (MAFF) and the Welsh Office (WO) represented a significant development and advancement in the government's policy approach to dealing with coastal hazards. Prior to this, coastal defence in England and Wales had been conducted on a scheme-by-scheme basis; this local perspective *modus operandi* saw, for example, local government undertaking schemes in isolation (Pettit, 1999; Fletcher, 1998). It is purported that a poor lack of understanding of coastal processes facilitated the notably parochial basis for undertaking coastal engineering, which showed little regard for the implications for neighbouring areas and environmental impact that occurred in the UK (Tunstall *et al.*, 2004; Evans, 1992). Several authors cite examples of instances where a lack of geomorphological foresight has been the basis for coastal engineering schemes that have failed to alleviate the issue, and in some cases, exacerbated problems locally and regionally (Evans, 1992).

The 'Strategy for Flood and Coastal Defence for England and Wales' (MAFF *et al.*, 1993) can, therefore, be regarded as being a landmark, heralding a new approach to shoreline management. Potts (1999, pg. 66) states that the development of this strategy was the result of, "substantial re-appraisal" by government of their policy framework and operational strategy. Its aim, as stated within the document, is to, "reduce risks to people and the developed and natural environment from flooding and coastal erosion by encouraging the provision of technically, environmentally and economically sound and sustainable defence measures" (MAFF & WO, 1993, pg. 3). An integral part of the strategy was the adoption of strategic (large-scale assessment) planning efforts utilising sediment cell –based management. The identification and delineation of coastal sediment cells is regarded as being both a valuable development and major advancement in the knowledge and understanding of coastal processes (McCue, 2000). As reported in the Literature Review (Section 2.5.4), eleven coastal sediment cells and forty-six sub-cells were identified around the English and Welsh coast in government funded research in the early 1990s (Motyka and Brampton; 1995) (Figure 6.1).

Figure 6.1: Boundaries of Major Coastal Sediment Cells in England and Wales

Source: adapted from MAFF *et al*. (1995)

In 1995 MAFF, WO and a number of other statutory bodies published 'Shoreline Management Plans – a guide for coastal defence authorities' (MAFF *et al.*, 1995). This was widely used to guide the development of Shoreline Management Plans (SMPs) based upon the coastal sediment cell concept (Martin Wright Associates, 2004; Swash, 1995). Their introduction was, "heralded as a new approach to coastal defence" (MacGuire, 1997). SMPs aim, "...to provide the basis for sustainable coastal defence policies within a sediment cell and to set objectives for the future management of the shoreline (MAFF *et al.*, 1995, pg. 4). An interesting aspect to these documents is that they are non-statutory and, as such, are not legally required or binding. O'Riordan and Ward (1997, pg. 262) note that, "Their significance depends upon informed consent and widespread support amongst all interested parties". As non-statutory documents, once prepared, SMPs rely upon Operating Authorities (*i.e.* bodies with statutory powers to undertake flood defence or coast protection activities) adopting the management recommendations contained within the plan. Central government *e.g.* Defra and WAG whilst consulted and receiving copies of the documents, do not formally adopt these plans and, as such, are therefore not considered to be central government policy.

The sediment-cell based management that underpins SMPs requires strong regional cooperation. This has been facilitated by Coastal Groups. Potts (1999a, pg. 479) purports that these have been, "...an integral component in moving towards the implementation of sustainable coastal management in England and Wales...". As voluntary collaborative partnerships, Coastal Groups contain a blend of practitioners that tend to reflect the coastal areas they cover, for example, they may contain Local Authority coastal engineers, representatives from conservation groups, the Environment Agency, Network Rail, ports, private landowners and utility companies (Beech and Nunn, 1996; Wright, 2004). Literature pertaining to Coastal Groups considers them to be unique in their role, remit and responsibilities as they bring together those responsible for coast protection and sea defence. Their early development since the mid 1990s has been described as gradual and *ad hoc* (Potts, 1999a). Oakes (1992) establishes that the impetus behind their development lay in the recognition, by Local Authorities, of the following:

- That coastal defence carried out by one authority may impact adjacent coastlines and authorities;

- An increasing awareness of the value of the natural environment and
- The use of traditional hard structures being challenged by government and a reduction in government coast defence grant aid.

Not based not on administrative boundaries, Coastal Groups coarsely mirror the eleven major coastal cells in England and Wales (Pettit, 1999). The groups that existed during the development of SMPs in the mid 1990s (Figure 6.2) illustrate the relationship between Coastal Groups and sediment cell boundaries. This correlation facilitates a greater strategic level of shoreline management planning and coastal defence. With groups well placed to aid the development of SMPs. As a consequence, the majority of these groups are primarily concerned with overseeing the production of these documents (Wright, 2004). This is often achieved through a Steering Group, with a nominated lead Local Authority delegated to manage the contracting of engineering consultants to undertake the plans production (MAFF, 2000).

Figure 6.2: Coastal Groups in England and Wales

Source: adapted from McInnes (2003) and Potts (1999)

One of the main objectives of a SMP is to, "assess a range of strategic coastal defence options and agree a preferred approach" (MAFF *et al.*, 1995, pg. 4). Sub-divisions of the sediment cell or management units, herein referred to as shoreline divisions, are then assigned one of four generic policy options for a management period of fifty years (Table 6.1). Other shoreline divisions and classifications of the 'intertidal zone' and the foreshore exist within the UK, with potential notable legal and coastal management implications arising from their associated use (McGlashan *et al.*, 2005). In the context of the thesis, shoreline divisions are referred to as Strategic Coastal Defence Option (SCDOs), as contained within the guidance. The policy options allocated to SCDOs can be considered to be examples of human adaptation to coastal change.

Table 6.1: SMP Policy Options adapted from Bullen Consultants (1999)

Policy Option	Description
Do Nothing	No actions are taken to affect coastal erosion / accretion or sea flooding within the management unit.
Hold the Line	The existing coastline is maintained in its present position.
Advance the Line	New coastal defences are built seaward of the present line of defence.
Retreat the Line	New coastal defences are built landward of the existing line or a monitoring/response strategy is adopted to manage the recession of the coastline in a pro-active manner.

As stated, in most instances consultants were commissioned by the Coastal Group to prepare the SMP following the government guidance. This process involved two principal stages of development (Figure 6.3).

Stage One

- Identify all with an interest in the area
- Collate and analyse data on key issues
    - Coastal Processes
    - Coastal Defences
    - Land Use and the Human & Built Environment
    - Natural Environment
- Set management objectives for the Plan area

↓

Stage Two

- Define management units
- Appraise Strategic Coastal Defence Options (SCDOs)
  Consult on the preferred SCDO
- Compile the Plan (SMP)

Figure 6.3: SMP Guidance Plan Preparation (1995)

Source: adapted from MAFF *et al.* (1995)

The primary task of Stage One of SMP production is stated within the central government guidance as the 'gathering, collation and analysis of data' (MAFF *et al.*, 1995). The collation of data is a significant task at the beginning of SMP development. The pooling together of information about the coast in one place to facilitate the establishing of a strategic plan were, for many stretches of the coast, an unprecedented task. Data to be collected was guided by a checklist within the guidance to ensure the following aspects were considered: coastal processes, coastal defences, land use and human and built environment and the natural environment. It is worth highlighting here, that many of the tasks and objectives undertaken in the later stages of the SMP are underpinned by the knowledge and information established in Stage One. Therefore Stage One data collation, in the majority of instances, does not generate new data *per se*; instead, the amalgamation of data and analysis occurs. Consequently, the task was limited to the existing state of information, as highlighted by the following quotation from the guidance, "...only available data can be analysed" (MAFF & WO, 1995, pg. 8).

The allocation of policy options to SCDOs is undertaken within the latter phases of Stage Two and considered a 'high- level' activity. Prior to this, a number of other phases, including the delineation of shoreline divisions, are undertaken. The ability to undertake the task of assigning management policies to these SCDOs, in theory, is directly informed and influenced by the data collation and analysis phase of Stage One. This task, should, in effect provide the evidence base for the assessing and identifying of the most appropriate and sustainable management policy.

6.2.1 Evolving guidance

The coastal defence framework in England and Wales is an evolving activity of government (both Defra and Welsh Assembly Government). An implication of this has been the refreshing of government guidance for SMP production for use by those tasked with preparing the plans (namely engineering consultants). Three sets of guidance can be identified: 1995, 2001 and 2006 (Table 6.2). These guidance documents have progressively become more detailed and iterative in nature. This facet is given due consideration within the review's findings (Sections 6.4.1.4 & 6.4.3).

Table 6.2: Shoreline Management Plan guidance: 1995-2006

Issuer	Document Title	Date of release
MAFF, WO, Association of District Councils, English Nature & National Rivers Authority	'Shoreline Management Plans: A guide for coastal defence authorities'	1995
Defra	'Shoreline Management Plans: A guide for coastal defence authorities'	June, 2001
Defra	Shoreline management plan guidance Volume 1: Aims and requirements Volume 2: Procedures	March, 2006

6.2.1.1 SMP Guidance: 1995 Blue Book & Government Review

Referred to as 'The Blue Book', the inaugural guidance issued in 1995 entitled 'Shoreline Management Plans: A guide for coastal defence authorities' was widely used by Operating Authorities preparing SMPs (Martin Wright Associates, 2004). It should be noted that the development of some SMPs commenced before this guidance had been issued. For example, some commenced development as early as 1993. SMPs that were completed in between 1996 and 1999 are referred to as 'first generation' or SMP1s. These plans were regarded by central government as being, "...a new concept..." (MAFF, 2000). As detailed in the previous section, the development of plans using The Blue Book was a two- stage affair that took on average between 18 and 46 months to complete, with costs for the production of plans ranging between £31,000-268,000 (MAFF, 2000). Within these statistics, a direct correlation exists between the length of coast, time and cost; with SMPs developed for longer stretches of coast incurring greater production times and costs.

MAFF and WAG commissioned consultants to review first generation SMPs (1996-1999) prepared under this guidance. This was undertaken in line with advice from the

Shoreline Management Plan Advisory Group with the view to incorporate the findings into updated SMP guidance (MAFF, 2000). This group was established in 1996 to assist, "...the acquisition and subsequent dissemination of information and experience gained from the preparation of the first generation SMPs..." (Potts, 1999a, pg. 93). Strengths and weaknesses of SMPs, along with recommendations from the review were used to inform new guidance. The findings from this review considered a number of specific topics, that included, *inter alia*, methods of procurement, outputs and format of plans, management units and process units, policy options, consultation, interface with the planning system, and aspects of plan adoption and implementation.

Key recommendations that emanated from the review that are pertinent to the thesis, include the finding that, "there is a need to utilise an improved understanding of both coastal processes and coastal morphology information...in order to identify sustainable shoreline management policies". Additionally, "A greater level of confidence should be demonstrated in the choice of preferred SCDOs with respect to economic viability, environmental sustainability and technical feasibility. This requires appropriate levels of assessment, and possibly the inclusion of, "confidence limits", rather than tacit assumptions that these criteria are satisfied" (MAFF, 2000, pg. 36). These points highlight an acknowledged weakness in the utilisation of the evidence base of SMP1s. Interestingly, the following was also brought to light, "need for a greater transparency of the decision making process within SMPs" (MAFF, 2000, pg. iii).

6.2.1.2 SMP Guidance: 2001

Informed by the MAFF review (2000), Defra issued 'Shoreline management plans: A guide for coastal defence authorities' in 2001, containing greater detail and clarity on issues, such as, policy appraisal and consultation. Furthermore, subsequent plan production under the revised guidance was to take account of new areas of information collected, changes in circumstances and the government-funded Futurecoast coastal evolution study (Defra, 2001).

Similar to the checklist in 1995, the 2001 guidance provides a list of five key issues to be addressed in the appraisal of the SDCOs. The guidance's suggested plan contents also included a new area of consideration with regard to the SCDOs, this being the inclusion of a section focussing upon risks and uncertainties associated with predicting future shoreline processes and management requirements. This notable addition is explained by the following statement in the guidance, "It will generally be appropriate to adopt a policy screening approach to rule out unsuitable policies. However, it may only be possible to proceed further with policy selection if the available knowledge permits. Where significant uncertainties about future conditions exist, it may be necessary to proceed with more than one policy or default to the current policy, and to identify the studies that would be required to resolve the outstanding issues" (Defra, 2001, pg. 12).

6.2.1.3 SMP Guidance: 2006

Refreshed government guidance was issued in 2006 for the development of 'second generation', SMP2s. In a similar vein to the 2001 guidance, it was informed by lessons learnt from past SMP development and implementation, particularly knowledge and understanding gleaned from the conducting of four pilot SMP2s. The most notable areas of divergence from previous guidance was the longer planning horizons of the new plans (*i.e.* from 50 years to 100 years), with a 100 year time span being divided into three planning epochs (2025, 2055 and 2100) (Defra, 2006a).

This latest iteration of guidance occurred in parallel with the refreshing of government policy by both Defra and WAG. The Literature Review (Section 2.5.3) identified Defra's 2005 'Making Space for Water' and WAG's 2006 'Environment Strategy', both of which represent the transition from 'flood and coastal defence' to 'Flood and Coastal Erosion Risk Management'. These central government strategies underpin and frame Defra's 2006 guidance. Similarly to previous guidance, the 2006 guidance's requirement of data collation and analysis remained a central component of the SMP production process. This is highlighted by the following quote, "Any study for the future of the coast needs a scientific basis for considering what policies should cover and to what extent" (Defra, 2006a, pg. 26). Furthermore, "In order for robust decisions to be made, a detailed review of existing information is important so that any uncertainties are clearly defined" (Defra, 2006b, pg. 34).

6.2.1.4 Implications of variety

Interpretation of guidance by those preparing SMPs produced a wide standard of plans, as identified in the government review that stated, "The lack of a national / regional consistency of approach and presentation format in SMP production" (MAFF, 2000, pg. 7). Furthermore, the following quotation raises issues regarding the decision making processes associated with the SCDOs used within SMPs to present the coastal defence policy option, "SCDO appraisal was generally inconsistent. Partly this was due to the different methods applied, but also to the essentially subjective nature of the process" (MAFF, 2000, pg. 36). The implications of inconsistency can be seen demonstrated in the following examples of SMP SCDO format and content from two different SMPs.

The first SMP was prepared in 1999 by consultants 'Shoreline Management Partnership' on behalf of the Liverpool Bay Coastal Group, using 1995 Blue Book guidance (an SMP1) (Shoreline Management Partnership, 1999). The chosen method of of SCDO format involved three parts (Part A through to C). Part A (Objectives, Issues and Statutory Details) presented various sets of information, for example, issues raised *via* the consultation stage, relevant statutory planning policies, conservation designations, land ownership details and information on existing coastal defences in place. Part B (Intervention Appraisal), in simplistic terms, presented the economic viability of various intervention options considered. Part C (Strategic Policy Appraisal) presented the screening of each type of policy options against their potential effects (*e.g.* on the coastal processes, natural environment, development and land use, adjacent Management Units), along with the chosen preferred policy option for the SCDO.

A contrasting example is an SMP prepared by consultants 'Royal Haskoning' for the North East Coastal Authorities Group in 2007, using Defra's 2006 guidance (an SMP2) (Royal Haskoning, 2007). The presentation of policy options is notably different due to the nested shoreline divisions created in the plan (Policy Development Zones are presented, within these are Management Areas and Policy Units). The first section sets out a summary of the preferred plan recommendation and justification. This establishes the policies and the timescales to which they apply. As indicated, SMP2s are notably different due to their timescale and associated planning epochs. This is accompanied by a statement indicating any changes in policy from the present management and cost implications of the intervention policy on the built environment, *i.e.* assets at risk. A map is also supplied showing the geographical location of the SDCO in the context of the wider SMP coastline, indicating future shoreline positions and nature conservation designations. Where appropriate, an environmental assessment is also presented detailing possible effects on nature conservation designations and suggested measures such as compensation and mitigation. The SCDO is concluded with a management action plan, including timescales for actions.

Together these examples of SCDOs prepared under 1995 and 2006 guidance, highlight the differences in both the decision making pathway and the presentation of natural coastal change information.

6.3 Shoreline Managements Plans: A scientific and transparent process? A Review

The developments in coastal defence and coastal risk management so far discussed present an opportunity to consider the thesis aim, *viz, 'To examine the role of science within coastal decision making, with particular reference to decisions pertaining to coastal risk.'* A review of SMPs was undertaken with the aim to examine the scientific underpinning and transparency of SMP decision making processes, thereby directly contributing towards the thesis aim. In doing so, this research exercise sought to unravel the thought processes within the SMP process, from the scientific foundations, through to the application of this knowledge and understanding for the selection of specific coastal defence management policies for stretches of the coastline. As indicated in Section 6.1, this case study, whilst having the same investigative puzzle as the other case studies, differs with regard to the methods employed (Section 6.3.2).

The SCDO component within the SMP presents the recommended coastal defence policy option for a shoreline division. Table 6.1 contains the policy options available under the 1995 SMP Blue Book guidance. This element of the SMP was selected as the primary mechanism for the review, in order to allow the consideration of both the utilisation of science (that is the scientific basis and underpinning of the SMP) and the transparency of decision making and the justification of the selection coastal defence management policy for the SCDO. The review devised and applied two proformas to seven SMPs, translating into twenty SCDOs (Table 6.3 & Figure 6.4). The findings associated with the first proforma (*Preliminary Assessment*) are of a qualitative nature and relate to background and contextual information from the SMP (*e.g.* sediment cell number, lead Local Authority and who prepared the plan) and the SCDO itself (*e.g.* management unit summary information, including coastal processes and natural environment). Findings gathered from the second proforma (*SCDO Grading*) facilitated the grading and classification of the SCDO in a quantitative form based upon the following two areas:

- SCDO's Decision making pathway and
- SCDO's Evidence base.

The SMPs reviewed were selected on the basis of the following criteria and addressed the following aspects:

- The generation of SMP and guidance used, *e.g.*:
    - Those developed during the first period of SMP development using 1995 guidance (undertaken between 1996-1999) (SMP1s);
    - Those developed as SMP2 pilots (undertaken in 2006) and
    - SMP2s prepared using the 2006 guidance (undertaken in 2007).
- The range of policy options present within the SMP: Do Nothing, Hold The Line, Natural Defence Management, Managed Retreat, No Active Intervention;
- The geography of the plan: England, Wales, cross-border areas, East coast, West coast and North West coast, developed and rural stretches of coast;
- A range of consultants (Shoreline Management Partnership, Halcrow, Royal Haskoning, Bullen Consultants) local, regional and national.

The utilisation of this list of criteria helped create a representative survey sample regarded as providing a wide range of SMPs, representative of the plans prepared around the coast of England and Wales between 1995 and 2007. A list of the reviewed plans is contained in Table 6.3. The Methodology Chapter (Section 3.6.2) highlighted that the greatest limitation of this review was accessibility. Accessing SMPs, either in hard copy or electronic form, was found to be extremely variable and required considerable time and effort. Thus constraining the inclusion of more plans in the review. The previously referred to government review of SMP1s (Section 6.2.1.1), noted this issue and included the following as a key recommendation, "(ix) there is a need to improve the dissemination of findings ...and improve the accessibility of all Plans produced in England and Wales" (MAFF, 2000, pg. iii).

As the location details of plans were not deemed relevant to the aim of the review, plans were allocated an alpha-numeric code *e.g. Plan Aiii* as opposed to 'SMP 8b: Worms Head to Lavernock Point'. Within the forthcoming tables and discussion, it should be noted that use of an alphabetic prefix identifies the SMP, whilst a Roman numeral prefix identifies the individual SCDO. As stated, a policy type from each reviewed SMP was included, for example *Plan A* relates to the reviewed SMP, and *Plan ai, Plan ai* and *Plan aiii*, relate to three individual SCDOs of differing policy types from SMP A. Consequently, the review does not seek to offer a critique according to the consultancy, Coastal Group or sediment cell / geographical location of the plan. Instead, inferences are made regarding the guidance used to develop the plan.

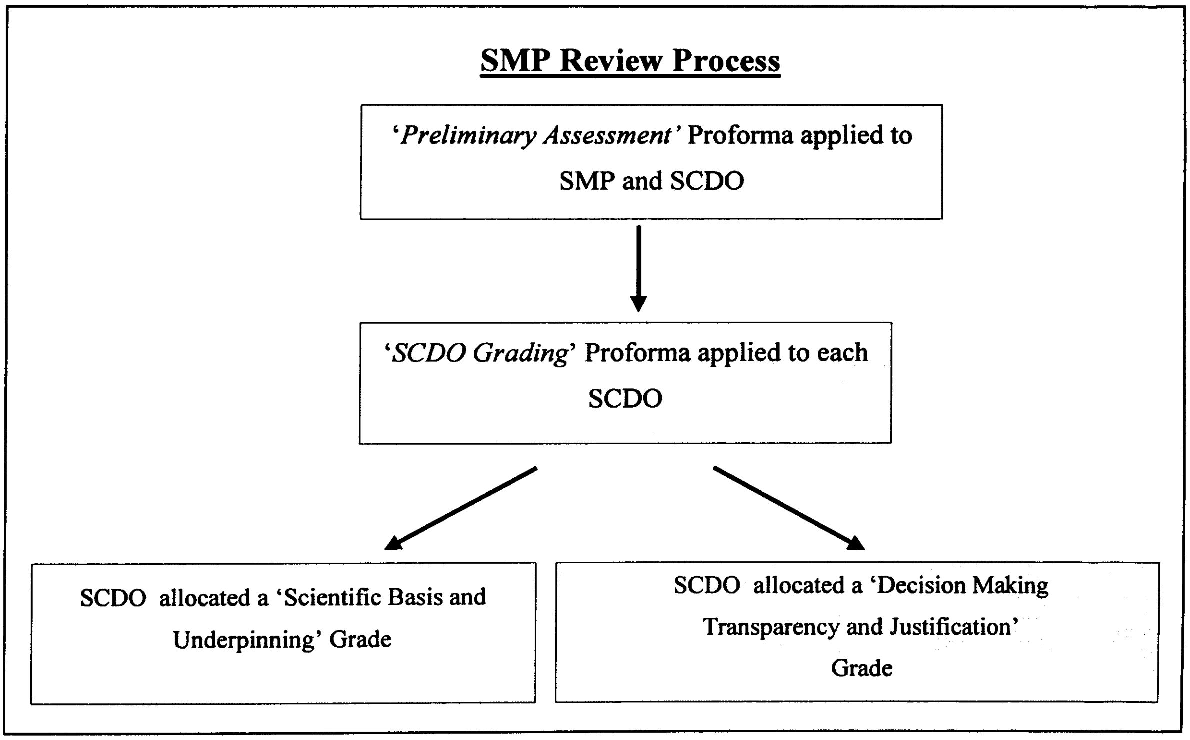


Figure 6.4: Case Study Three SMP Review Process

Source: Original

Table 6.3: Reviewed Case Study Three Shoreline Management Plans

Coastal Cell Number & Location	Coastal Group	Guidance	Consultant	Shoreline Division & Policy Option
1b, c, d: River Tyne to Flamborough Head	North East Coastal Authorities Group	2006	Royal Haskoning	MA01 PDZ 1.1: Hold The Line MA03 PDZ 3.2: Retreat MA06 PDZ 6.2: Managed Retreat MA09 PDZ 9.1: No Active Intervention
3b: Kelling to Lowestoft Ness	Anglian Coastal Authorities Group	SMP2 Pilot	Halcrow	3b01: No Active Intervention 3b04: Hold The Line 3b20: Hold The Line – No Active Intervention 3b15: Hold The Line – Managed Realignment
8b: Worms Head to Lavernock Point	Swansea Bay Coastal Engineering Group	1995	Shoreline Management Partnership	MU No. 1/5: Do Nothing MU No. 5/2: at MU No. 1/6: Hold The Line

11a: Great Ormes Head to Formby Point	Liverpool Bay Coastal Group	1995	Shoreline Management Partnership	MU No. 1/1: Do Nothing MU. No. 2/2: Hold The Line
11b: Formby Point to River Wyre	Ribble Estuary Shoreline Management Plan Partnership	1995	Shoreline Management Partnership	MU No. 5/2: Do Nothing MU No. 5/1: Hold The Line MU No. 7/1: Natural Defence Management
11c: River Wyre to Walney Island	Morecambe Bay Shoreline Management Plan Partnership	1995	Shoreline Management Partnership	MU No. 1/1: Do Nothing MU No.1/2: Hold The Line
11e: St. Bees Head to River Sark, Scottish Border	North West Coastal Group	1995	Bullen Consultants	MU 1: Do Nothing MU 15: Hold The Line

6.3.1 Preliminary Assessment Proforma

The *Preliminary Assessment* Proforma comprised four sections (Table 6.4). The first of these (Plan Overview) gathered background contextual information from the SMP, including the coastal sediment cell location, Coastal Group name and date of its preparation. The second section (Management Unit Summary) collected information concerning attributes of the SCDO (coastal processes, natural environment, land usage *etc*). The last two sections (Intervention Appraisal and Strategic Policy Screening) concerned the range of coastal defence policy options and associated feasibility screening.

The utilisation of a standard proforma allowed a systematic and consistent system within the review process for the collection of information from the SCDOs. As highlighted in Section 6.2.2, SMPs during the 1990s and early to mid 2000s were prepared under different versions of government guidance, by numerous engineering consultancies, thus creating a lack of consistency in approach. In order to develop a proforma that could be universally applied in to a wide variety SMPs and their SCDOs, it was necessary to understand how various stages and volumes of the SMP process were organised and presented. This task was achieved by examining the format and contents of the following SMPs:

- Swansea Bay (Worm's Head to Lavernock Point): Sub Cell 8b, Shoreline Management Partnership (2001), Swansea Bay Coastal Engineering Group;
- Pembrokeshire (St. Govans Head to Teifi Estuary): Sub Cell 8d (part) & 9a (part), Shoreline Management Partnership (Stage 1) and Atkins (Stage 2) 2000, Pembrokeshire County Council;
- Cardigan Bay (Teifi Estuary to Dyfi Estuary): Sub Cell 8c, Posford Duvier (1997), Cardigan Bay Coastal Group;
- Liverpool Bay (Great Orme to Formby): Sub Cell 11a, Shoreline Management Partnership (1999), Liverpool Bay Coastal Group and Tidal Dee Users Group;
- Severn Estuary (Lavernock Point to Hurlstone Point) Sub Cell 7e & 8a, Gifford Associated Consultants (2000), Severn Estuary Coastal Group;
- Kelling to Lowestoft Ness: Sub Cell 3b, Halcrow (2006), Anglian Coast Authorities Group.

This sample was regarded as being an appropriate selection to base the proforma upon, as it includes SMPs prepared by four different consultants in England and Wales, using the three sets of guidance discussed in Section 6.2 (1995, 2001, 2006), in differing coastal systems, including open coast and estuaries. Despite differences in the organisation and presentation of SCDOs, similarities were observed. The proforma was, therefore, designed upon these observations and acquired knowledge and understanding of SMP documents.

The application of the *Preliminary Assessment* proforma to the three parts of the plan (Management Unit Summary, Intervention Appraisal and Strategic Policy Screening) involved the SCDO being assessed according to the following criteria:

- Presentation of information (*e.g.* tabular, bullet points, discursive text);
- Organisation of information (*e.g.* concise, clear, logical);
- Use of supporting references and
- Indication of any assumptions, limitations and uncertainties associated with the evidence base.

Table 6.4 presents an overview of the proforma, whilst Appendix A4 contains the full proforma. The proforma also contained a section that sought auxiliary information, such as extra comments and observations about the plan to be noted.

Table 6.4: Preliminary Assessment Proforma Overview

<table>
<tr><th>Proforma Section</th><th>Information Gathered</th><th>Assessment Criteria</th></tr>
<tr><td>Plan Overview</td><td>• SMP Context Information:
Coastal Cell Number
Lead Authority
Coastal Group
Consultant
Shoreline Divisions...</td><td></td></tr>
<tr><td>Management Unit Summary</td><td rowspan="3">• SCDO Information Areas:
Coastal Processes
Land Use
Economics
Natural Environment</td><td rowspan="3">• SCDO Level of Detail:
Generic to coastal cell, specific to shoreline division.
• SCDO Presentation of Information:
Tabular, bullet points, paragraphs of text.
Concise, clear, logical, integrated.
• SCDO Cross-referencing & Referencing
• SCDO Indication of Assumptions, Gaps & Uncertainties.</td></tr>
<tr><td>Intervention Appraisal</td></tr>
<tr><td>Strategic Policy Screening</td></tr>
</table>

6.3.2 SCDO Grading Proforma

To further the review of SMPs, another phase of SCDO analysis was undertaken. In a similar vein to the *Preliminary Assessment* proforma, a *SCDO Grading* proforma was devised and consistently applied to all SCDOs. This latter proforma used a number of criteria to assess the scientific basis and underpinning evidence base of the SCDOs main categories (Management Unit Details and Intervention Screening Appraisal). A summary of this proforma (*SCDO Grading*) is presented in Table 6.5. The full proforma and its associated Scoring Sheet are contained in Appendix A4.

The reviewed categories of the SCDO consisted of the following sub-divisions:

- Management Unit Details
    - Statutory Details;
    - Shoreline Description / Evolution;
    - Coastal Defence, Consultation and
    - Land Ownership.
- Intervention Screening Appraisal
    - Policy Screening and
    - Future Monitoring and / or Studies.

The four assessment criteria used as follows:

1. Data content and coverage;
2. Presentation and synthesis;
3. Traceability and
4. Scrutiny and quality assurance.

Table 6.6 contains the guidelines for these criteria.

The qualitative information generated from this process was then divided into two constituent parts, in order to allow the allocation of grade for the SCDO's:

- Scientific Basis and Underpinning and
- Decision Making Transparency and Justification.

Table 6.5: SCDO Grading Proforma Summary

SCDO Grading (x axis = assessment criteria & y axis = SCDO categories)		Data Content & Coverage	Presentation & Synthesis	Traceability	Scrutiny & Quality Assurance
Management Unit Details	Statutory Details				
	Shoreline Description/ Evolution				
	Coastal Defence				
	Consultation				
	Land Ownership				
Intervention Screening Appraisal	Policy Screening				
	Future Monitoring & /or Studies				
Individual Score					
Weighted Score					
TOTAL SCORE					

Table 6.6: SCDO Grading Assessment Criteria and Guidelines

Assessment Criteria	Guidelines for comments
Data Content & Coverage	Range / type of data sets / depth / detail / temporal & spatial
Presentation & Synthesis	Clear / well structured / logical presentation & organisation / tables / bullets / lists / maps / wordy paragraphs of text
Traceability	Cross – referencing to other volumes / stages of the SMP
Scrutiny & Quality Assurance	Reference to gaps/ uncertainties in data & understanding

To summarise the qualitative findings and move towards an overall assessment of the SCDOs *scientific basis and underpinning*, an ordinal three-point scale scoring system was devised. Scores from 0-2 were allocated to each of the assessment criteria (*e.g.* Data Content and Coverage, Presentation and Synthesis *etc*). Table 6.7 presents the scoring system and associated guidelines. Within the review, the relative importance of these assessment criteria was considered. In light of this, it was recognised that some were more important in helping to determine the SCDOs scientific basis and underpinning. Accordingly, individual assessment criteria were given a relative weighting (Table 6.8). For example, the review considered 'Presentation and Synthesis' of the SCDOs evidence base to have greater importance than 'Scrutiny and Quality Assurance'. These weighted scores were then combined, with the overall score used to allocate the SCDO's *scientific basis and underpinning* grade (Table 6.9).

A hypothetical example of this process is as follows:

Plan XYZi

Individual Assessment Criteria Scores:

Data Content = 1, Presentation = 2, Traceability = 2, Scrutiny= 1

Weighted Assessment Criteria Scores:

Data (1*0.2) = 0.2, Presentation (2*0.5) = 1,Traceability (2*0.2) = 0.4, Scrutiny (1*0.1) = 0.1

Total Score = **1.7**

Allocated Grade = **A** (SCDO - Strong scientific evidence basis and underpinning)

Table 6.7: SCDO Grading: Individual Assessment Criteria Scores and Meanings

Theme	Score	Meaning
Data Content & Coverage	0	Generic brief statements that are often not site specific to the SCDO.
	1	Variable, some sections detailed and site specific; along with some sections that are scarcely populated.
	2	Extensive range of data and information presented. Good level of site detail.
Presentation & Synthesis	0	Presentation of lists, numbered points and bullets points with no analysis, integration or synthesis. Use of large paragraphs of text.
	1	Mixture including lists and bullets, often very short descriptive text.
	2	Good presentation of data using tables, matrix. Concise, relevant, organised and structured SCDO. Maps presented in the SCDO are integrated.
Traceability	0	No cross-referencing.

	1	Limited amounts of cross-referencing.
	2	Most sections of the SCDO are cross referenced to various other sections or volumes of the plan.
Scrutiny & Quality Assurance	0	No referencing or use of scientific citations within the SCDO. No attempts to indicate data gaps and uncertainties within any sections.
	1	Gaps and uncertainties indicated in some sections. Future studies and monitoring indicated.
	2	Explicit reference made to areas of uncertainty and limitations. Sources of information cited / referenced in relevant sections.

Table 6.8: SCDO Grading: Assessment Criteria Weighted Values and Grades

Weighted Scoring System	
Assessment Criteria	*Value*
Data Content & Coverage	20%
Presentation& Synthesis	50%
Traceability	20%
Scrutiny& Quality Assurance	10%

Graded Science Scoring	
Grade	*Scoring Range*
C	0 - 0.7
B	0.8 - 1.5

Worked Example:

Plan XYZi

Individual Assessment Criteria Scores:

Data =1, Presentation =2, Traceability =2, Scrutiny =1

Weighted Assessment Criteria Scores:

Data (1*0.2)= 0.2, Presentation (2*0.5)= 1, Traceability (2*0.2)= 0.4, Scrutiny (1*0.1)= 0.1

A	1.6 – 2	*Total SCDO Score* = 1.7 *Allocated SCDO Grade* = A SCDO = Strong Scientific Basis and Underpinning

Table 6.9 contains the associated explanations of the three possible grades (A to C) awarded to each SCDO for their *scientific basis and underpinning*. It is recognised that the three grades represent a certain degree of generalisation. However, the information and analysis of the *Preliminary Assessment*, in addition to the information and analysis gathered from the *SCDO Grading*, together allow for wider analysis of reviewed SCDOs individually and comparatively.

Table 6.9: SCDO Grading: Scientific Grades and Meanings

Scientific Basis & Underpinning Grade		**Meaning**
A	*Strong scientific evidence basis and underpinning*	The SCDO is well presented and organised. Information is comprehensive, site specific and concise. Explicit reference is made to assumptions, limitations and uncertainties, along with referencing/citations and comprehensive cross-referencing. The SCDO could not have been done without the Data Collation stage of the SMP process.
B	*Limited amount of scientific evidence basis and underpinning*	The SCDO is clearly presented. There is a notable mixture of data content and coverage within the various sections of the SCDO. Some sections contain significant site-specific information, whilst others are scarcely populated. Future monitoring and studies information is provided. Attempts are made to disclose areas of uncertainty and limitations.

C	*No visible scientific evidence base and underpinning*	The majority of the information provided is brief and generic. No attempt is made to indicate areas of uncertainty or limitations with no referencing or cross-referencing, therefore the sources of the information is unclear. The SCDO could have been done without the Data Collation stage of the SMP and been informed by site visits, discussions with Local Authority engineers and coastal / shoreline management expertise.

The next stage of analysis associated with the *SCDO Grading* Proforma was the examination of the SCDOs decision making. To enable this, the proforma collected information to allow for an assessment of the decision making transparency and justification. Based upon this a grade was allocated to each SCDO. the three grades (0-2) and their associated meanings are contained in Table 6.10.

Table 6.10: SCDO Grading: Decision Making Grades and Meanings

Decision Making Transparency & Justification Grade		**Meaning**
2	*Decision making pathway is both transparent and well justified*	The SCDO presents a full screening of policy options with a detailed technical, economic and environmental appraisal &/or Well justified and clear decision making of the preferred policy option.
1	*Decision making pathway is not clearly presented or justified*	The SCDO presents a partial screening of policy options &/or The preferred policy option is marginally

		justified by screening and intervention appraisal.
0	*Decision making pathway is neither transparent nor fully justified*	The SCDO does not present a policy screening or intervention appraisal &/or The justification of the preferred policy option is not clear OR the preferred policy option appears to be pre-determined based on factors that override the SCDO screening approach.

6.4 Results

The results of the application of the *Preliminary Assessment* and *the SCDO Grading* to twenty individual SCDOS from seven SMPs are presented separately in Sections 6.4.1 and Section 6.4.2. This is followed by an integrated analysis of findings (Section 6.4.3).

6.4.1 Preliminary Assessment Proforma Analysis and Results

Section 6.3.1 introduced the *Preliminary Assessment* proforma and associated methodology. The qualitative information gathered by this assessment, in essence, examined the information content and presentation style of the twenty reviewed SCDOs. The data generated and analysis presented here, is structured as follows:

- Part A Management Unit Summary (Section 6.4.1.1)
- Part B Intervention Appraisal (Section 6.4.1.2)
- Part C Strategic Policy Appraisal / Screening (Section 6.4.1.3)

It is worth restating that information contained within the first of parts should, theoretically, inform Part C (Strategic Policy Appraisal / Screening). As it is within Part C, that the chosen or 'preferred' policy for the SCDO is presented.

6.4.1.1 Part A Management Unit Summary

Part A (Management Unit Summary) was found to contain information on several aspects including, *inter alia,* consultation issues, objectives and statutory details for the specific shoreline divisions used within the SCDOs. This part of the plan is considered stand-alone in nature, as this contextual information does not appear to be carried forward to the rest of the SCDO. This aspect will be discussed in further detail shortly.

Part A: Statutory planning policies

The majority of SCDOs developed under the 1995 guidance, *i.e.* SMP1s, referred to the statutory land-use plans applicable to the lengths of shoreline within the SCDO, the exception to this being *Plan F.* The presentation and level of detail was variable, often Borough, District and County-level plans were cited, with some SCDOs providing the relevant policy numbers and an indication of the policy content. For example, *Plan ai*, whilst not stating the relevant planning documents indicated policy content "Presumption against development outside designated village boundaries" cross-referenced to the SMP appendices. Others SCDOs stated the plan title and their applicable policies, for example, "Gywnedd Structure Plan, Policies: D5, D10, D15, DD11", *Plan ci.* Of SCDOs from SMP2s, these did not have any explicit sections or information provision on statutory planning policies.

Part A: Nature conservation designations

Where SMP1s provided current statutory and non-statutory nature conservation designations, information was extremely coarse. In most cases, it was presented without specific site details, reasons for designations, details of site managers and implications for coastal defence provision. Notably, no plans indicated possible future designations within the SCDO area. Additionally, there was only minimal cross-referencing to the Appendix for further information on the designations. SMP2 SCDOs presented information on nature conservation designations very differently, with the inclusion of maps (GIS-based) that visually indicated the locations of designations such as SSSI's, SAC's and Ramsar sites e.g. *Plan B.* Interestingly, some of the SCDOs in *Plan G* contained very coarse environmental impact assessment, providing a description of the designation, and the effect of the preferred plan and measures to offset effects and impacts (compensation / mitigation).

Part A: Coastal defence

The provision of information regarding existing coastal defence provision in the SCDO was an explicit element of the SMP1s. This may appear at first to be fundamental or vital requirement within the management summary so as to inform the future direction of coastal defence provision. However, whilst the majority of SMP1s did provide some information, it was evident that detailed information was lacking and had not been collected and collated by the SMP. The common information provided was the location, type and length of defence; information, such as, the condition and residual life of the defence was, in most cases, not presented. Additionally, operational responsibility was often not indicated. Only one plan, *Plan A*, cross-referenced this section of the SCDO to the Data Context Report. Similar information on coastal defence was not presented within SMP2s. This lack of coastal defence-related information prompted consideration of the possible presence of this information within other volumes of the SMP. In the case of *Plan C*, coastal defence data for the SMP was found within the volume presenting supporting information about management unit appraisals. This notes the disparate sources used for providing information on the coastal defences in the SCDO, including a number of surveys carried out by different bodies over different years, *viz* MAFF Coast Protection Survey (1994), NRA Sea Defence Survey (1991), British Rail Survey of Defences (1990-1991) and Welsh Office Coastal Survey (Shoreline Management Partnership, 1999).

Part A: Overview

This part of the SCDO presented information mainly in tabular form that was generally in a clear and concise format. It was noted that often information presented was too summarised and brief, being presented in a tokenistic, rather than a meaningful way. However, there was some degree of cross-referencing of this section within the reviewed SCDOs, for example within consultation issues, coastal defence and statutory planning policies. This section was noted for having little or no reference to gaps, uncertainties and assumptions within the evidence base.

6.4.1.2 Part B Intervention appraisal

In the majority of reviewed plans, Part B of the SCDO was found to deal with the intervention appraisal, including information on shoreline physical characteristics and land usage. Additionally, some SCDOs included preliminary economic appraisal of assets at risk and cost implications to determine the economic viability of policy options.

Part B: Shoreline description

This section, when present, provided information on the physical characteristics of the SCDO, including its geology, geomorphology, shoreline movement, coastal processes, exposure; along with limited information on shoreline interests and usage. This information was presented in short bullet point-like statements with no cross-referencing or scientific citations. This information did not appear to add value to the SCDO, as the information provided had little useful detail. SMP2s did not include an explicit section entitled shoreline description, however, some of the summary statements within the SCDO contained some elements of shoreline description.

Part B: Shoreline evolution

The presentation of information, such as, the geology, shoreline movement and geomorphology was often very descriptive. In many cases, this information did not appear to be specific to the SCDO, being more general to the sediment sub-cell, and in some cases could be regarded as a mere visual description of the SCDO. On occasions where the level of detail was high, for example, "This section of shoreline has been historically stable/modestly accreting over the past 150 years" *Plan diii*, no citations or referencing was present. This information, therefore, appears to be based on expert judgement and not linked or traceable, to the data collation stages of the SMP and associated reports and appendices. Within this section no SCDOs indicated gaps, uncertainties in the coastal processes and geomorphological understanding of the SCDO. Additionally, it was not indicated where local expert knowledge and opinion had been utilised to support these statements.

Part B: Economic assessment

All SCDOs reviewed involved some level of commentary on assets at risk. SMP1s presented a division of assets at risk into tangible and intangible benefits. Only six SCDOs (30%) included preliminary costed figures of the value of assets at risk, for example, "annual toll fees for the use of the road equate to about £50,000 (Local Authority figures) *Plan ci*, "Potentially extensive but realistically less than £1.0 million" *Plan cii.* Only in one case was there a clear statement on uncertainty regarding economic assessment, "Unknown, would require consideration of economic value of environmental resource" *Plan eii.* No cross-referencing was provided to support these economic assessments.

Part B: Overview

It was considered that the inclusion of shoreline descriptions and shoreline evolution in Part B would have been more appropriate and relevant to Part A, as when read together they provide a clear outline of the physical and human geographical aspects of the SCDO. Only three SCDOs (15%) indicated gaps and uncertainty with regard to the information used, these concerned erosion rates and the residual life of existing defence schemes. There was found to be no referencing in any element of Part B by any of the reviewed SCDOs. Economic assessments in SMP2 SCDOs were found to contain greater detail and it was more apparent as to how these figures had been calculated.

6.4.1.3 Part C Strategic Policy Appraisal / Screening

Part C of the SCDO presented the chosen or 'preferred' policy, along with associated issues and implications of this policy choice.

Part C: Strategic assessment

The appraisal and presentation of all policy options within a matrix was a common approach within SMP1s. This full screening of all policy options was presented against a number of matrix criteria, for example, effects on coastal processes, opportunities for environmental enhancement, sustainability and concordance with objectives. The level of detail provided for each criterion was variable across the SCDOs, with the majority often only having a few words accompanying each. However, some areas gave greater consideration and quite often consisted of notably more information than others. The wording used to detail the potential effects of policies on the natural environment, was often succinct for example, 'likely detrimental impact depending upon from and extent', 'erosion of cliff and soft rock shore affecting landscape and SSSI', 'reduction in intertidal zone areas'. In comparison, regularly cited statements for possible opportunities for environmental enhancement were notably shorter and less informative, for example 'unknown', 'unlikely', 'little change', 'no information'. In addition to the issue regarding the level of detail in the matrix, a lack of cross-referencing was found. This showed possibly that much of the information contained was based more on judgement and expert opinion, with little indication of uncertainties and gaps in the knowledge base.

Part C: Preferred policy

In addition to the matrix screening, a table containing the existing coastal defence policy (seventeen of the twenty SCDOs, 85%) along with the recommended preferred policy were presented for each SCDO. Accompanying these were statements on uncertainties and dependencies, with nine out of twenty SCDOs (45%) stating sea level rise and increased storminess. This element of the evidence base however, did not translate into stating existing monitoring or proposed future studies and monitoring. Of the twenty SCDOs, six indicated future studies and monitoring that were crossed referenced to other sections of the plan, which in some cases included the costs of these studies, for example, "sediment movement definition £50-100k" *Plan ci*. Others were observed as providing more basic areas for studies, for example 'beach levels' *Plan gi*. SMP2 SCDOs in contrast, did not present full screening of all possible policy options. Instead, these contained a significant amount of text containing policy justification and reasoning.

Consideration of all reviewed SCDO policy recommendations found that only six SCDOs were recommending a change to the current policy (for example, from Hold The Line to No Active Intervention). This was often explained by a need to allow sediment movement along the coast, *e.g. Plan biii*. The provision of information and reasoning regarding the selection of a policy was identified as a common characteristic, for example, "public safety" *Plan ai* and, "to avoid crises management" *Plan aii*.

Plan G, an SMP2 SCDO, was the most detailed with regard to the proposed implementation of the preferred policy, with the inclusion of a breakdown of costings and an action plan. This detailed actions, such as, schemes, monitoring, by who, when and forecasted costings. Information on the implementation of the preferred policy within the older generation of plans generally consisted of a comment against 'Intervention Priority', for example, *Plan ai*, "coast path – set back when and where appropriate". An additional inclusion in some SCDOs was the existence of guidance on timescales of intervention priority, for example, "Capital 5-10 years, Revenue <5 years" *Plan cii*.

There did not appear to be any difference between the information presented within the four different policy options, such as Hold The Line, in comparison to Do Nothing. Within those SMP2 SCDOs that had transitional policies, the rationale was presented in a discursive statement at the beginning of the SCDO section of the plan.

Section C: Overview

The presentation of a full screening of policy options to inform the decision making process underpinning the SCDO was valuable, although, as previously stated, the level of information presented was variable. However, whilst this element of the SCDO was found to be brief, in most cases it provided the most transparent consideration of the issues involved in determining the most economic, environmental and socially acceptable shoreline management policy.

The strength of reasoning and justification of the preferred policy was variable. The stated justification for preferred policies included protection of assets, the allowal of natural processes, *Plan biii*, "...in the long term a retreat policy will be implemented, which would improve sediment input and throughput", "...to allow retreat of the coastline, to improve sediment feed to downdrift areas...would also become technically more difficult, and thus more expensive, to maintain" *Plan biv*, "thereby maintaining operation of the Port of Tyne". *Plan cii* states that whilst Do-Nothing in the short term was economically and environmentally sustainable, as a policy, however, it was noted as, "Socially unacceptable at present time". Consequently, this SCDO recommends Hold The Line as the preferred policy in both the short and long term.

6.4.1.4 Integrated Preliminary Assessment Results

Emerging from the findings so far discussed, are distinct variations amongst those SCDOs prepared under different guidance. This section, therefore, pays particular attention to these patterns, most notably variations amongst SMP1 and SMP2 SCDOs.

Firstly, it was identified that SMP1 SCDOs contained greater Management Unit Summary information, for example, land ownership, statutory details, nature conservation, shoreline description and evolution. Additionally, there was a clearer screening of policy options for the SCDO, often using matrix format. In contrast, SMP2 SCDOs did not contain full screening of policies options. Instead, there was found to be the 'up-front' presentation of preferred policy at the beginning of the SCDO, with greater contextual justification for preferred policy and supporting text on the justification of policy direction and its role within the wider SMP.

Also, different information types were found to exist within SMP1s and SMP2s. For example, whilst in SMP2s there was no presentation of existing coastal defence information (*i.e.* coastal structures currently in place or consultation issues) there was additional information presented visually, including the presentation of maps (GIS based) containing EA Flood Zone mapping, predicted shoreline mapping of coastline 2025, 2055, 2105, nature and historic conservation designations. Furthermore, there was greater detailed costings of preferred policy and in some cases an action plan (containing information on the actions proposed, named bodies action and timescales). The final area of divergence related to shoreline divisions. It was observed that was a greater nesting of shoreline divisions, for example *Plan G* contained Policy Development Zones, within where Management Areas and within these, Policy Units. In comparison, many first generation plans contained Coastal Process Units and Management Units and in some cases solely policy units.

Despite these divergences, commonalities existed regardless of plan guidance. These included a lack of cited referencing of information sources, a lack of cross referencing to other sections of the plan and a lack of explicit statements or indications on gaps, uncertainties. In summary, this is considered as reflecting, in the majority of SCDOs, a weak natural coastal change scientific underpinning for recommended coastal defence policies.

6.4.2 SCDO Grading Analysis & Results

Section 6.3.2 introduced the methodology associated with the *SCDO Grading* proforma. This process, in essence, comprised an initial qualitative assessment that was then developed into a quantitative assessment of the two following aspects:

- The scientific basis and underpinning (Section 6.4.2.1)
- The transparency and justification of decision making (Section 6.4.2.2)

The first of these aspects, *i.e.* the SCDOs scientific basis and underpinning, was achieved by assessing the main categories of the SCDO against four assessment criteria. These criteria were allocated individual scores, which were then given a weighting score to address their relative importance. The combined weighted score was then allocated a scientific basis and underpinning grade (Table 6.9). The final stage of assessment within the *SCDO Grading* analysed the SCDO decision making pathway. Grades for this aspect were based upon the transparency and justification in the SCDO for the recommended coastal defence policy (Table 6.10).

6.4.2.1 SCDO Grading: SCDO Scientific Basis

The *SCDO Grading* scientific assessment of SCDOs will now be considered. Table 6.12 presents the individual scores allocated to the four assessment criteria (Data Content and Coverage, Presentation and Synthesis, Traceability and Scrutiny and Quality Assurance). The range of scores (0-2, with 0 being poor and 2 being good) and associated detailed meanings are contained in Table 6.7

It was identified that for the *Data Content and Coverage* criterion, five plans received a score of 2, thirteen plans received a score of 1, leaving two plans receiving a score 0. The majority of plans (65%) were, therefore, considered to contain variable levels of detailed data content and coverage, with a quarter (25%) containing an extensive range of data and information that was specific to the SCDO.

With regards to the *Presentation and Synthesis* theme, five plans received a score of 2, eight plans received a score of 1 and seven plans received a score of 0. This theme has a lesser clustering than the *Data content and Coverage* theme, with a more even split across the three available scores indicating a variation in SCDO presentation and synthesis. The greatest number (40%), were regarded as having a mixed level of presentation that included lists, bullets, with short descriptive text with minimal synthesis or integration and clear presentation. This is closely followed by 35% of SCDOs that had large paragraphs of texts in some sections, with others including lists and bullet points, with no supporting or analysis. Twenty-five percent of SCDOs were considered to have good presentation of data with SCDO being well organised, structured and concise.

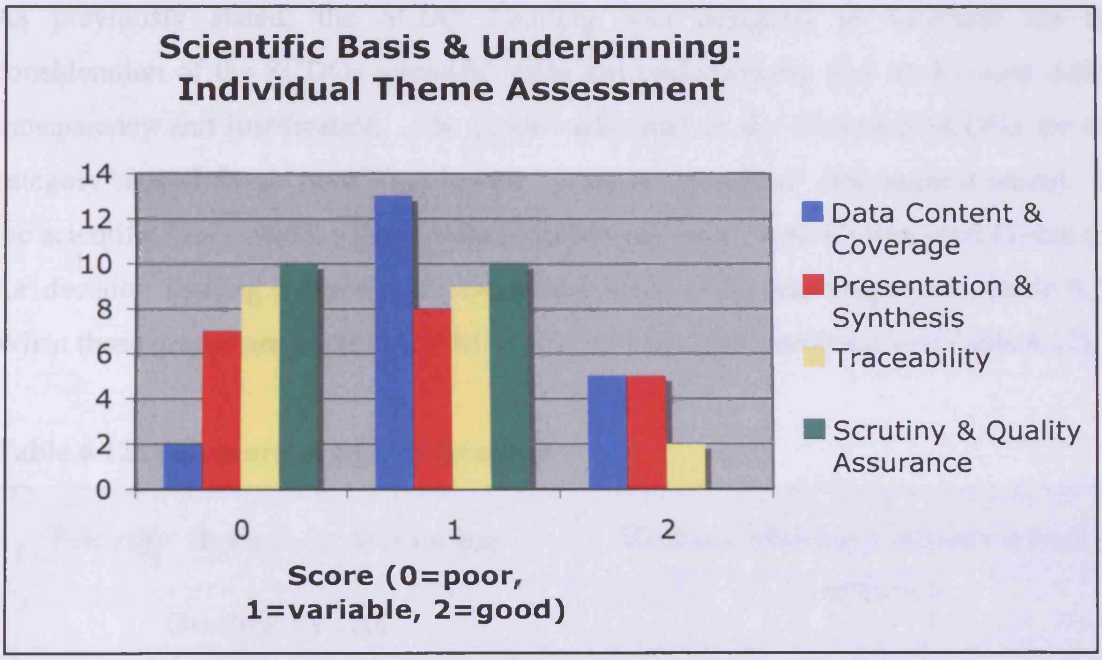
The *Traceability* theme saw nine plans receiving a score of 0; another nine plans received 1 and only two were allocated a score of 2. This translates to 45% of SCDOs containing no cross-referencing, 45% having limited amounts and only 10% having cross-referencing in most sections; these findings are both surprising and disappointing. This pattern is mirrored within the *Scrutiny and Quality Assurance* theme, with ten plans, or 50%, having no referencing or scientific citations and no attempts to indicate gaps and uncertainties associated with the data. The other 50% of plans indicated gaps and uncertainties in some sections and stated future studies and monitoring. Notably, none of the SCDOs explicitly reference areas of uncertainty and limitations, or indicated the sources and references of the information contained in the SCDO.

Table 6.11: SCDO Grading: SCDO individual assessment criteria scores and scientific grade

SCDO ID	Data Content & Coverage	Presentation & Synthesis	Traceability	Scrutiny & Quality Assurance	Overall Grade
ai	1	2	2	1	A
aii	1	1	1	1	B
aiii	1	2	2	1	A
bi	0	0	0	0	C
bii	1	1	0	1	C
biii	1	0	0	1	C
biv	0	0	0	1	C
ci	2	1	1	1	B
cii	2	2	1	0	A
di	1	1	1	0	B
dii	1	1	1	0	B
diii	2	1	1	1	B
ei	2	2	1	1	B
eii	2	2	1	1	A
fi	1	0	0	0	C
fii	1	1	0	0	C
gi	1	0	0	0	C
gii	1	1	0	0	C
giii	1	0	1	0	C
giv	1	0	0	0	C

The majority of SCDOs for all four criteria received a variable score of 1(Figure 6.6). *Data Content and Coverage* along with *Presentation and Synthesis,* in summary received the most number of high scores (*i.e.* a score of 2). In contrast, the themes of *Traceability* and *Scrutiny and Quality Assurance* received the greatest number of low scores (*i.e.* a score of 0), illustrating that these two components of scientific basis and underpinning assessment were the weakest.

Figure 6.5: SCDO Grading SCDO Scientific Basis Assessment of Individual Themes



In summary, only four SCDOs (20%) were regarded in this review as being excellent examples of a SCDO with a strong scientific evidence basis and underpinning. Six SCDOs (30%) were identified as being examples of SCDOs exhibiting a limited amount of scientific evidence basis and underpinning; with a further ten SCDOs (50%) were considered as having no visible scientific evidence base and underpinning. Table 6.11 also presents the SCDOs overall calculated grade for its scientific basis and underpinning. Four SCDOs were given an excellent grade, six were variable and the remaining 50% were variable.

6.4.2.2 SCDO Grading: SCDO Decision Making

With regard to SCDO's decision making transparency and justification assessment, only three SCDOs (15%) were regarded as having both a transparent and well-justified decision making pathway. Conversely, eight SCDOs (40%) were considered as having decision making pathways that were neither transparent nor fully justified. Nine SCDOs (45%) in between these two grades were considered to have a decision making pathway not clearly presented or justified.

As previously stated, the *SCDO Grading* was designed to facilitate the dual consideration of the SCDOs scientific basis and underpinning and its decision making transparency and justification. The grades allocated to the reviewed SCDOs for each category ranged from 'poor' (the lowest value) to 'excellent' (the highest value). For the scientific basis grade, a three point alphabetical scale (A to C) was used (Table 6.9), for decision making a three point numerical scale (1-3) was employed (Table 6.10). When these grades are combined, 'A1' is the best possible combination (Table 6.12).

Table 6.12: Summary of SCDO Grading

Scientific Basis & Underpinning Grading System		**Decision Making Transparency & Justification Grading System**	
A	*Strong scientific evidence basis and underpinning*	**1**	*Decision making pathway is both transparent and well justified*
B	*Limited amount of scientific evidence basis and underpinning*	**2**	*Decision making pathway is not clearly presented or justified*
C	*No visible scientific evidence base and underpinning*	**3**	*Decision making pathway is neither transparent nor fully justified*

An overview of allocated SCDOs grades is contained in Table 6.13, with a detailed presentation in Table 6.14. Only a small number of SCDOs achieved an 'excellent' grade in either category, with a greater number being 'variable' or 'poor' for both scientific basis and transparent decision making aspects of the SCDO. In combination, a total of only 2 SCDOs were graded excellent for both categories (receiving 'A' and '1' scores), whilst 8 SCDOs were regarded as being poor (receiving 'C' and '3' scores). Therefore, 50% of SCDOs, were variable overall.

Table 6.13: Overview of reviewed SCDO grades

Grade: Scientific Basis	No. Of SCDOs	Grade: Transparent Decision Making	No. Of SCDOs
Excellent	4	*Excellent*	3
Variable	6	*Variable*	9
Poor	10	*Poor*	8

Table 6.14: SCDO Grading combined grades

SCDO ID	Scientific Basis & Underpinning	Decision Making Transparency and Justification
ai	A	1
aii	B	1
aiii	A	1
bi	C	3
bii	C	3
biii	C	3
biv	C	3
ci	B	2
cii	A	2
di	B	2
dii	B	2

diii	B	2
ei	B	2
eii	A	2
fi	C	2
fii	C	2
gi	C	3
gii	C	3
giii	C	3
giv	C	3

6.4.3 Dual Proforma Integrated Findings

This section amalgamates appropriate sections of the *Preliminary Assessment*'s qualitative findings with the quantitative scores and grades derived from the *SCDO Grading*. Furthermore, it presents a synthesis of the review's main findings and brings to light emerging patterns and prominent findings.

The *Preliminary Assessment* qualitatively examined the SCDO using assessment criteria that included: level of detail, presentation of information, cross-referencing and referencing and consideration of assumptions, gaps and uncertainties. To further this, the *SCDO Grading* facilitated an examination of the scientific basis of the SCDO using four assessment criteria, (Data Content and Coverage, Presentation and Synthesis, Traceability and Scrutiny and Quality Assurance). When these two sets of proforma results are compared, a similar picture emerges.

In particular, the *SCDO Grading* determined that the weakest aspects of the scientific basis of the SCDO related to Traceability and Scrutiny and Quality Assurance (Section 6.4.2.1). The *Preliminary Assessment* also found evidence of this within Part A (Management Unit Summary) and Part B (Intervention Appraisal). Limited cross-referencing within the Part A was observed, for example, within consultation issues, coastal defence and statutory planning policies. It was also noted for having little or no reference to gaps, uncertainties and assumptions with the evidence base (Section 6.4.1.1). As such, most SCDOs did not indicate where local expert knowledge and opinion had been utilised to support these statements. For example, shoreline evolution descriptions appeared to be based upon expert judgement and not linked or traceable to the data collation stages of the SMP and its associated reports and appendices. The Intervention Appraisal (Part B) (Section 6.4.1.2) found that only three SCDOs (15%) indicated gaps and uncertainty with regard to the information used, these concerned erosion rates and the residual life of existing defence schemes. There was found to be no referencing of any element of Part B by any of the reviewed SCDOs.

The *Preliminary Assessment* of Part C (Strategic Intervention Appraisal) (Section 6.4.1.3) examined the presentation of the chosen or 'preferred' policy proposed for the SCDO. It identified that a common feature of the reviewed plans was the appraisal and presentation of all policy options within a matrix, particularly reviewed first generation plans. However, it observed that the level of detail provided against each element of these matrices to be variable, with the majority often only having a few words accompanying each aspect of the matrix. In addition, a lack of cross-referencing was found, possibly indicating that much of the information in the matrices was more judgement and expert opinion, with little indication of uncertainties and gaps in the knowledge base. The presentation of a full screening of policy options to inform the decision making process underpinning the SCDO was considered valuable, although, as previously stated, the level of information presented was found to be variable and, in the majority of cases, brief. Whilst this was the case, it provided the most transparent consideration of the issues involved in determining the most economic, environmental and socially acceptable shoreline management policies. The strength of reasoning and justification of the preferred policy was also variable. The stated justification for preferred policies included protection of assets, the allowal of natural processes, *Plan biii*, "...in the long term a retreat policy will be implemented, which would improve sediment input and throughput".

These findings of variability regarding the presented decision making were echoed in the *SCDO Grading* findings. This process determined that only three SCDOs (15%) were regarded as having both a transparent and well-justified decision making pathway. Conversely, eight SCDOs (40%) were considered as having decision making pathways that were neither transparent nor fully justified; with nine SCDOs (45%) in between these two grades having been considered to have a decision making pathway that is not clearly presented or justified (Section 6.4.2.2).

Variations within the findings of the *Preliminary Assessment* proforma, most notably the prominent pattern regarding the distinction between SMP1 and SMP2 SCDOs, were reported in Section 6.4.1.4. As this potential influencing factor or parameter, *i.e.* the version of guidance used, was a criteria used to select SMPs for this purposes of this review, it was considered appropriate that other selection criteria should be examined against the *SCDO Grading* findings. To do so, comparative analysis was undertaken of proforma findings (*i.e. scientific basis and underpinning* and *decision making transparency and justification* SCDO grades) against the criteria used for selecting the SMPs (Section 6.3). Geographical location was excluded from this process, as it was felt that whilst a good geographical range was present within the surveyed SMPs (North West England and Wales, South West Wales and North East England), it would not be appropriate to include this consideration, without a greater geographical coverage within the survey sample.

Table 6.15 presents two areas of SMP selection criteria (plan guidance and plan generation). These are presented against the SCDOs allocated scientific basis and underpinning grades, revealing interesting results. As indicated previously, government guidance for the SMP preparation has been evolving since 1995; this review shows that this has been an influencing factor of the reviewed SMPs. Over half of the SCDOs (twelve) were developed under the original 1995 guidance. Within these, there was found to be a full range of SCDO grades for scientific basis and underpinning (excellent through to poor). The greatest numbers of SCDOs (six) were considered variable; four were allocated an excellent grade and two considered poor. The most interesting results under this parameter is highlighted by all eight SCDOs developed using the 2006 guidance considered in the review to have a poor scientific basis and underpinning. The influence of the SMP version or generation, for example, SMP1, SMP2 pilot or SMP2s is apparent; all SMP2 pilots and SMP2s were regarded as poor, only SCDOs from SMP1s were found to be excellent. A trend within the review, therefore, emerges which portrays SCDOs fairing better under the older guidance with regard to the SCDOs scientific basis and underpinning.

Those SCDOs regarded as being 'excellent' were found to have the following two characteristics: SMP1s, developed using the 1995 guidance. At the other end of the scale, poor SCDOs (*i.e.* no visible scientific evidence base and underpinning) had more variable characteristics. Most of these SCDOs were developed under the 2006 guidance, with only two being SMP1s.

A similar exercise was conducted to consider the SCDO decision making transparency and justification grade (Table 6.16). This identified that only SCDOs developed using 1995 guidance were allocated the best potential grade of '1' and all developed under the 2006 guidance were considered to be poor (*i.e.* received a score of 3). Plan generation also appeared to be an influencing factor, with only SMP1 SCDOs regarded excellent for their decision making transparency and justification of the recommended policy option.

Table 6.15: SMP Selection Criteria and SCDO Science Grades

SCDO ID	**Guidance**		**Plan Generation**		
	1995	**2006**	**First**	**SMP2 Pilot**	**SMP2**
ai	A		A		
aii	B		B		
aiii	A		A		
bi		C		C	
bii		C		C	
biii		C		C	
biv		C		C	
ci	B		B		
cii	A		A		
di	B		B		
dii	B		B		
diii	B		B		
ei	B		B		

eii	A		A		
fi	C		C		
fii	C		C		
gi		C			C
gii		C			C
giii		C			C
giv		C			C

Table 6.16: SMP Selection Criteria and SCDO Decision Making Grades

Plan ID	Guidance		Plan Generation		
	1995	2006	First	SMP2 Pilot	SMP2
ai	1		1		
aii	1		1		
aiii	1		1		
bi		3		3	
bii		3		3	
biii		3		3	
biv		3		3	
ci	2		2		
cii	2		2		
di	2		2		
dii	2		2		
diii	2		2		
ei	2		2		
eii	2		2		
fi	2		2		
fii	2		2		
gi		3			3
gii		3			3
giii		3			3
giv		3			3

6.5 Discussion and Findings

This section considers prominent findings from the Review of SMPs with regard to range of results from reviewed SCDOs for their decision making transparency and justification and scientific basis and underpinning (Section 6.5.1). Followed by discussion of strategic case study findings in relation to the aim and objectives of the thesis (Section 6.5.2). Lastly, it considers limitations of the research process (Section 6.5.3).

6.5.1 Critical Review Findings

This review has highlighted significant variety amongst SMPs (twenty individual SCDOs). The variations are considered to be multi-faceted with regards to decision making transparency and justification and scientific basis and underpinning.

The review's assessment of the SCDOs decision making transparency and justification identified that only 15% (three reviewed SCDOs) were considered as having both a transparent and well-justified decision making pathway. In contrast, 40% (eight SCDOs) have a decision making pathways that were neither transparent nor fully justified. This suggests that the recommendation emanating from the government review of SMP1s (Section 6.2.1.1.) of the need for clearer decision making processes as being accurate in its proposal. Furthermore, that it has not yet been fully realised as evidenced by those reviewed SMPs prepared under later guidance (*e.g.* SMP2s). The review's assessment of the SCDOs scientific basis and underpinning found that only 20% (four SCDOs) were considered excellent examples of a SCDO (*i.e.* with a strong scientific evidence basis and underpinning). In contrast, 50% (ten SCDOs) had no visible scientific evidence base and underpinning. The grading scale used for this assessment proposed that for those SDCOs considered excellent, they were very clearly based upon the data collation stage of the SMP process (Figure 6.3).

Despite the existence of comprehensive guidance for the development of SMPs (Sections 6.2.1.1 – 6.2.1.3), this review has ascertained that decision making variety was found to exist not only amongst SCDOs developed under different versions of guidance, namely the 1995 and 2006 versions, but also and importantly, within plans prepared under the same guidance. Over half of the reviewed SCDOs (twelve) were developed under the original 1995 guidance. Within these the use of the *SCDO Grading* proforma revealed a full range of grades for scientific basis and underpinning (excellent through to poor). The greatest number (six), however, were considered to be variable, four were allocated an excellent grade and two considered poor; thus highlighting variability under plan generation. The most interesting result, however, was that all eight SCDOs developed using the 2006 guidance were considered to have a poor scientific basis and underpinning. The influence of the SMP generation, for example, first generation, SMP2 pilot or second generation SMPs was apparent, with all pilots and second generation being regarded as poor; only first generation plans were excellent in this aspect of the review. This was mirrored in the decision making assessment that found only SCDOs developed using 1995 guidance were allocated a grade 1 for having an SCDO considered excellent for its decision making transparency and justification of the recommended policy option. A trend within the review, therefore, emerged which portrayed SCDOs fairing better under 1995 guidance with regard to the SCDOs scientific basis and underpinning and transparent and justified decision making.

In summary, despite the revision of procedural guidance, variation in both decision making transparency and utilisation of the natural coastal change scientific evidence base still remains. This review has proposed a number of external forcing factors that may create diversity and variation, such as, the consultant engaged to prepare the plan on behalf of the coastal group and guidance version. In relation to the first of the thesis objectives (*i.e. To identify the salient decision making characteristics particular to coastal risk*), the decision making process within the reviewed SMPs was found to be framed both by government policy and structured by the procedural guidance. Whilst central government appears to strive for uniformity, with regard to the process undertaken and the resultant content of the SMP, through the issuing of guidance for Operating Authorities. It is unclear, however, as to whether the variation observed amongst the reviewed SMPs reflects local coastal risk management-specificity and that the process of developing SMPs is flexible to facilitate this specificity. These were, for example, considered with Case Study One (Chapter Four, Section 4.4.4.). With regard to the second objective of the thesis (*i.e. To evaluate the application of natural coastal change science as evidence used within coastal risk assessment and its associated* *decision making procedures*), due to the observed lack of traceability, scrutiny and quality assurance, the review could not discern if the 50% of reviewed SCDOs with no visible scientific evidence base and underpinning, were as a result of the evolutionary and uncertain state of the available coastal knowledge base (Section 6.2; Section 2.5.4) or other unknown factors and variables.

6.5.2 Strategic Case Study Findings

This case study sought to develop and apply, for the first time, a system for assessing both the decision making pathway and scientific underpinning of a particular mode / component of coastal risk decision making, *i.e.* SMPs. In devising the methods to do so, research time was invested in familiarisation with a sample of SMPs, due to the complexities and numerous stages of SMP process, including the various iterations of government procedural guidance. Emanating from this, it was considered appropriate and necessary that the proformas for the assessment process would need to mirror, to a certain extent, the composite contents of the SMP. Consequently, the proformas created for the review were in effect, tailor-made for SMPs and not generic; and as such, there is a high level of uncertainty as to whether the proformas themselves could be modified and applied to other forms of coastal risk decision making planning documents. Furthermore, a strategic level, it is questionable whether a generic 'off-the-shelf' assessment proforma could be devised for all coastal risk-related decision making, due to difficulties encountered in this review. What is considered to be more appropriate, is an assessment process that maintains a division between the following:

- An examination of the underpinning evidence base using the indicators of:
    - Data Content and Coverage;
    - Presentation and Synthesis;
    - Traceability and
    - Scrutiny and Quality Assurance.
- An examination of the decision making pathway using the indicators of:
    - Transparency and
    - Justification.

Based upon the data and subsequent analysis within this review, these are considered strong indicators for this unique dual-form of critique and review despite limitations of the process outlined below (Section 6.5.3).

6.5.3 Limitations

Section 6.4.3 of this chapter sought to synthesise findings from the two aspects of the review, *i.e.* the *Preliminary Assessment* and the *SCDO Grading* (Sections 6.4.1 and 6.4.2) and in doing so, many findings within these components were corroborated. Whilst this illustrates that the methods devised and engaged within this review can produce replicable results, these methods are not without limitations.

Central to the *SCDO Grading* quantitative assessment was the allocation of scores and grades for the scientific basis and decision making of each SCDO. The use of detailed guidelines for the allocation of scores and grades sought to address potential subjectivity within this process. However, the scales were limited to three-point scales for all aspects. It is, therefore, proposed that a greater number of points on these scales may have allowed a more detailed assessment. Furthermore, the two grades could have been amalgamated into one overall score for the SCDO. However, it was felt that this could mask some of the subtleties present with regards to decision making and scientific basis (*i.e.* loss of data detail). There was only a limited amount of clustering of the top grades (*e.g.* A1) and low grades (*e.g.* C3), with many of the reviewed SCDOs, being of a variable nature. As the findings were analysed to identify influencing factors, such as plan guidance, this would not have been possible if plans had been allocated one overall score.

The reviewed considered twenty individual SCDOs that were taken from seven different SMPs across England and Wales. It suggested here that increasing the number of SMPs in the review would contribute to strengthening the findings from the review. This point is counterbalanced with accessibility issues (Section 6.3.3).

A precursor to the application of the *Preliminary Assessment* and *SCDO Grading* proformas could have included an assessment of the data collected within Stage One of the SMP production process (Figure 6.3). These findings could then be integrated into a greater assessment of the application of Stage One Data Collation to support and inform the SCDO policy recommendation. This, for example, may have provided context to explain gaps and uncertainties associated with the information presented in the SCDO that was assessed by the proformas. Again, issues of accessibility and availability of such documents need to be considered.

6.6 Conclusion

SMPs in England and Wales deliver an important element of the government's coastal defence framework. The process of developing them has, and continues to evolve in an iterative and adaptive manner. The Review of SMPs undertaken and presented within this chapter has examined the SCDO component of SMPs, as it is within the SCDO that proposed management policy options for shoreline divisions, such as, management units, are presented. The undertaking of the *Preliminary Assessment* and the *SCDO Grading* provided a full examination of the SCDO aspect of SMPs. These assessments facilitated different scales of examination to be undertaken, for example of the SMP itself, the SCDO component and its sub-sections. Using a range of SMPs from around England and Wales, the review offers insight into the notable variability of SCDO content produced within the evolving coastal defence framework, both with regard to the application and presentation of natural coastal change information, and the clarity and visibility of the decision making behind the preferred management decisions.

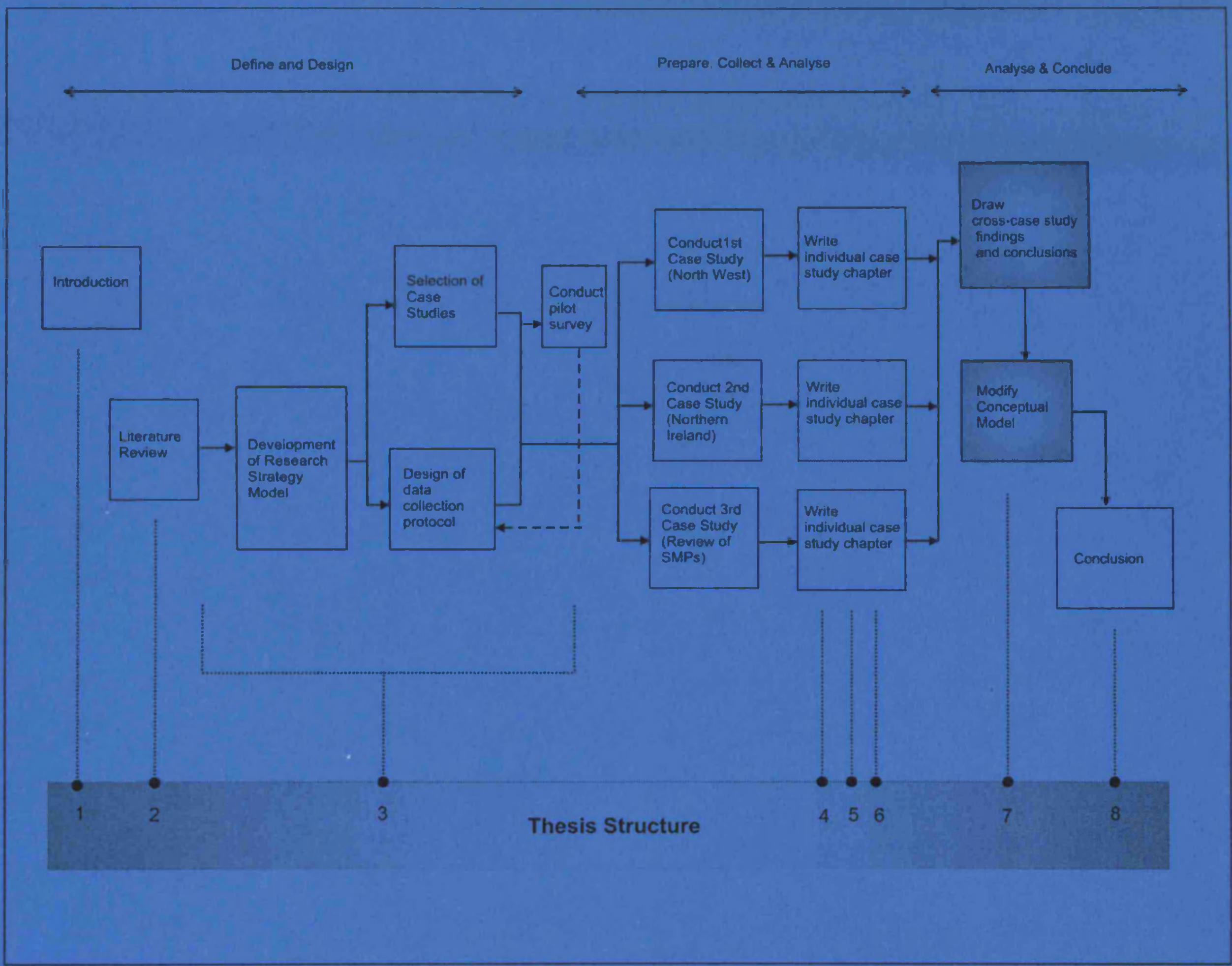
This case study differs from the two geographical case studies of thesis in its approach. However, the task of examining the scientific basis and underpinning and decision making transparency and justification of the SMPs coastal defence policy options, sought to mirror the thesis RSM used in Case Studies One and Two. That is, this review duplicated the two constituent elements of the RSM 'Decision Process Tracing' and 'Decision Making Aid and Context' by devising mechanisms that examined the decision making processes occurring at the Tactical level of decision making. It also considered the salient issues surrounding the application of natural coastal change science within the decision making process. Although the methods established for this review are novel and distinctive in their approach, it is recognised that there are still some limitations. However, the use of both qualitative and quantitative assessments brought greater confidence to the review's findings. It is recognised that other methods and procedures could be devised in future and applied to other forms of coastal risk decision making, such as Flood Risk Management Plans. As such, this review presents its methods as experimental and exploratory; whilst other procedures are currently absent, this review is therefore considered to be pioneering in approach.

The review did not call into question the validity of the coastal defence policy presented in the SCDO and its scientific robustness, instead, it sought to the question the role of the data collation stage of the SMP to underpin the decision making within the SCDO, and to identify the decision making processes and pathway. The review's assessment of the SCDOs scientific basis and underpinning found that only four of the twenty reviewed SCDOs (20%) were considered to be excellent examples of a SCDO with a strong scientific evidence basis and underpinning. In contrast, ten SCDOs (50%) had no visible scientific evidence base and underpinning. The data collation and analysis task, in all sets of government guidance, is a critical element of the SMP production process. It is proposed, therefore, that SMPs and associated SCDOs should clearly present data and information that is succinct, congruous in its temporal and spatial scale, traceable (cross-referenced to other sections of the SMP) and, where appropriate, referenced. Furthermore, uncertainties and limitations, along with the use of expert opinion, should be indicated. Those SCDOs that were seen as poor within the review did not exhibit these characteristics. It is proposed that these SCDOs may have been based upon site visits, discussions with Local Authority engineers and the use of national coastal change studies, such as, Futurecoast and the Foresight Future Flooding report (no citation of these were found). This finding suggests that whilst the SMP guidance places considerable emphasis and value upon the data collation and analysis aspect of SMP development, the application of this for the underpinning evidence base of SCDOs was not apparent within the reviewed plans.

The review's assessment of the SCDOs decision making transparency and justification identified that only three SCDOs (15%) had both a transparent and well-justified decision making pathway. In contrast, eight SCDOs (40%) had decision making pathways that were neither transparent nor fully justified.

Despite the existence of comprehensive guidance for the development of SMPs, this review found that there was variety not only amongst SCDOs developed under difference versions of guidance (1995; 2006), but also within those plans developed under the same guidance. A trend emerged which portrayed SCDOs fairing better under 1995 guidance with regard to the SCDOs scientific basis and underpinning, as well as transparent and justified nature of this decision making. Whilst this review has questioned the evidence base and transparency decision making of SMPs, it could be conceived that the appropriate level of evidence base is provided and used for the purposes of determining management policies for the chosen shoreline divisions. However, the current format and methods used within SMPs (*i.e.* using SCDOs to present preferred management policies) creates an expectation with regard to the presentation and synthesis of information (evidence base) and the presentation of the preferred policy (decision making pathway). For example, a clear, informed and sequential process from Stage One to Stage Two of plan preparation (Figure 6.3), also, a 'learning while doing' transition within the main categories of the SCDO (*i.e.* Part A through to Part C).

The findings, whilst specific to SMPs developed in England and Wales between 1995 and 2007, raise a number of wider issues associated with coastal risk decision-making. The most pertinent of these being the difficulties associated with attempting to trace the natural coastal change evidence base within coastal risk decision making. The *Preliminary Assessment* identified that, for example, shoreline descriptions within SCDOs were often not referenced, cross-referenced, with no indication of associated assumptions or uncertainties regarding the information presented. An implication was that it was impossible to determine the source of the information. As such, it could not be ascertained when expert knowledge, information and intuition had been engaged within the natural coastal change evidence base to support decision making. This has a bearing on the thesis RSM, addressed in Chapter Seven.


Define and Design
Prepare, Collect & Analyse
Analyse & Conclude
Introduction
Literature Review
Development of Research Strategy Model
Selection of Case Studies
Design of data collection protocol
Conduct pilot survey
Conduct1st Case Study (North West)
Conduct 2nd Case Study (Northern Ireland)
Conduct 3rd Case Study (Review of SMPs)
Write individual case study chapter
Write individual case study chapter
Write individual case study chapter
Draw cross-case study findings and conclusions
Modify Conceptual Model
Conclusion
1
2
3
Thesis Structure
4 5 6
7
8

7 Chapter Seven Discussion

7.1 Introduction

This chapter addresses the last two elements of the Thesis Research Strategy Pathway (Figure 3.2), namely 'Theory vs. Practice' and 'Theory Reconstruction'. It presents the cross-cutting analysis of the three case study chapters (Chapters Four, Five and Six), before producing a conceptualisation of coastal risk decision making.

Section 7.2 synthesises discussion of findings from Case Studies One and Two in relation to the underlying case study selection hypothesis. Furthermore, this section contains findings from all three case studies. As shown in Figure 7.1, two approaches to the case studies were undertaken; Sections 7.2.2 and 7.3 present critiques of the methods associated with these. Section 7.4 utilises a summary of these appraisals, in addition to empirical knowledge and understanding, to reconstruct a conceptualisation of decision making that is specific to coastal risk. A short conclusion then follows.

7.2 Case Study Discussion

The multiple-case study approach (Figure 7.1) was designed to address the aim and objectives of the thesis. Section 7.2.1 examines the geographical case study approach; whilst Section 7.2.2 considers the strengths and weaknesses of the documentary-based, third case study.

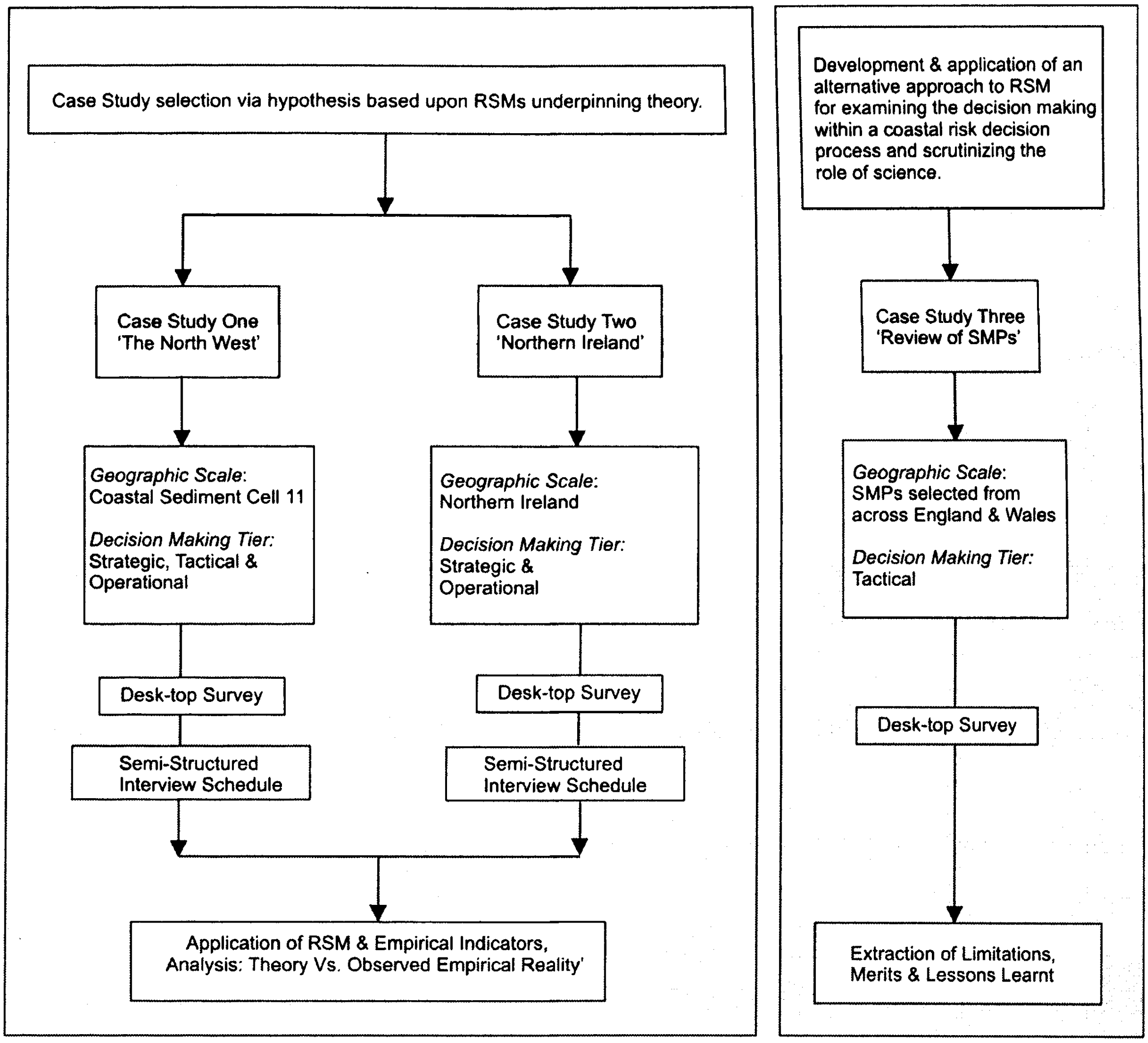


Figure 7.1: Overview of Case Study Methodology

Source: Original

7.2.1 Geographical Case Study Discussion

This section integrates findings from Case Study One 'The North West' and Case Study Two 'Northern Ireland', in relation to the hypothesis used for their selection. In doing so, this section delivers crucial findings concerning the thesis' research objectives:

- *'To identify the salient decision making characteristics particular to coastal risk;*
- *To evaluate the application of natural coastal change science as evidence used within coastal risk assessment and its associated decision making procedures'.*

Using a hypothesis stemming from the RSM concerning Decision Making Aid (Part B), two geographical case studies were selected (Section 3.3.2). The associated rationale used the premise of gaining insight by considering extremes, specifically the two variables of RSMs Decision Making Aid spectrum, Decision Structure and Decision Support (Figure 7.2).

This section explores the validity of the hypothesis through an assessment of empirical findings, to address theory verification and falsification. The Literature Review (Section 2.5.3) discerned that, within the United Kingdom, the approach to coastal risk differed notably in England and Wales compared with that conducted in Northern Ireland and Scotland. In particular, the review identified divergence relating to the existence of government legislation, policy and guidance pertaining to coastal defence and coastal planning. Furthermore, it was ascertained that there had been greater strategic coastal defence research effort in England and Wales. It was, therefore, hypothesised that in those areas with coastal defence legislation, policy and planning mechanisms, decision making processes (Decision Structure) would exhibit different traits and idiosyncrasies compared to those areas without. Additionally, it was hypothesised that the role of scientific evidence (Decision Support) would differ in relation to the level of government investment on coastal risk-related matters. Suitable geographical localities for case studies were identified as Northern Ireland and the North West of England and Wales (Section 3.4; Chapters Four & Five). These test sites, in addition to their political and administrative differences, span a range of coastal environments, with differing coastal processes and importantly, comprise varying levels of coastal hazards and risk management approaches.

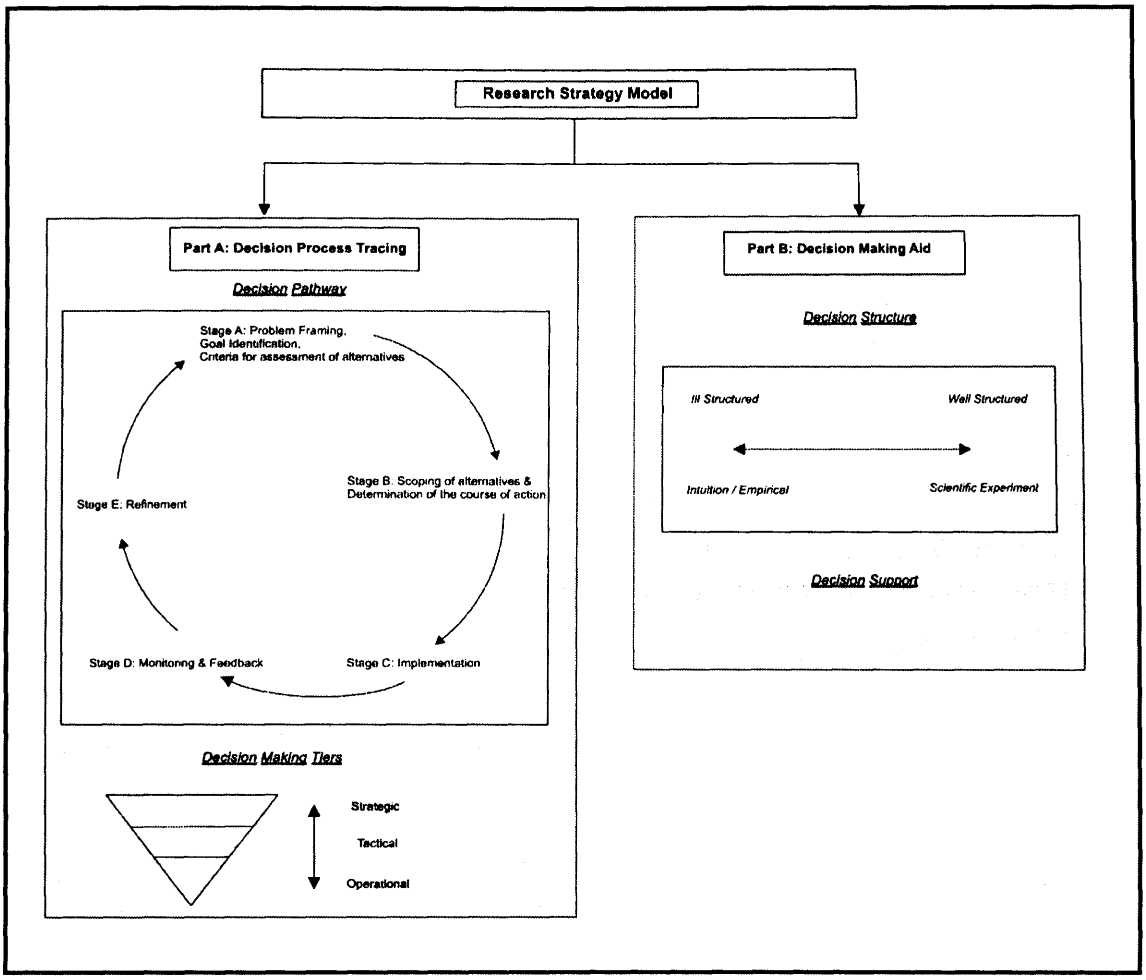


Figure 7.2: Research Strategy Model

Source: Original

The thesis RSM Empirical Indicators (EIs) were used to frame and present case study findings within Chapters Four and Five. Cross-case study findings were combined from a number of the RSMs EIs spanning Decision Pathway, Decision Making Tiers and Decision Structure. Together, they provide supporting evidence to identify dominant coastal risk decision making practices and characteristics, namely:

- Multi-sectoral (coastal defence, coastal planning...)
    - o Decision makers (local and central government and private landowners);
- Legislative and policy frameworks (decision pathway framing);
- Hierarchical decision making tiers and decision making frequency;
- Inter-sectoral decision pathway connections and
- Cross-sectoral decision pathway connections.

Only with respect to findings concerning decision makers, was there found to be clear similarities and consensus across the two sets of case study findings; all other areas exhibited varying levels of divergence. Notable deviation in decision practices was observed within the North West Case Study, namely the significant level of decision framing, inter- and cross-decision context connections and tied decision pathway relationships (Sections 4.4.5 & 4.6.1).

Scrutiny of the role of natural coastal change information within the case studies established the following primary themes:

- Characteristics of the natural coastal change task information (uncertainty);
- Sourcing (internal and external) mechanisms for natural coastal change task information and
- Management and sharing practices concerning natural coastal change task information.

However, limited similarities were visible between the two case studies with respect to Decision Structure and Decision Support (Sections 4.6 - 4.7 & Sections 5.6 - 5.7). The testing of Decision Support produced noteworthy observations within the Northern Ireland findings. This included an absence of natural coastal change strategic government investment in research concerning coastal processes, such as, coastal sediment cells and assessments of long-term geomorphological change (Section 5.7). Similarly, Decision Structure findings identified insubstantial decision framing *i.e.* no coast protection legislation, strategic shoreline management planning or coastal planning guidance, resulting in predominantly reactive decision making pathways, with extremely limited application of natural coastal change task information (Sections 5.4.3 & 5.7.1). In striking contrast, Case Study One revealed substantial amounts of Decision Structure. For example, decision framing (legislation, policy and procedural guidance) was identified at all decision tiers across both decision contexts (Sections 4.5 - 4.6), thus, creating a highly structured coastal risk decision making environment. This was supported by extensive Decision Support, in the form of a notable natural coastal change evidence base (Section 4.7). Interestingly, it was revealed that, despite these arrangements and provisions, *i.e.* strong Decision Structure and Support, a significant amount of uncertainty remained for coastal risk decision makers (Section 4.7.5).

In light of the above, it is argued that the coastal risk decision contexts of the case studies differed significantly. This provides support for, and validation of, the case study selection. The geographical case studies generated much in-depth empirical data concerning coastal-risk decision making and the role of natural change information within these processes. As such, this satisfied both of the research objectives of the thesis. In addition to empirical testing of the hypothesis, the case study investigations facilitated the application of RSM and the EIs to a wide scope of coastal-risk decision making circumstances. These encompassed three of the four UK counterparts, cross-border administrative regions, and two sectors of coastal decision making in the form of coastal planning and coastal defence. The transition from internal case study observations, for example, specific decision making instances (*i.e.* Ocean Plaza Section 4.4.3 and Portballintrae Section 5.4.3), to synthesised cross-case study findings is considered as being a credible deductive research process. The next section explores the contrasting research process within the third case study.

7.2.2 Case Study Three Discussion

As illustrated in Figure 7.2, the 'Review of SMPs' (Case Study Three, Chapter Six) developed and utilised a contrasting, distinct and innovative research process compared to the geographical case studies. This facilitated the critical examination of both decision making transparency and justification, and its scientific basis. This process was designed from a methodological position to be antithetic to that of the RSM. However, it also allowed scope for comparison, and importantly, was also aligned with the objectives of the thesis.

Case Study Three's deductive research process concentrated upon Shoreline Management Plans (SMPs) as the coastal risk decision making process to be examined. The critical appraisal of these included a review of both the decision making pathway and their scientific underpinning. This was achieved *via* the application of two proformas (Appendix A4) utilising both qualitative and quantitative forms of assessment (Sections 6.4.1 & 6.4.2). This saw the coastal defence policy recommendation within the plan, referred to as the Strategic Coastal Defence Option (SCDO), allocated a score according to the grading of the SCDOs in terms of:

- Decision making transparency and justification and
- Scientific evidence base and underpinning.

Whilst differing to the RSM, these two areas mirror both constituent parts of the RSM, Part A Decision Making Pathway and Part B Decision Making Aid; furthermore, there is a clear desired correlation with the two objectives of the thesis (Section 7.2.1).

In summary, Case Study Three's findings revealed the variability of SCDOs produced within the evolving coastal defence framework in England and Wales. For example, with regard to the application and presentation of natural coastal change information and the clarity and visibility of the decision making process behind the preferred management decisions. The assessment of the SCDOs' scientific base and underpinning found that only four of the twenty reviewed SCDOs (20%) were considered excellent examples of a SCDO with a strong scientific evidence base and underpinning. In contrast, ten SCDOs (50%) had no visible scientific evidence base and underpinning (Section 6.4.2.1). The assessment of the SCDOs' decision making transparency and justification identified that only three SCDOs (15%) were considered as having both a transparent and well-justified decision making pathway. In contrast, eight SCDOs (40%) had decision making pathways that were neither transparent nor fully justified (Section 6.4.2.2). Despite the existence of comprehensive central government guidance for SMP development, the review found variety not only amongst SCDOs developed under difference versions of guidance (1995; 2006), but also and importantly, within plans developed under the same guidance (Section 6.4.3). These findings, whilst specific to SMPs developed between 1995 and 2007, raise wider issues associated with coastal risk decision-making. The most pertinent of these are the methodological difficulties associated with attempting to trace the natural coastal change evidence base within coastal risk decision making.

This section considers the research process undertaken in Case Study Three to support the critique of the RSM EIs (Section 7.3), including limitations, and importantly, areas of merit and lessons learnt.

Drawing upon the discussion section of the case study (Section 6.5), the first consideration to be raised here is the selection of the empirical coastal risk decision making process chosen (*i.e.* SMPs). The development of the case study survey instruments (*Preliminary Assessment* and *SCDO Grading* proformas; Figure 6.3) was customised for SMP application. This, therefore, poses some uncertainty as to whether these could be modified for application to other forms of coastal risk decision making processes, for example, Catchment Flood Management Plans. It is, therefore, proposed that revised survey instruments would be needed to widen the applicability of the proformas. However, it is further suggested (Section 6.5.3) that there was considerable merit in maintaining the division (and criterions) between the following two areas within the *SCDO Grading* proforma:

- An examination of the decision making pathway facilitated by the application of the indicators:
  - Transparency and
  - Justification.
- An examination of the underpinning evidence base facilitated by the application of the indicators:
  - Data Content and Coverage;
  - Presentation and Synthesis;
  - Traceability and
  - Scrutiny and Quality Assurance.

These indicators were considered strong markers to gauge and assess both the decision making pathway and supporting evidence base. Section 7.4 contrasts the merit of these in comparison to the RSM EIs.

An integral facet of the case study approach was the quantitative assessment of SCDOs, through the allocation of scores and grades for their scientific basis and decision making process (Section 6.4.3; Table 6.5). This system utilised guidelines to inform the allocation of scores and grades to address potential subjectivity (Tables 6.6, 6.7 & 6.9). Section 6.5.3 identified potential improvements to these guidelines; namely increasing the number of points upon the scales used on the ordinal scale. A further point relates to the grading system: potentially this could be developed to provide a combined score for each reviewed SCDO. This could encompass both the decision making and evidence base scores and grades into one overall assessment. However, in light of the case study results (Sections 6.4 & 6.5), it was suggested that this would be undesirable. In particular, the subtleties and differences between the two elements of 'decision making' and 'evidence base' would be lost within an aggregated score. However, findings (Section 6.4.2) within the review did bring the two sets of results alongside one another to allow a more 'strategic' review of the SCDOs (Table 6.14). The prototype employed within Case Study Three is considered satisfactory in its ability to facilitate the appraisal of SMPs in line with the case study's research aims and thesis objectives. Furthermore, it is concluded that the research process offers 'lessons learnt', discussed in Section 7.4.

7.3 Critique of Research Strategy Model and Empirical Indicators

This section presents a critique of the thesis RSM (Figure 7.3) and associated EIs (Table 7.1). In doing so, the RSM is assessed regarding its ability to facilitate the exploration and measurement of both decision making processes and the underpinning scientific evidence base.

To facilitate the critique, the discussion integrates results from Case Studies One and Two (Chapters Four and Five). It is structured around the constituent parts of the RSM and contains a number of sub-sections:

- Part A Decision Process Tracing (Section 7.3.1): *Decision Pathway & Decision Making Tiers;*
- Part B Decision Making Aid (Section 7.3.2): *Decision Structure & Decision Support.*

Each sub-section of Part A and Part B contains individual EI appraisals, followed by short summaries. EI appraisals consider the following:

1. Relevancy?
2. Ease of application?
3. Clearly defined?

Table 7.1: Research Strategy Model Empirical Indicators

Research Strategy Model: Empirical Indicators	
Part A Decision Process Tracing	Part B Decision Making Aid
Decision Pathway	*Decision Structure*
• Who is the decision maker being examined? • What is the context / sectoral domain of the decision being examined? • Are there discrete stages to the decision pathway and what stage is being examined? • Is the decision pathway connected to other decision pathways (past, present and future)? • Is the decision pathway connected with those occurring within other decision contexts / sectoral domains?	• Is the pathway of the decision cycle framed? • What is the frequency of this type of decision?
Decision Making Tiers:	*Decision Support*
• What level or scale of decision making is being examined? • Can the three scales of decision making, Strategic, Tactical and Operational, be identified within the examined decision context?	• What is the nature/characteristics of the task information involved? • What mechanisms (internal and external) were engaged to aid the retrieval and application of task information? • Do different decision making tiers require different task information? • Were aspects of the decision pathway aided by other sources in addition to task information? • What is the level of certainty regarding decision outcome?

7.3.1 Part A Decision Process Tracing

Part A of the RSM, Decision Process Tracing, comprises a suite of EIs (Table 7.1) that translate the visualisation RSM's Decision Pathway and Decision Making Tiers into research questions, based upon the underpinning theoretical constructs (Methodology Chapter; Section 3.1). The following sub-sections examine the efficacy and merit of Part A EIs related to the key questions: *Relevancy? Ease of Application? Clearly Defined*?

7.3.1.1 Empirical Indicators

EI: Who is the decision maker being examined?

Decision Maker

This EI facilitated the identification of decision makers involved with coastal risk. In both geographical case studies three main decision makers were differentiated, including both organisations and individuals (*i.e.* local government, central government and private landowners). Within the decision theory literature there is often a demarcation between decision making processes associated with the categories of individuals and organisations (for example: Jabes, 1982; Section 2.4.1). The case study findings, however, do not support the need or value of this form of differentiation as no results were obtained that suggest differential outcomes on the decision pathway with respect to these categories of decision maker. Influences upon the decision making process were noted and will be discussed later (*e.g.* Decision Connections and Decision Framing EIs). It is, therefore, suggested that there is merit in a model that does not separate or eliminate certain decision makers from empirical examination. Furthermore, the RSM was applied to both coastal planning and coastal defence decision making contexts in England, Wales and Northern Ireland; thus reflecting the ease of applicability to a variety decision making contexts.

EI: What is the context / sectoral domain of the decision being examined?

Decision Context

The position of this EI establishes the decision context or sector of decision makers identified by the previous EI, thus, giving greater context and a wider understanding to the decision tracing process. As stated, within both case studies the RSM was applied to the decision contexts of both coastal planning and coastal defence in England, Wales and Northern Ireland. This reflects the applicability of the RSM to a variety of decision making contexts, particularly coastal risk that involves multi-sectoral decision making. This is considered to add value to the RSM as a conceptual model that is not limited in its application.

EI: Are there discrete stages to the decision pathway and what stage is being examined?

Decision Pathway Stages

The RSM proposes a number of discrete decision pathway stages (Stages A through to E) (Figure 7.3). The associated EI, when applied to the data identified discrete stages. Furthermore, it was revealed that these could then be cross-referenced with those of the RSM. This illustrates both the applicability and relevance of the RSM's idealised pathway. The most visible stages were found to be Stage C (Implementation), Stage D (Monitoring and Feedback) and Stage E (Refinement). Greater examination of both an empirical coastal planning decision and an empirical coastal defence decision revealed two pertinent issues concerning the RSM's normative theory and the studied practice. The first is an absence of certain stages within the empirical pathways and secondly, limited undertaking of specific stages. These issues will now be expanded using examples from coastal defence and coastal planning.

The coastal defence decision making associated with Portballintrae (Case Study Two, Section 5.4.3) demonstrated the iterative nature of decision making. Due to the historical and contentious nature of decision making at the site, the first two decision pathway stages of the RSM, Stage A (Problem Framing) and Stage B (Scoping of Alternatives), appeared loosely defined and not visibly undertaken. In contrast, Stage

C (Implementation) was identified as corresponding with the introduction of various coast protection works and schemes over numerous decades. The perceived immediacy required to address coastal risk at the site by the community, was attributed to the decision making at Stage C. This, therefore, effectively bypassed the first two stages. Stage B (Full scoping of alternatives) was not visible; for example, a potential coastal defence policy of no active intervention was discarded without full consideration, due to strong community desire for action with no scientific underpinning. These reactive and reiterative practices have been occurring for decades with decision makers in effect 'yo-yoing' between Stage C (Implementation), Stage D (Monitoring and Feedback) and Stage E (Refinement), without undertaking Stages A or B. These findings do not mirror the RSM hypothetical normative cyclical decision pathway that proposes a linear and consecutive decision process.

Another area of notable divergence between the theory of the RSM and the case studies was the observed relationship between the RSM's Stage A (Problem Framing) and Stage B (Scoping of Alternatives). Case Studies One and Three both highlighted the development process of SMPs within in England and Wales since the early 1990s (Sections 4.4.4 & 6.2). The North West Case Study (Section 4.6.1) identified clear and explicit framing of Stage A by central government in the form of both policy and procedural guidance. The determining of specific coastal defence policies for coastal sediment cell management units (SCDOs), as part of the SMP process, is regarded as corresponding with Stage B of the RSM. Interestingly, the 2006 Shoreline Management Plan guidance 'Volume 2: Procedures' (Defra, 2006b) contains four discrete coastal defence policy options or Stage B 'alternatives' available to decision makers at this stage. Decision making in theoretical terms involves the choice between a number of possible courses of action (Kolkman *et al.*, 2005; Section 2.4.1). The pre-selection of options within the SMP process, as contained within the procedural guidance, existed prior to the commencement of the decision pathway. Accordingly, it is posited that Stage A (Problem Framing) and Stage B (Scoping of Alternatives) are externally framed and driven. When these findings are considered in relation to the theoretical decision stages of the RSM, they are regarded as presenting a narrow and constrained decision pathway for SMP decision making.

Further focus on the SMP process presents additional findings concerning this EI. Stages of SMP development contained within the current central government guidance (Defra, 2006) are considered as only corresponding to Stages B through to C of the RSM, as Stages D and E are not carried out within the SMP process. It was identified that both Stage D (Monitoring and Feedback) and Stage E (Refinement) are undertaken externally. Stage D, for example, is commonly undertaken by independent consultants at a later time than the SMPs development. In Case Study One this occurred eight years after the plan's adoption (Section 4.6.2). Similarly, Stage E (Refinement) is conducted externally by central government through the collation of lessons learnt and the refinement of procedural guidance (for example: MAFF (2000); Defra (2001)). In light of these findings, it is clear the RSM decision pathway stages and those studied with respect to SMPs, do not fully correspond with one another. The empirical decision making suggests framing and forcing factors can influence the decision making pathway. This point will be revisited in Section 7.3.2 (Part B Decision Making Aid).

The RSM provides a useful reference point by which to consider empirical decision making in relation to theory. The use of this EI identified a cyclical nature to coastal risk decision making, confirming this facet of the RSM. Due to this, it is proposed there may be no clear starting point at which a decision pathway commences, as suggested by the RSM that commences with Stage A. Therefore, there is potential for the RSM's normative decision pathway to be shown as ongoing iterative cycles, rather than a single cycle that starts at A and finishes at E.

EI: Is the decision pathway connected to other decision pathways (past, present and future)? &
EI: Is the decision pathway connected with those occurring within other decision contexts / sectoral domains?

Decision Pathway Connections

By applying these two indicators to the data, temporal connections and relationships between decision pathways were identified. Consequently, a number of pertinent issues associated with coastal risk decision making were found. This has potential implications for the adequacy for the RSM, as the model does not contain visual 'links' between decision pathways. It is suggested that there is scope to combine these indicators due to the interlinkages between them, as the following discussion highlights.

Within Case Study One, it was observed that many past coastal planning decisions were still influencing current decision pathways, within the coastal planning and coastal defence decision contexts (Sections 4.4.5 & 4.4.5). Similarly, cases of regeneration highlight relationships between historic and contemporary decision making pathways. The decision making associated with the Ocean Plaza regeneration example (Section 4.4.3; Case Study One) supports this. A clear relationship at this site between historical coastal usage and present planning decisions was identified. If the site had not been a brownfield site, it would not be applicable for planning permission under current government coastal planning guidance. Interestingly from a coastal risk perspective, this development opportunity was allocated in spite of the recognised high flood risk of the locality, as identified within the authority's Strategic Flood Consequence Assessment. The decision to pursue the development in light of this natural coastal change scientific information, and indeed to grant planning permission against the Environment Agency's advice (to reject planning permission) indicates a high level of predetermining of the decision pathway and strong control by the Local Authority with respect to their coastal planning function. This EI, therefore, highlights that many land-use (coastal) planning decisions have long-term implications. Future decision pathway connections were also identified by considering this EI, with the SMP process providing evidence of this (Section 4.4.5).

In light of these findings, the absence of a temporal component of the RSM to illustrate connections and links between historic and contemporary decision making pathways is regarded as a weakness of the current model. Additionally, the model is limited by its current inability to reflect or encapsulate complex decisions that have multiple decision pathway links, *e.g.* to more than one sector, as shown in the empirical findings to be the case between the coastal planning and coastal defence decision contexts and others (*e.g.* tourism and coastal conservation).

EI: What level or scale of decision making is being examined?
EI: Can the three scales of decision making, Strategic, Tactical and Operational, be identified within the examined context?

Decision Making Tiers

Distinction between the three different tiers of decision making, Strategic, Tactical and Operational (for example: Gilligan *et al.,* 1993; Fabbri, 2002; French and Geldermann, 2005; Section 2.4.1), informed the RSM's Decision Making Tiers visualisation (Figure 7.2).

The analysis of data collected for Case Study One revealed that it was possible to identify all three decision making tiers within both the coastal planning and coastal defence decision contexts (Section 4.6; Tables 4.5 & 4.6). This is, therefore, considered as validating the underpinning theoretical literature proposals of the RSM using a grounded approach. Corresponding empirical data were not, however, present within Case Study Two (Northern Ireland). Within the coastal defence sector, an absence of tactical and operational decision making tiers was observed (Section 5.6; Table 5.6). Similarly within the coastal planning sector, the operational level was not identified (Table 5.7). The absence of certain decision making tiers within Northern Ireland was surmised as being a result of the smaller geographic area being examined within this case study locality and a by-product of political / devolution arrangements (Section 5.6).

The most significant and interesting finding with respect to this EI was the observed tendency to consider decision making tiers as having geographical boundaries. Positive correlations between the three decision making tiers and geographic scales of decision making were made within Case Study One (Section 4.6). This is illustrated by the alignment between strategic decision making effort in the coastal defence sector at a macro-geographic scale (*i.e.* national Flood and Coastal Erosion Risk Management strategies in England and Wales) and tactical decision making effort (*i.e.* SMPS, occurring at the sediment cell level). However, these apparent relationships between decision making tiers and quasi-spatial scales remain unverified within the decision research literature. It is, therefore, uncertain, as to whether this is a finding relating specifically to the coastal risk decision making within the two geographic case studies, or a crucial finding of the thesis research with respect to coastal risk.

To increase the ease of application of this EI and strengthen its associated findings, the development of supporting definitions of the three decision making tiers (Strategic, Tactical and Operational) is considered beneficial.

7.3.1.2 Summary

The critique presented above considers the efficacy of EIs pertaining to Decision Process Tracing, as well as observations concerning the coastal risk decision making practices in the studied localities. In summary, all Part A EIs effectively facilitate the examination of coastal risk decision making processes in a straightforward manner. The first two EIs, for example, allow multi-sectoral decision contexts, with numerous decision makers to be identified and examined. The Decision Pathway Stages EI provide the ability to compare theoretical decision making with empirical studies. The Decision Pathway Connections EI in particular is considered as being valuable, allowing for the identification of inter- and cross-decision context pathway connections, which have been shown to be significant within coastal risk decision making. Suggested modifications to the last Part A EI, Decision Making Tiers, are considered as increasing its applicability and purpose.

7.3.2 Part B Decision Making Aid

This section discusses the adequacy and validity of EIs associated with Part B of the RSM (Decision Making Aid). This section includes both Decision Structure and Decision Support EIs. The Decision Structure EIs are proposed to facilitate the consideration of external influences upon the decision making process. Decision Support EIs are designed to investigate the role of information in supporting the decision making process.

7.3.2.1 Empirical Indicators

EI: Is the pathway of the decision cycle framed?

Decision Pathway Framing

The decision making process, in particular the choices made by a decision maker during a decision pathway, are considered as being framed to a certain degree (Kolkman *et al.*, 2005; Section 2.4.1). Examination of this elicited differing findings concerning the extent of framing upon the studied decision contexts. Case Study One identified a substantial volume of decision framing within both decision contexts. This comprised the legislative frameworks, government strategies, policies, procedural guidance and plans that spanned the three decision making tiers. As these occur across the three decision making tiers (Tables 4.5 & 4.6), they represent a hierarchal form of decision framing. This was evidenced in particular by the Ocean Plaza decision example (Sections 4.5.3 & 7.3.1.1). This illustrated the range of framing within both coastal defence and planning decision contexts, including legislation, government policy on coastal defence, coastal planning guidance, regional planning guidance and Local Authority planning policies. In stark contrast, the Portballintrae example (Case Study Two, Sections 5.4.3 & 7.3.1.1) highlighted the lacuna of national coastal planning guidance and the limited coastal content of the applicable statutory development plan. It also revealed an absence of government policy on coastal defence or shoreline management to guide the plethora of coast protection works at the site. This EI, therefore, confirms the underlying proposition by Kolkman *et al.* (2005). Research by Gregory *et al.* (1997) into decision pathways highlight that, within the field of behavioural decision making, there is much literature describing how decision makers attempt to simplify complex decisions (Section 2.4.1). With regard to this EI, it is suggested that the degree of framing within coastal defence may occur in response to the perceived degree of decision making complexity. Accordingly, it is proposed that policies, plans, strategies and procedural guidance attempt to simplify decision making by creating a well-structured decision making environment. For example, the coastal defence sector in England and Wales is risk-based and, as such, is framed nationally to locally by flood and coastal erosion risk management (Section 4.7.1; Table 4.5). It is further posited that the greater the level of framing, the greater the boundaries and constraints within the decision pathway. Alternatively, within a less framed and structured process there is potential for more decision alternatives and opportunities to be taken by a decision maker. Decision makers could perceive this decision making environment as being 'adaptive' and may foster and stimulate ingenuity and innovative coastal risk decision making. This *modus operandi* does not necessarily facilitate coordinated and benchmarked working practices by decision makers, for example, as sought by Defra in England and Wales. As the Portballintrae example highlighted (Section 5.5.3 & 5.7.1), the decision making landscape in Northern Ireland does not provide any structure for coordinated or long-term decision making, or any mechanisms to facilitate the input and application of natural coastal change information to support management decisions. Decision making at Portballintrae was, therefore, found to be reliant upon parochial, traditional hard engineering approaches that are short-term and reactive in nature.

The identification of decision framing is regarded as constructive, providing insight into external forcing factors and influences of the decision pathway. This EI is, therefore, considered relevant and is supported by the literature.

EI: What is the frequency of this type of decision?

Decision Frequency

As discussed in the Literature Review (Section 2.4.1), frequency of decision making can be considered the number of times a decision occurs, with decision frequency commonly used as an indicator of decision complexity (Gilligan *et al.*, 1993; Simon, 1960; Section 2.4.1). This EI explores the routine nature of the decisions being undertaken in the empirical decision contexts and correlations with decision complexity.

Case study findings concerning decision frequency were variable due to the existence of a range of decisions, including short-term, routine operating decisions (*e.g.* development control by Local Authorities within the coastal planning decision context: Section 4.7.2) and longer-term and less routine decision making (*e.g.* the development of Second Generation SMPs by Operating Authorities within the coastal defence context: Section 5.7.2). Accordingly, decisions of varying levels of a 'routine' nature were observed. The value of this EI is considered limited in its current guise due to the level of subjectivity of determining decision frequency (*e.g.* a lack of numerical reference points and decision scales) and, therefore, decision complexity. It is felt that an associated calibrated scale for this indicator or guidelines could increase the strength of certainty and add greater value.

The RSM's Decision Making Aid conceptualisation (Figure 7.3) comprises a hypothetical distinction between structured and un-structured decisions, using decision complexity to determine the level of associated structure. The two Decision Structure EIs discussed (*i.e.* decision framing and decision frequency), were selected to explore this. However, their adequacy, in combination to facilitate measurement of decision structure, is limited due to the issues associated with the discussed Decision Frequency EI. Nevertheless, due to the strengths associated with the Decision Framing EI, there is merit in the communication within the RSM that a decision pathway can be influenced by external forcing factors.

EI: What is the nature/characteristics of the task information involved?

Task Information Characteristics

Task information is defined by Schrah *et al.* (2006) as information that the decision maker acquires *via* an information search; additionally, they stress that task information is distinct from other information inputs and sources, such as advice (Section 2.4.3). This indicator (as the first of the Decision Support EIs) provides the baseline or context for subsequent Decision Support discussions. As such, it is considered vital for an empirical assessment of decision making, due to the need for understanding the nature and characteristics of the task information involved.

The application of this EI to case study findings facilitated the comparison of Literature Review findings concerning the nature of natural coastal change information used to support coastal risk decision making (Section 2.5.4). It was reported that uncertainty is an inherent characteristic of natural coastal change information (for example: Burgess *et al.*, 2007; Hinton *et al.*, 2007; Woodroffe, 2002). This process, therefore, focussed upon examining the natural coastal change information and proving, or disproving, literature claims. Case Study One's findings produced a large amount of in-depth material concerning relationships between the natural coastal change evidence base, decision timescales and decision certainty (Section 4.8.1). The development, for example, of SMP2s brought to light the uncertainty of the natural coastal change evidence base being utilised by decision makers (Section 4.8.5) thus, confirming literature claims. Case Study Two identified a particularly weak and fragmented natural coastal change base, with decision makers having limited understanding of the complexities of coastal systems (Section 5.8.1).

In order for this EI to be relevant and useful, it requires some development in the form of criteria or framework by which to assess the 'nature' of task information. For example, in the previous discussion, literature propositions concerning natural coastal change were used to benchmark case study findings (Section 2.5.4). Prior to application of this EI there is a requirement for, either an in-depth understanding of the subject matter, or the undertaking of a detailed Literature Review. Without this, findings produced by this EI have the potential to be discursive without the ability to making meaningful interpretations.

EI: What mechanisms (internal and external) were engaged to aid the retrieval and application of task information?

Task information Sources, Retrieval and Application

This EI explores the capture, analysis and application by decision makers of the task information established by the previous EI, *i.e.* natural coastal change information. In doing so, this EI provides a clear process of examining the usage of task information, as opposed to merely collating an itemised list of all information that a decision maker may have utilised, or alternatively becoming sidelined by the information management systems that may be available to the decision maker. The indication of both 'internal' and 'external' types of mechanisms provides a structure for the findings and analysis.

Case Study One detailed the sourcing activities, monitoring efforts, inspections and commissioned research within local government in the North West (Section 4.8.2). Frequent and commonly cited regular internal activities included: beach surveys and topographic profiles; beach monitoring; maintenance inspections; annual survey / inspections of assets and annual monitoring reports. These were supplemented by other types of *ad hoc* coastal work in response to site-specific issues *e.g.* detailed topographic surveys. Within these activities, examples of innovative approaches to the sourcing and application of natural coastal change were identified, *e.g.* pioneering work trialling satellite imagery of Morecambe Bay to investigate channel movements by Lancaster City Council. With regards external sourcing, the widespread usage and reliance of engineering consultancies as a mechanism by ten out of the eleven surveyed North West Local Authority coastal engineers is a prominent finding (Section 4.8.2). This, therefore, supports the validity of this EI. The level varied significantly from *ad hoc* through to annual, frequent and regular usage. The rationale behind the engagement of consultants was found to be diverse, including the specialist services, knowledge and expertise that they can provide local authorities. A further aspect was raised by an engineer was the trend within the industry to do so, as highlighted by, *"follow the lead that the Environment Agency take, we hire in a consultant to do it"* (Engineer C). From these investigations it was also possible to examine and review the technical skills and capacity of the surveyed authorities. Discernable relationships were identifiable between the coastal defence capacity of the authority and the level of consultancy service required. Authorities with small-scale in-house coastal defence capacity (Authorities B, E, F, G, J and I) were found to require technical assistance and procedural assistance, from consultants.

Findings within Case Study Two revealed historic differences between England, Wales and Northern Ireland, for example, no mapping of littoral cells nor other significant government investment patterns were also noted (Section 5.8.2). Interestingly, the EU Floods Directive was found to have driven rapid and substantial investment in flood risk mapping to address significant gaps in data. However, these efforts do not include coastal erosion or wider coastal risk considerations. Little consistency to sourcing activities by government departments, such as monitoring, was observed. Interestingly, no in-house local government engineers with coastal expertise were identified, and as in the North West, there was found to be a common practice of consultant engineering firms being engaged to support the technical capacity of councils.

This EI produced valuable findings concerning divergences between case studies. For example, in Case Study One a number mechanisms to facilitate the sharing and transfer of natural coastal change information by coastal defence decision makers were identified. These included Coastal Groups and the Cell 11 Regional Monitoring

Programme (Section 4.8.2). This was contrasted within Northern Ireland where no such fora or mechanisms currently exist, and as such a greater science-practice disconnect was observed (Section 5.8.2).

During the application of this EI the ability to differentiate between sources of information and mechanisms was not always possible. For example, applicable case study findings that address this EI are:

- Data types and categories of natural coastal change
    - Forcing factors (wind, wave, tidal and currents), topographic (profiles, extent lines) *etc*;
- Information sourcing activities & in-house coastal defence work
    - Monitoring, maintenance inspections, annual coastal inspection *etc*;
- Usage of externally sourced data
    - Statutory agencies, Coastal Groups, research institutions, academia *etc*;
- Commissioning of coastal work by consultants (procurement)
    - monitoring, surveying and annual inspections, scheme design, grant aid applications *etc*.

To ease the future application and to strengthen findings, it is suggested that this EI be split into two new indicators. Firstly, one that examines information types (*e.g.* forcing factors) and activities undertaken (*e.g.* beach monitoring and annual coastal inspections). Secondly, an EI that seeks to identify 'mechanisms' available for the souring of data and information, undertaken both internal and externally. As it was not possible for interviewed engineers to articulate or provide evidence with regard to the application of information, as requested by this EI, it is suggested that this component of the EI be removed. Its relocation will be discussed next.

EI: Do different decision making tiers require different task information?

Pathway Information Needs

This EI is linked with the Decision Making Tiers EI (Part A). The Pathway Information Needs EI seeks to ascertain whether or not there are differing levels of task information requirements for different decision making tiers. Findings provided limited, but positive, evidence that the different decision making tiers (Strategic, Tactical and

Operational) require differing levels of natural coastal change task information. Case Study One for example, compared the natural coastal change information requirements of SMPs at the Tactical decision making tier, with the information needs of coastal works by local government at the Operational level (Section 4.8.3). Case Study Two, however, was not able to undertake similar investigations due the limited number of pathways investigated. Whilst this EI only generated limited results, it confirmed the EI's assertion, *i.e.* that different decision making tiers require different task information. In light of this, there is validity in maintaining this EI within the Decision Support EI, particularly as this consideration is not visually illustrated within the RSM.

For the successful application of this EI, it is suggested that empirical studies need a minimum of three decision examples, *i.e.* a decision example at each of the three decision making tiers, and ideally, more than one decision at each tier to allow for more detailed analysis. Furthermore, this EI could be expanded to consider information needs of the discrete pathway stages, thereby addressing the 'application of information' investigative line of the previous EI.

EI: Were aspects of the decision pathway aided by other sources in addition to task information?

Additional Pathway Support

This indicator builds upon the proposition by Schrah (2006) presented earlier (Section 7.3.2.1) that, in addition to task information, the decision maker may support the decision pathway with other forms of decision aid, for example, inputs and sources, such as expertise and advice. Case Study Two findings highlighted this well with respect to the utilisation and application to decision making of professional expertise and knowledge. This identified, for example, the use of in-house engineering colleagues by Local Authority policy planners, for advice and provision of non-technical information on aspects of coastal erosion and flood risk (Section 5.8.4). This indicator facilitated a full assessment of Decision Support. It considers other forms of decision aid (in addition to task information) that may form part of a scientific assessment, for example, expert knowledge and judgement. To increase the ease of application, it is suggested that a supporting definition of 'other sources' would be beneficial. For example: 'other sources of decision aid to support the decision pathway may include advice, opinion, intuition and judgement, that would not commonly be considered in the traditional scientific sense as constituting hard facts and data'.

EI: What is the level of certainty regarding decision outcome?

Decision Outcome Certainty

As the last indicator associated within Decision Support, the findings associated with this EI provide an opportunity to be reflective and consider a number of aspects from Decision Process Tracing and Decision Making Aid. In Case Study One, key findings from this EI revealed that coastal risk decision makers are required to manage coastal risks that remain, despite continued investment in coastal defence. This is illustrated within the situation faced by one authority in the North West that reported despite a current £19 million coastal defence scheme, *"it's not a case of if a flood event will happen, but more when"* (Engineer A) (Section 4.8.5). Decision outcome uncertainty is, therefore, a dominant characteristic within coastal risk decision making, exacerbated by natural coastal change information uncertainty and climate change (Section 7.3.2.1). Accordingly, this EI is considered an essential element of Decision Support. This EI explores, for example, potential implications of the task information, such as uncertainty, upon the decision pathway and the associated outcome. Whilst this is an important reflection, this EI assumes that the decision being examined is a completed decision pathway that allows consideration of the decision pathway's outcome. For example, within the Ocean Plaza development (Section 4.5.3) only a partial empirical study was possible, due to planning permission having only recently been awarded and site construction having not yet commenced.

The Decision Support visualisation within Part B of the RSM (Figure 7.3) proposes two forms of information input exist within the decision pathway (scientific experiment and intuition / experiment); with these being presented at either ends of a spectrum, *viz* scientific experiment at one and intuition / experiment at the other. The merit in this visual construction lies in conveying the range of decision support that can be utilised by a decision maker.

7.3.2.2 Summary

Part B Decision Making Aid EIs (Decision Structure and Decision Support) comprehensively examine external influences on decision making, such as decision framing, and the role of information to support the decision pathway. As discussed in Section 7.3.2.1 (Decision Frequency EI), due to the observed relationships between decision frequency, complexity and decision making tiers, it is proposed that this EI is more suited to being within Part A, specifically the Decision Making Tiers EI. Decision Support EIs are regarded as valuable. For example, Task Information Characteristics, Task Information Sources and Additional Pathway Supports EIs, all generated relevant and interesting findings within case study investigations. Decision Certainty is accordingly, regarded as critical to the process of examining decision making, prompting consideration and reflection of the decision outcome. With previous EIs (Part A and Part B) providing a strong contextual understanding of the decision situation and context.

7.4 Theory Reconstruction: Coastal Risk Decision Making Conceptualisation

This section establishes the merit of, and methods for the development of the Coastal Risk Decision Making Conceptualisation, a key output of the thesis. Firstly, the formulation and function of the model is considered (Section 7.4.1), followed by presentation of the conceptualisation (Section 7.4.2) and then the supporting Empirical Indicators (Section 7.4.3).

7.4.1 Formulation and Function

As reported in Chapter Three (Section 3.1), the formulation of the thesis RSM and associated EIs prior to undertaking Case Studies One and Two, sought to provide an intellectual framework for understanding and explaining coastal risk decision making in the geographical case studies. Handfield and Melynk (1998, pg. 321) state, "Without theory, it is impossible to make meaningful sense of empirically-generated data". As such, a conceptual model is a constructive and beneficial way of conceptualising the primary themes of decision making and associated evidence base. The previous section (Section 7.3) brought to light key strengths and weaknesses associated with the RSM EIs. Accordingly, there is scope for the modification of the RSM to more accurately reflect coastal risk decision making. This development is based upon a combination of the RSM's underpinning theory, empirical study and lessons learnt from the analysis of case study findings (Sections 7.2 & 7.3).

The driver and underlying reasoning behind this reconstruction is twofold. Firstly, the RSM and EIs enabled the critical study and tracing of both decision making and the role of science within the decision making process within a structured framework. As explored in Section 7.2.1, this process facilitated the comparison of coastal risk decision making in various geographical localities. Accordingly, there is value and utility in a conceptual model that is supported by EIs (*i.e.* built upon theory) that can measure and 'make sense' of empirical data or 'the real world'. In summary, the RSM and EIs aid the transition from observation through to empirical generalisation to inform theory, and knowledge and understanding. This is aligned with the intellectual puzzles of the thesis identified in the Methodology Chapter, *i.e.* how do x and y work?; what can we learn from comparing x and y? (Section 3.2; Figure 3.1).

Secondly, as identified within the Literature Review (Section 2.4.3), there is an absence of mechanisms to examine coastal decision making. For example, mechanisms to trace the internal decision making processes undertaken by a decision maker operating in the field of coastal risk management, and to identify external forcing factors that may influence the decision making process. Furthermore, no other methodology has been designed to assess the role and application of task information, such as, natural coastal change science, and additional sources of input to aid and support the decision maker. It is, therefore, posited that a conceptual model with indicators provides both a research lens and an intellectual framework to address these two themes (decision making and evidence base), and represents a clear contribution to the field. Notwithstanding the limitations of conceptual models (for example, representing an over simplification of reality), the function and merit so far discussed is considered as warranting the research effort in the form of the reconstruction of the RSM and the generation of further knowledge in this field.

7.4.2 Conceptualising Coastal Risk Decision Making

To close the gap between theory and the findings of the three case studies, a modified conceptualisation of coastal risk decision making will now be presented.

Using the critique of the *SCDO Grading* proforma from Case Study Three (Section 7.2.2) and Part A of the RSM (Section 7.3.1.1), a summary concerning decision making is contained in Table 7.2. In order to determine the efficacy and validity of the various variables to directly inform the revised model, this table presents a critique of the decision making-related RSM EIs and assessment criteria from the *SCDO Grading* proforma (Sections 7.2.2 & 7.3; Table 6.10). Those variables given an A rating are regarded as fundamental in the visual communication of coastal risk decision making. In essence, they represent the most significant empirical findings associated with coastal risk decision making and key constructs. Variables graded A:

- *Decision Context / Sector*: Regarded as a vital visual variable, as it establishes the basis for the conceptualisation *i.e.* cross-sectoral decision making and associated interfacing (Section 7.3.1.1);
- *Decision Pathway Stages*: Considered a primary variable to the purposes of the model, *i.e.* the communication that an individual coastal risk decision can be examined and discrete stages within the decision making process can be identified and analysed (Section 7.3.1.1);
- *Decision Pathway Connections*: Introduces a temporal aspect to the model that conveys links and relationships between decisions and sectors, identified as intrinsic to coastal risk decision making (Section 7.3.1.1);
- *Decision Making Tiers*: Considered integral due to the various scales of coastal decision making that can occur of a hierarchical nature (Section 7.3.1.1).

Those variables graded B form part of the wider understanding of the coastal risk decision situation and used as supporting Empirical Indicators. Variables graded B:

- *Decision Maker*: A necessary aspect to an assessment of coastal risk decision making, but not vital to the visualisation (Section 7.3.1.1);
- *Decision Transparency*: Consideration of the decision pathway's transparency forms part of the analysis and assessment. As such, is not considered a key construct to be visualised (Section 6.5.2);

- *Decision Justification*: In a similar vein to Decision Transparency, the justification of the decision pathway is not regarded as a useful visual variable (Section 6.5.2).

Table 7.2: Critique of Case Study-related Decision Making Empirical Indicators and Assessment Criteria

<table>
<tr><th colspan="2">RSM (Case Studies One and Two)</th><th colspan="2">Review of SMPs (Case Study Three)</th></tr>
<tr><th>Part A Decision Process Tracing EIs</th><th>Validity & Efficacy</th><th>SCDO Grading Decision Making Review Themes</th><th>Validity & Efficacy</th></tr>
<tr><td>Decision Maker</td><td>B</td><td>Decision Transparency</td><td>B</td></tr>
<tr><td>Decision Context</td><td>A</td><td>Decision Justification</td><td>B</td></tr>
<tr><td>Decision Pathway Stages</td><td>A</td><td colspan="2" rowspan="3"><u>Critique Rating</u>
A = Considered as both vital within model's visualisation and as a supporting Empirical Indicator
B = Considered only as a supporting Empirical Indicator</td></tr>
<tr><td>Decision Pathway Connections</td><td>A</td></tr>
<tr><td>Decision Making Tiers</td><td>A</td></tr>
</table>

The proposed conceptualisation has modified the two constituent elements of Part A of the RSM, *i.e.* Decision Pathway and Decision Making Tiers. It is notable that two additional variables previously not contained within the original RSM have been proposed, *viz,* 'Decision Context' and 'Decision Pathway Connections'. Their previous absence is, in part, explained by the generic nature of the RSM that was constructed to be applicable to all forms of decision making. The introduction of the variable 'Decision Context' seeks to communicate cross-sectoral decision making that occurs within the context of coastal risk. This aspect conveys the decision making interface between, for example, planning and engineering that have mutual objectives in safeguarding people and property from coastal risk (Section 7.3.1.1). The addition of a temporal aspect to this new construction is achieved through the introduction of variable 'Decision Pathway Connections'. This considers relationships between past, present and future pathways within decision contexts (inter-sectoral decision making) and links across decision pathways (cross-sectoral decision making) (Section 7.3.1.1). Greater justification and merit of these is contained in the summary critique of the Part A EI (Section 7.3.1.2).

The visualisation of Coastal Risk Decision Making presented in Figure 7.3 utilises the general idea of the 'quantum entanglement' concept from the field of Quantum Mechanics (Comstock, 2007). This formulation communicates linked relationships between the variables discussed above and portrays assertions about these. In doing so, the model seeks to convey dynamic and complex inter-linkages and connections, as well as relationships that may occur within the context of coastal risk decision making, as evidenced within all three thesis case studies. In summary, this conceptualisation asserts that a coastal risk-related decision pathway can be examined in order to identify its individual coastal risk decision pathway stages (*e.g.* Stages A through to E). Additionally, this examination should consider potential connections between the examined decision and other:

- Decision pathways that have occurred within the same decision context at other temporal scales (*e.g.* past, present and future);
- Decision pathways that have occurred within the same decision context at different decision making tiers (*e.g.* Strategic, Tactical and Operational) and
- Decision pathways that have occurred within other decision contexts (*e.g.* coastal planning and coastal defence).

This reconstruction has sought to highlight and articulate key findings arising from both coastal-risk related decision contexts of coastal planning and coastal defence in England, Wales and Northern Ireland. It has not been a research desire to construct a conceptual model based solely upon empirical findings of reality, rather, the assimilation of the original theoretical RSM with contributions from empirical findings. Methodological 'lessons learnt' from the multiple-case study approach have in combination, given rise to the Coastal Risk Decision Making Conceptualisation.

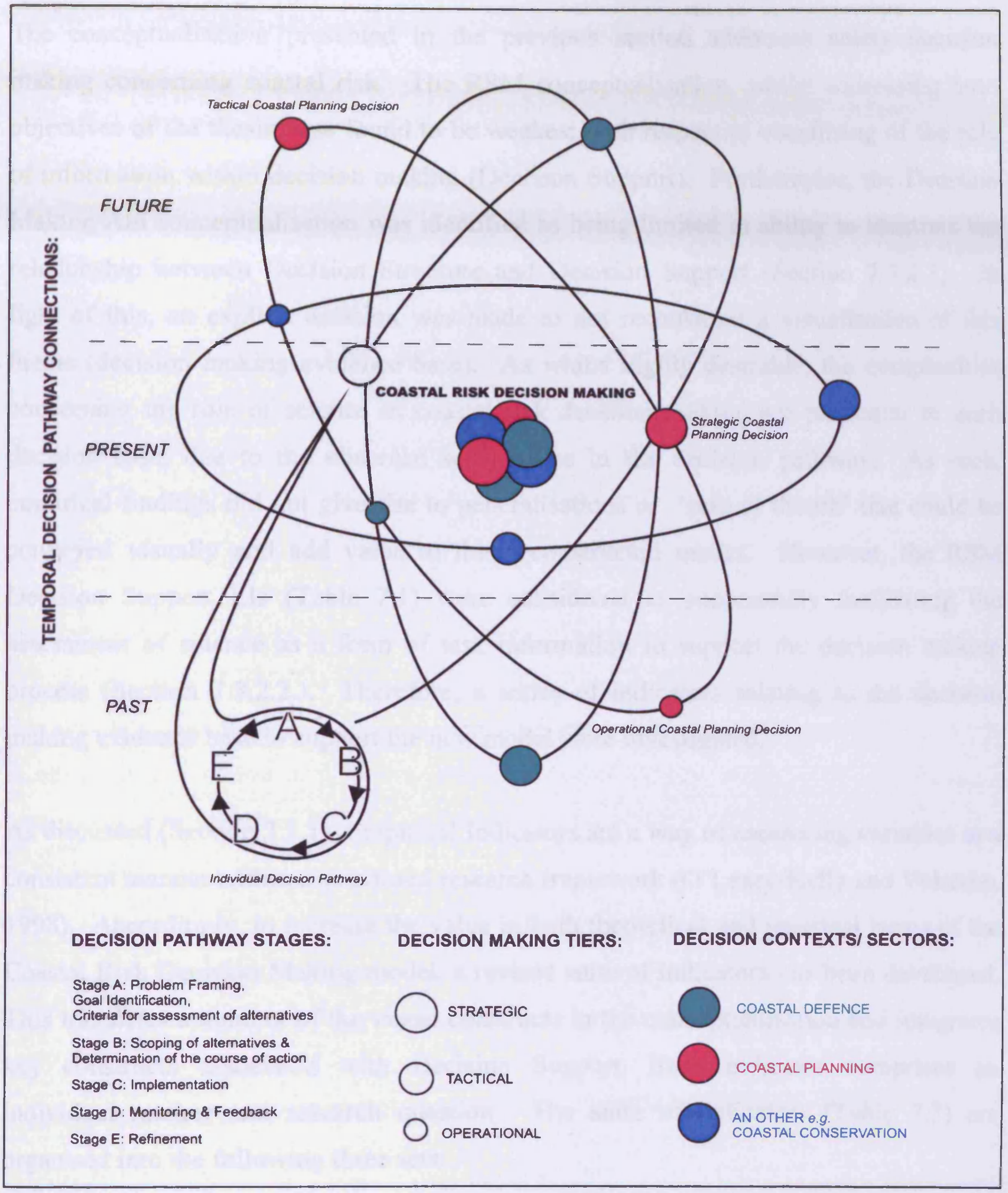


Figure 7.3: Conceptualisation of Coastal Risk Decision Making.

(Note: This Figure illustrates individual decision pathway stages (A-E) that may occur at different tiers (S-T-O), within various decision contexts. These pathways may interface with other decisions over time (past, present and future).)

Source: Original

7.4.3 Supporting Empirical Indicators

The conceptualisation presented in the previous section addresses solely decision making concerning coastal risk. The RSM conceptualisation, whilst addressing both objectives of the thesis, was found to be weakest with respect to visualising of the role of information within decision making (Decision Support). Furthermore, the Decision Making Aid conceptualisation was identified as being limited in ability to illustrate the relationship between Decision Structure and Decision Support (Section 7.3.2.2). In light of this, an explicit decision was made to not reconstruct a visualisation of this theme (decision making evidence base). As whilst highly desirable, the complexities concerning the role of science in coastal risk decision making are particular to each decision case, due to the observed sensitivities in the decision pathway. As such, empirical findings did not give rise to generalisations or 'rule of thumb' that could be conveyed visually and add value to this reconstructed model. However, the RSM Decision Support EIs (Table 7.1) were considered as successfully facilitating the assessment of science as a form of task information to support the decision making process (Section 7.3.2.2.). Therefore, a series of indicators relating to the decision making evidence base to support the new model were investigated.

As discussed (Section 3.3.1), Empirical Indicators are a way of measuring variables in a consistent manner within a structured research framework (O'Leary-Kelly and Vokurka, 1998). Accordingly, to increase the value in both theoretical and practical terms of the Coastal Risk Decision Making model, a revised suite of indicators has been developed. This translates a number of the visual constructs in the conceptualisation and integrates key constructs associated with Decision Support. Each indicator comprises an individual marker and research question. The suite of indicators (Table 7.3) are organised into the following three sets:

1. Decision Process Tracing;
2. Decision Making Aid and
3. Decision Outcome.

The first set, 'Decision Process Tracing', contains seven markers (*e.g.* Decision Maker, Decision Context...) and associated research questions (*e.g.* Who is the decision maker being examined...). The information from the application of these includes detail concerning the background and general setting of the decision; who the decision maker is; the legislative and policy framework; and the scale and tier of decision making being undertaken. Additionally and importantly, this set of indicators can establish in-depth insight into the external inter-linkages of the examined decision pathway being with others within the wider coastal risk decision realm. The second set of indicators, 'Decision Aid', when applied to a decision pathway may extract details into the role and application of science and other forms of task information (previously referred to as Decision Support in the RSM). The range of markers within this set of indicators, explores overall the nature and role of information within the decision pathway comprehensively and at specific stages. This includes identifying the range of information available to the decision maker, constraints to the application of information and other forms of decision aid that may exist. The last set of indicators (Decision Outcome) contains three markers that integrate the two review themes from Case Study Three's *SCDO Grading* and the RSMs Decision Outcome EI (Section 7.2.2; Table 7.2).

In summary, the suite of empirical indicators contained within Table 7.3 is regarded as providing a comprehensive research lens that can be used to critique a coastal risk decision making process. As the indicators stem from grounded research using a number of innovative and novel methods, applied in a number of geographical locations, there is a noted level of credence as to the efficacy and validity offered by the indicators and the conceptualisation.

Table 7.3: Coastal Risk Decision Making Conceptualisation Supporting Empirical Indicators

EMPIRICAL INDICATORS	
Marker	***Research Question***
Set One: Decision Process Tracing	
Decision Maker:	Who is the decision maker being examined?
Decision Context:	What is context / sectoral domain of the decision being examined?
Decision Pathway Stages:	Are there discrete stages to the decision cycle and what stages is being examined?
Decision Pathway Connections:	Is the decision pathway connected to other decision pathways? *e.g.* past, present and future
	Is the decision pathway connected with those occurring within other decision pathways ? *e.g.* inter and cross-sectoral
Decision Making Tiers:	What level or decision making scale is being examined? e.g. strategic, tactical, operational
Decision Frequency:	What is the frequency of this type of decision?
Decision Framing:	Is the decision pathway framed?
Set Two: Decision Making Aid	
Task Information Characteristics:	What is the nature / characteristics of the task information involved?
Task Information Types and Categories:	What types and categories of task information are utilised by the decision maker?
Mechanisms for Sourcing and Retrieval:	What mechanisms (internal and external) are available to aid the retrieval of task information?
Task Information Requirements:	Do different decision making tiers and pathway stages different task information?
Other Decision Aids:	Where aspects of the decision pathway aided by other sources in addition to task information? *e.g.* advice, expert opinion, judgement
Set Three: Decision Outcome	
Decision Transparency:	How transparent is the decision pathway? e.g.

	clear decision making pathway
Decision Justification:	How justified is the decision pathway? e.g. well justified, marginally justified, no justification
Decision Confidence:	What is the level of certainty regarding decision outcome?

7.5 Conclusion

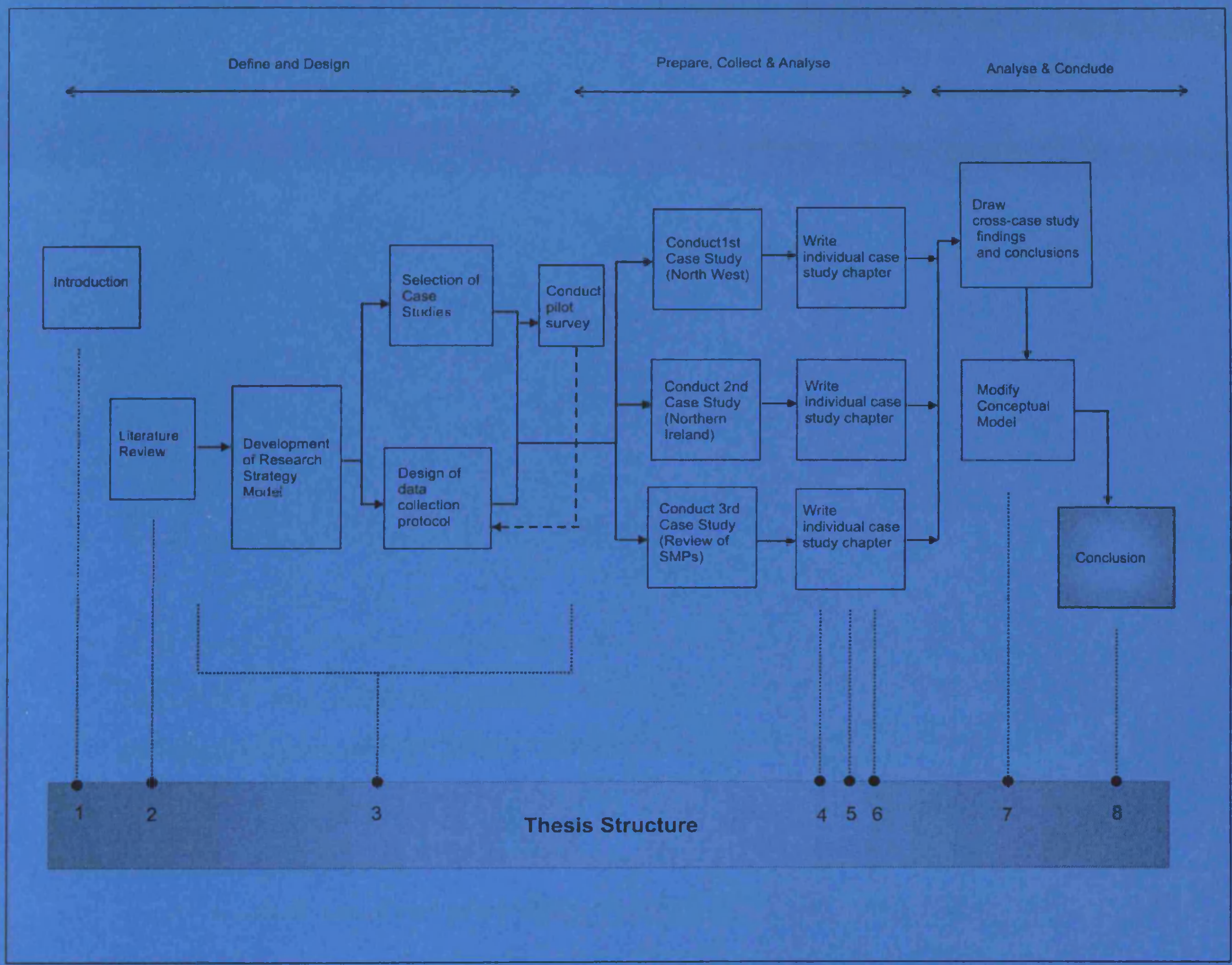
This chapter has presented the key outputs of the thesis. Section 7.2 contains a synthesis of the main findings in relation to the aim and objectives. Using the RSM as a lens for the interpretation of empirical data, it was possible to establish the salient empirical decision making characteristics of coastal risk from the two geographical case studies (Section 7.2.1). This identified: decision makers; decision framing (legislative and policy frameworks); operational landscapes; decision making tiers; decision making frequency and inter-sectoral and cross-sectoral decision pathway connections. The latter are considered as representing principal findings with respect to the first objective of the thesis, concerning the realities, established practices and constraints facing coastal risk decision makers. With regard to the second objective, this section (Section 7.2.1), also presented findings concerning the application of natural coastal change information as a form of task information by decision makers within the case studies. The primary themes considered were: the characteristics of the natural coastal change task information (predominantly found to be uncertainty); the sourcing, both internally and externally by decision makers for natural coastal change task information, and mechanisms that aid the transfer of science into decision making.

Furthermore, this section verified the underlying hypothesis for the geographical case study selection process, which recorded divergent approaches to coastal risk in Northern Ireland, England and Wales with regard to both Decision Structure and Decision Support. In summary, empirical findings in Case Study Two identified insubstantial Decision Support. For example, decision framing (*i.e.* no coast protection legislation and no coordinated shoreline management planning), resulted in predominantly fragmented, reactive and uncoordinated coastal defence decision making pathways, with extremely limited application of natural coastal change task information. Only with respect to flood risk management, was decision making structured or supported in

Northern Ireland, driven by the recent EU Floods Directive. In striking contrast, Case Study One revealed large amounts of decision framing at all decision tiers across both decision contexts (coastal defence and coastal planning). Additionally, strong connections within and across decision pathways to past, present and future decision making were identified, in relation to historic planning decisions and technocratic hard engineering approaches to coastal risk. These arrangements were found to be driving and necessitating an interface between the decision contexts of coastal engineering and coastal planning in order to address coastal risk. Also identified was the existence of Decision Support in the form of an extensive natural coastal change evidence base, with mechanisms in place to facilitate the transfer of science to support decision making at various decision making tiers. Interestingly, it was revealed that despite arrangements and provisions for Decision Structure and Decision Support within Case Study One, a significant amount of decision outcome uncertainty remained for coastal risk decision makers.

Findings associated with the third case study (Section 7.2.2) included the notable lack of decision making transparency and justification within reviewed SMPs. Furthermore, the review identified that it was impossible to ascertain when expert knowledge, information and intuition had been engaged to support decision making and supplement the natural coastal change scientific evidence base. Importantly, lessons learnt were taken forward to the critique of the RSM and EIs (Section 7.4). This combined scrutiny informed a new conceptual framework specific to coastal risk. The formulation and function associated with this is detailed in Section 7.4.1. The Coastal Risk Decision Making conceptualisation is presented in Section 7.4.2 (Figure 7.3), along with a supporting suite of Empirical Indicators (Table 7.3; Section 7.4.3).

This original conceptual model seeks to communicate the complex, inter-connected and dynamic relationships that may occur within the context of coastal risk decision making. In light of empirical findings and associated weaknesses of the RSM in portraying the role of information, such as science within the decision making process, an explicit decision was made not to attempt within the new conceptualisation to visualise the relationship between science and decision making, *i.e.* observed aspects of the science – practice disconnect within the coastal risk context. Whilst the model is an over-simplification of reality, the supporting Empirical Indicators strengthen its function and value. As stated previously, there is a noted absence of existing conceptualisations of coastal risk decision making and mechanisms to scrutinise the role of science. As such, the development of both the model and indicators are regarded as being a clear contribution to the literature. As the conceptualisation was not an aim or objective of the thesis (Section 1.3), its development, therefore, supplements other key outputs.


Define and Design
Prepare, Collect & Analyse
Analyse & Conclude
Introduction
Literature Review
Development of Research Strategy Model
Selection of Case Studies
Design of data collection protocol
Conduct pilot survey
Conduct1st Case Study (North West)
Conduct 2nd Case Study (Northern Ireland)
Conduct 3rd Case Study (Review of SMPs)
Write individual case study chapter
Write individual case study chapter
Write individual case study chapter
Draw cross-case study findings and conclusions
Modify Conceptual Model
Conclusion
1
2
3
4
5
6
7
8
Thesis Structure

8. Chapter Eight Conclusion

8.1 Introduction

The chapter revisits the aim of this research, *'To examine the role of science within coastal decision making, with particular reference to decisions pertaining to coastal risk'*, and presents concluding comments with respect to the objectives of the thesis (Section 8.2). The chapter then examines the contribution of the various stages of the Research Strategy Pathway (Section 8.3), before outlining potential future research investigations (Section 8.4).

8.2 Concluding comments

8.2.1 Coastal risk decision making

This research examined coastal risk decision making within the North West of England and Wales and Northern Ireland. With respect to the first objective, *'To identify the salient decision making characteristics particular to coastal risk decision making'*, case study investigations examined:

- Levels and awareness of coastal hazards and risks;
- Coastal risk decision makers and their associated duties and responsibilities;
- Provision and levels of coastal defence activity and
- Decision making practices.

Tidal flood risk was identified as being a significant issue for several Local Authorities within the North West of England and Wales. For example, Lancaster City Council were found to have the second worst exposure to flood risk of all districts in the North West of England, with an estimated 30% of 59,000 living in Flood Zone 3. Flooding events in the 1977, 1983 and 1990s, have created community awareness of flood risk within several generations. Coastal erosion rates in the region were found to be variable due to varying coastal geomorphological systems and significant lengths of defended frontages.

Coastal defence Operating Authorities are clearly defined in the North West Case Study. Apart from obligations to protect internationally important habitats under the EU Habitats Directive, all flood and coastal defence works are undertaken under permissive powers. This means that Operating Authorities, such as local government, are not legally obliged to carry out flood and coastal defence works. Whilst levels of coastal activity were variable at the time of survey, all eleven surveyed authorities had undertaken coastal works at various times in the past. For example, in the case of Conwy Borough Council, 45.3 km of their 73 km coastline is artificially defended, representing a fifth of the total Welsh artificially protected coastline. It was ascertained that the majority of Local Authority- maintained defences originated from Victorian times. In summary, there was found to be a clear relationship between heavily urbanised stretches of coast and the presence of coastal defence structures in the North West. Privately owned coastal defences were also identified, for example by Network Rail, and those publicly owned and maintained by the Environment Agency. In light of the considerable amount of coastal defence activities by local government, awareness of coastal risk and matters of coastal defence is high. Furthermore, the involvement of all surveyed engineers within North West Coastal Groups, increases professional awareness of coastal risk matters.

Knowledge and appreciation of coastal risk matters within the planning sector in the North West is considered as having improved recently. For example, development of SMP2s and SFRAs / SFCAs in England and Wales, respectively, was observed as encouraging greater 'buy-in' by the local government planning community within matters of shoreline management and flood risk management; both driven by central government guidance. The former has been encouraged by central government *via* SMP guidance (Defra, 2006a) and the latter by central government planning guidance (*i.e.* PPS25 (DCLG, 2007)). Liaison and a growing relationship between planning and engineering within Local Authorities, is considered as more closely resembling coastal risk management than the previous traditional approaches to planning and coastal defence as reported within the literature (for example: MAFF, 2000; English Nature, 2005).

Interestingly and despite differences between Case Studies One and Two, the range of decision makers was similar within both geographical case studies, *i.e.* local, regional and central government and private landowners. Within England and Wales, these decision makers operate within a complex hierarchical institutional framework for both coastal defence and coastal planning. This results in decision making being extensively framed by various aspects of government guidance, for example, dealing with coastal planning, development and flood risk and shoreline management. This was evidenced within the Ocean Plaza decision example (Section 4.5.3).

In stark contrast, institutional arrangements within Northern Ireland with respect to coastal erosion operate on a site-by-site, 'as and when needed' basis with a lack of a single authority responsible for coastal defence. This compares with past coastal defence decision making in England and Wales, *i.e.* pre-SMPs (Section 6.2). Whilst several sites were reported as experiencing coastal erosion, this matter is only considered a minor concern by government that does not necessitate the existence of a formal government policy or operating guidance. A government agreement 'the Bateman Formula 1967', informs provision of coast protection works by central government departments related to the infrastructure assets threatened. In summary, an un-structured and marginally framed coast protection decision making environment exists. This is characterised by a lack of legislation, government policy, strategic planning and operational guidance, which perpetuates a parochial, reactive, short-term and extremely fragmented and sectoral approach. Flood risk management arrangements were, however, found to be distinctly different. Flood risk is a greater concern in Northern Ireland; the Foresight Future Flooding identifies 63,000 properties within the indicative flood plain and 12,715 properties within the coastal zone and below the 5 metre contour line (Chatterton and Suter, 2007). Prior to the floods of August 2008, flooding had been infrequent. The EU Floods Directive has rapidly changed the management approach to flooding in Northern Ireland. The development of a revised government aim and policy on flood risk has recently been undertaken to address requirements from the European Commission on flood management. Accordingly, flood risk-related decision making in Northern Ireland, in contrast to coast protection, is considerably more aligned with that currently occurring in England and Wales. However, the remaining segregated approach to matters of coast protection and flood risk in Northern Ireland, separates these UK counterparts. Whilst divided in legislative terms, integrated flood and coastal erosion risk management polices in England and

Wales have evolved in an attempt to address the need for joined-up, strategic and (ultimately) sustainable coastal risk management.

As many historic planning decisions have long-term implications due to the permanency of engineering structures, current decision making in Case Study One, in both the coastal defence and coastal planning sectors, are defined and tied by past decision making. Future avoidance of inappropriate coastal development is considered likely in light of flood and coastal erosion policies intended to steer development away from risk areas (*i.e.* risk-based management). It is the management of inherited defences, and communities at risk, in light of climate change that pose coastal risk decision makers in the North West the greatest challenge. Within this contemporary coastal risk management, the needs and expectations of future generations and implications for future decision makers need to be considered. The absence of significantly defended frontages in Northern Ireland, gives rise to contemporary coastal risk decision making that is less connected to the past. This creates a less restricted decision making environment for coastal risk managers. Furthermore, the frequency of decision making within both studied decision contexts was found to be less, again reducing connections and implications between sectors, such as the burdening requirements for defence works in light of coastal developments in risk areas. However, increasing pressures for housing supply and expected climate change impacts may change these Northern Ireland coastal risk decision making characteristics.

In light of these case study findings, it is proposed that coastal risk decision making in Northern Ireland is aligned with the 'Open Systems Decision Cycle' proposed by Gilligan *et al.* (1993) (Section 2.5.3; Figure 2.5). This form of decision making is 'open' to influences including, human elements and forcing factors. The Portballintrae decision example (Section 5.4.3) highlighted the potential influences and drivers that occur within a decision making pathway, for example, community driven action, based upon tourism and economic development drivers. In the North West, due to the tied nature of decision pathways, coastal risk decision making is considered as resembling the 'incremental decision making' identified in the Literature Review (Section 2.4.1). This sees the decision maker operating within a restricted decision making environment, with limited decision choices and alternatives available. Furthermore, both reflect a technocratic approach, driven predominantly from an engineering and political basis.

These forms of decision making or 'typologies', can be contrasted with the hypothetical rational decision making pathway portrayed in the RSM (Figure 7.2). Rational decision making, in essence, seeks to achieve the ideal or best decision outcome, after consideration of all potential decision alternatives (Smith and May, 1981; Section 2.4.1). Neither case studies identified coastal risk decision making that was able, due to forcing factors, to be 'rational' and consider all alternatives. For example, in Portballintrae, Do Nothing as a decision alternative was not considered due to strong community pressures for action. Whilst the development of SMP1 policies in some parts of the North West maintained past Hold The Line policies, due to significant proportions of settlement at coastal risk. These influences or 'forcing factors' upon coastal risk decision making will be revisited later in this chapter.

Emerging from the above investigations were the salient decision making characteristics associated with coastal risk. Presented and discussed in Section 7.2.1, they were then used to inform the Coastal Risk Decision Making Conceptualisation (Figure 7.3). The prevailing characteristics are as follows:

- Multi-sectoral (coastal defence, coastal engineering…)
    - Decision makers (local and central government and private landowners);
- Legislative and policy frameworks (decision pathway framing);
- Hierarchical decision making tiers and decision making frequency;
- Inter-sectoral decision pathway connections and
- Cross-sectoral decision pathway connections.

The greatest idiosyncrasy, however, of coastal risk decision making is its sensitivity to external forcing factors or 'context issues'. Whilst the thesis has regarded coastal risk as discrete area of decision making, it is this last point concerning context issues, that brings it in line with generic policy making described by Jasanoff and Wynne (1998) discussed in the Literature Review (Section 2.4.2). These authors describe policy formulation as the product of interactions between four domains (Bureaucratic, Academic, Economic and Civic) (Figure 2.1). Similarly, using a PEST analysis (Political, Economic, Social and Technology), the following range of context issues can be illustrated within coastal risk decision making:

Political:

Whilst private landowners were identified as coastal risk decision makers within the thesis' geographical case studies, the greatest number, however, were government decision makers. These may occur locally, regionally and nationally. Furthermore, within England and Wales, for example, the sectors of coastal defence and coastal planning are extensively framed at all decision making tiers by legislation, government policy and procedural guidance.

Economic:

As identified within the previously discussed European study of coastal erosion management, 'EUROSION', the cost of coastal defence is predominantly borne by the public purse (Doody *et al.* 2004; Section 2.5.3). In England and Wales, for example, annual government investment is estimated at £240 million (including capital schemes and maintenance) (Halcrow *et al.*, 2001). In light of the rising costs of coastal defence for example, according to EUROSION, estimated annual public expenditure for coastal defence for the period 1990-2020 is expected to average 5.4 billion Euros (European Commission, 2006). Justification for defences (cost-benefits) will become increasingly harder, particularly due to the current global economic climate facing both the public and private sector.

Social:

The social issues associated with coastal risk are ultimately those communities who are safeguarded from the potentially devastating effects of flooding, and coastal erosion. The safety function of coastal defence is evidenced by many coastal localities, with the Netherlands being a noteworthy example (Doornkamp, 1992; Klein *et al.*, 1998). The needs and desires of coastal communities (*i.e.* greater than 'safety' alone, for example, economic development) are able to influence their political representatives, and ultimately, therefore, coastal risk decision making.

Technology:

The maintaining of coastal communities in hazard areas has been achieved by significant advances in science and coastal engineering; along with the presence of political, economic and social will. Table 2.2 contains a summary of the range of coastal defence measures that can be designed and installed to address coastal hazards

(Section 2.5.3). These coastal engineering feats or 'technological advances' ultimately reinforce the social utility of science discussed in the Literature Review (Section 2.2). Uncertainty within the evolving state of natural coastal change science is, however, an inherent characteristic of this evidence base (Section 2.5.4); addressed below (Section 8.2.2). At the very core of coastal risk decision making, and risk management generally, is the issue that 'risk' cannot be entirely removed, only managed and mitigated against. This is highlighted by an interviewed engineer within Case Study One, despite this authority investing £12 million a year in total on coastal defence activities (including staffing), with £400,000 on maintenance (2007-2008) to address flood risk, *"it's not a case of if a flood event will happen, but more when"* (Engineer A).

8.2.2 Natural coastal change evidence base within coastal risk decision making

In light of the second objective of the thesis, '*To evaluate the application of natural coastal change science as evidence used within coastal risk assessment and its associated decision making procedures*' research has examined the bridge between science and practice in the context of coastal risk.

In summary, research investigations within both geographical case studies showed historic limited appreciation and application of natural coastal change science within coastal risk decision making (Chapters Four and Five). Furthermore, the third case study relating to SMPs (Chapter Six) identified only limited visibility of the application of natural coastal change science within these coastal risk-related plans. Management decisions, such as maintaining the status-quo of past coastal defence decision making in SMPs in the North West (Section 4.5.4), highlights that decisions, in several instances, continue to be made without clear and transparent scientific input. Furthermore, the coastal planning example of Ocean Plaza (Section 4.5.3), illustrated the case of natural coastal change information being 'retro-fitted' into the decision making process to facilitate regeneration and mitigation of flood risk. These findings confirm aspects of the literature concerning the science-policy disconnect (Section 2.3). It is posited that due to the tied relationships within coastal risk decision making (Section 8.2.1), decision pathway connections prevent the full application of natural coastal change information. Decisions do not commence from scientific understanding *per se*, instead scientific understanding aids various stages of the decision pathway. In addition, decision pathways are supported and informed by other forms of decision support, such as expertise and advice. These findings verify research by Allio *et al.* (2006) into the role of science within the European Commission's published Extended Impact Assessments and Explanatory Memoranda (Section 2.3). Specifically, scientific assessments by experts often combine scientific evidence along with the application of judgement and opinion. Also, the extent to which scientific advice used is often not clearly specified and scientific uncertainties not reported.

In greater detail, Case Studies One and Two considered:

- Characteristics of natural coastal change scientific information;
- Existing and available natural coastal change information needs, sources and usage and
- Mechanisms that aid the transfer of natural coastal change science into decision making.

Within the thesis, the key term 'science' was defined as natural coastal change information. Accordingly, the research focused upon this when examining coastal risk decision making. A key finding was the uncertainty associated with the natural coastal change evidence base, thus confirming literature findings, namely, those propositions by Woodroffe, (2002); Kamphuis (2006); Burgess *et al.* (2007) and Nicholls *et al.* (2007) (Section 2.5.4.) Interestingly, this was found to be the case despite extensive coastal monitoring efforts by Local Authorities within the North West, for example, since the 1930s. Additionally, other frequent and commonly cited regular internal activities by these authorities included: beach surveys and topographic profiles; beach monitoring; maintenance inspections; annual survey / inspections of assets and annual monitoring reports. Across both geographical case studies, limited Local Authority in-house engineering capacities were identified, along with the widespread usage and reliance of engineering consultancies as the predominant external source of natural coastal change information. This situation raises considerable issues as noted in the Literature Review (Section 2.2), concerning science that is 'produced, packaged and presented' for end-users. When this process occurs outside academia, for example, within consultancies and research centres, science is often exempt from conventional peer review (Jasanoff, 1990 & 2003). As such, trust in the science and its sources by those commissioning it, gives rise to concerns of reliability, quality assurance and objectivity (Jasanoff, 1990 & 2003; Functowicz and Ravetz, 1990; Wiltshire, 2002). An additional challenge is the handling and interpretation of scientific evidence by the non-scientific community, for example, local government, to adequately inform and benefit decision making.

Differences were observed between the existing natural coastal change evidence base in Northern Ireland, in comparison to England and Wales; for example, differences in government investment in coastal research and a lack of coastal sediment cell mapping. However, a greater finding concerns the barriers to the application of the available science within decision making in Northern Ireland. This is due to the a lack of any formal mechanisms to facilitate the transfer of natural coastal change information and understanding to coastal risk decision makers. Currently the only conduits were identified as being academics within the University of Ulster, with this limited to predominantly informal and *ad hoc* occurrences. In contrast, the role of Coastal Groups in England and Wales with respect to the commissioning, storage, management and transfer of natural coastal change information was notable. Initiatives, such as the Cell 11 North West Regional Monitoring Strategy, will collate and provide a central depository for natural coastal change monitoring information and establish a strategy for the North West for future coastal data collection and monitoring activities. This form of information management is lacking in Northern Ireland.

In light of these decision support 'mechanism' findings, the sources of natural coastal change science are distinctly different. In Northern Ireland, it is proposed that due to an absence of formal 'decision support' mechanisms and the applied nature of research undertaken at the University of Ulster, a greater transfer occurs between academically based coastal research and decision making. With only limited similar instances within the North West, the predominant source of natural coastal change science is commercially produced by consultancies. This science is, therefore, tailored for the clients or 'end-users' *i.e.* local government, suggesting that public sector decision makers favour commercially produced science. Further research could investigate this aspect and examine influences upon the scientific community, particularly for those involved in academic research programmes that have potential application for management that may not be reaching the desired end-users.

Furthermore, within North West local government, planning and engineering engagement practices, which develop professional relationships and trust, were found to encourage a greater transfer of knowledge and understanding of local natural coastal change. A number of instances were identified in which planners have actively approached in-house coastal engineers for relevant information and input into planning matters, due to the existence of personal relationships. This process is based upon trust in the sources of scientific information, and again raises issues noted previously. These activities, however, were limited, and are strained by workloads. This is particularly so in England and Wales due to the downscaling of Local Authority engineering departments. However, this highlights the use of professional coastal expertise and advice on coastal matters to support the work of planners in both their day-to-day work dealing with development control and the development of planning policy.

In light of findings from interviews with planners and reviews of planning documents, it is proposed that coastal planning does not utilise the available natural coastal change evidence base sufficiently to benefit decision making. It is proposed that coastal hazards and risk mapping needs to be better incorporated into planning and that there needs to be a stronger interface between planning and engineering. It should be recognised that the incorporation of natural coastal change science is necessary for coastal planning. In Northern Ireland, a more strategic and integrated approach to coastal risk is required for the sustainable development of vulnerable coastal areas. To assist this, it is suggested that there needs to be greater investment in the natural coastal change evidence base, for example, the stocktaking of coastal defences around the whole coast and the identification of coastal sediment cells. An important component could be the development of a central depository for the storage and management of natural coastal change information, which is publicly available.

Case Study Three 'Review of SMPs' found that whilst the various iterations of government guidance for SMP development emphasise the importance of a scientific basis for decision making (Section 6.2.1), the majority of SCDOs coastal defence policy recommendations had limited or no visible scientific evidence base. For example, it revealed that it was not possible with the reviewed SCDOs to determine where expert opinion on natural coastal change had been used (Section 6.5.1).

In summary these findings confirm the general finding of the current body of knowledge that regard science as a vital part of decision making (Section 2.1). However, it has been found that information does not adequately inform decision making because of the science-practice disconnect (Section 2.3). The operational implications of this were found to be decision making processes that are not strongly supported by natural coastal change scientific information.

8.3 Contributions of this research

The research pathway was specifically designed to reflect the requirements of the investigative line of the aim and objectives of the thesis. The contribution of each Research Strategy Pathway component (Figure 3.2) will now be examined.

- *Literature Review:*

The broad scope of the Literature Review (Chapter Two) encompassed a number of disciplines and contexts and served multiple functions. These included creating a strong understanding of the current thinking within the literature, for example, on coastal risk management practices, coastal and environmental management, decision literature and policy research. This facilitated the development of working definitions for key thesis terms, *i.e.* science and decision making. Lastly, and importantly to the thesis, a number of literature gaps were identified that this research, within the scope of the aim and objectives, has sought to address. These include most notably, a lack of coastal-specific conceptualisations of decision making and mechanisms by which to assess the role of science within decision making.

- *Theory Construction*:

The process of constructing the Research Strategy Model and Empirical Indicators integrated, for the first time, current thinking within the literature on numerous aspects of both decision making and policy making into one single integrated theory (Chapter Three). This theoretical analysis provided strong foundations for the data generation process and for explaining empirical findings within a coherent and structured framework. As such, it avoided a 'data dredging' research exercise and sought to add-value to existing coastal research; for example, Pettit (1993) and Potts (1999a). Empirical data were evaluated in relation to the current understanding and review of the literature from coastal and wider disciplines, *e.g.* decision theory literature and the coastal management field.

- *Data Generation*:

The implementation of the multiple case study approach, encompassing three case studies, did not attempt to record all coastal risk decisions. Instead, the design of two novel and contrasting methods to explore coastal risk decision making was considered as being a strategic and rational approach to the collation of primary data, which explicitly addressed the two objectives of the thesis (Section 8.2). This facilitated a greater range of localities, contexts and coastal risk decision examples to be investigated. Primary data were generated in Case Studies One and Two (Chapters Four and Five) *via* semi-structured interview schedules and documentary reviews, whilst Case Study Three (Chapter Six) used a documentary-based review.

The Data Generation component makes a number of contributions. Firstly, the empirical findings provide greater understanding of the decision making situation and context within which coastal risk decision makers operate in England, Wales and Northern Ireland. Secondly, findings offer insight into the role of natural coastal change information within coastal risk decision making. In combination, a strong picture was generated of the complexities of coastal risk decision making within the localities studied.

- *Theory vs. Practice:*

The development of the case study selection hypothesis integrated theories concerning aspects of decision making and information support identified within the Literature Review (Section 2.5.3). This process is considered an original way of selecting potential constructive, valuable and justifiable case study 'test-sites' to explore aspects of coastal risk decision making. Furthermore, the comparison of empirical findings in relation to the hypothesis added to the data analysis process, by placing these within a wider theoretical context (Section 7.2).

- *Theory Reconstruction*:

Whilst not a aim or objective of the thesis, the development of a coastal risk decision making conceptualisation provides a theoretical understanding that aids the communication of complex constructs (Section 7.4). It conveys that coastal risk decisions do not occur in isolation, but instead decisions are framed by hierarchical legislation and policy, and connected to and shaped by past decisions, present needs and desires (Figure 7.3). The intent of this research output has been to promote a more in-depth understanding of coastal risk decision making in the England, Wales and Northern Ireland. In doing so, this thesis has contributed to the coastal risk-related literature, decision research and offers potential to the coastal management field.

8.4 Future research pathways

The boundaries of this research were deliberately chosen to focus the scope of the research and to validate the stated aim and objectives. However, as this study concentrated upon theory development, future studies may further test empirically, modify and strengthen this theory. Accordingly it is suggested that the conceptualisation of coastal risk decision making and supporting Empirical Indicators (Section 7.4) be applied to empirical studies of coastal risk in different localities than used by previous RSM-based investigations. This would explore whether or not the new model is applicable only to the context in which it was developed, *i.e.* coastal risk management in England, Wales and Northern Ireland. This section now considers potential future research pathways divided between the two investigative lines of the case study approach.

The first suggested areas for further investigation relate to the geographical Case Studies. As identified in Section 3.6.2, geographical limitations resulted in only partial UK coverage of the research. The application of the RSM and EIs, or indeed the new conceptualisation, to Scotland, the North East and Southern England would give a stronger UK-wide picture. In particular, widening the geographic boundaries would introduce other coastal systems facing a number of contrasting pressures and coastal hazards (such as the soft glacial cliffs, and the Fens). To further increase confidence in the results, it is suggested that a larger sample of decision making pathways be investigated at the three decision making tiers (Strategic, Tactical and Operational). Additionally, there could be widening of semi-structured interview schedule to include:

- Local Authority development control planners;
- Environment Agency planning liaison officers;
- A greater number of natural coastal change-scientific researchers and academics and
- A focus group with central government representatives *e.g.* Defra and WAG, and subsequent analysis of the differing perspectives of these.

Furthermore, increasing the number of detailed site specific examples, similar to the Ocean Plaza and Portballintrae developments, may reveal interesting findings.

With respect to Case Study Three, the further application of the devised survey instruments to a greater number of SMPs is suggested, for example representative SMPs from all eleven coastal sediment cells in England and Wales. Additionally, there is further scope for the diversification of this documentary-based review to other natural coastal change-related planning documents, for example, Catchment Flood Management Plans, and potentially to wider-environmental plans such as River Basin Management Plans. This would increase understanding concerning the application of natural coastal change scientific evidence within important coastal risk decision making mechanisms in the UK.

The science-policy issues that have been examined in the thesis with respect to coastal risk should not be viewed in isolation from those within other coastal and marine sectors. There is much scope to investigate and compare those associated with, for example, the fisheries industry that exhibits parallels in light of significant scientific uncertainties (Daw and Gray, 2005). This future research might identify transferable areas of best practice and lessons learnt.

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Appendix A1

Case Study One Semi-Structured Interview Schedule Documentation

Induction Correspondence: Research Brief
Interview Questions: Local Authority Planner
Interview Questions: Local Authority Engineer
Interview Questions: Consultants
Interview Questions: Natural England
Interview Questions: Environment Agency
Interview Questions: Coastal Group Chairs
Interview Questions: North West Regional Assembly
Interview Questions: Higher Education
Interviewee Profiles

CARDIFF UNIVERSITY PRIFYSGOL CAERDYDD

THE CROWN ESTATE

Research Brief:
"An examination of coastal risk decision making in England, Wales and Northern Ireland"

Wendy Dodds, School of Earth, Ocean and Planetary Sciences, Cardiff University, Wales, UK

Research Aims & Objectives:

This doctoral research project is supervised by Cardiff University's School of Earth, Ocean and Planetary Sciences and is part funded by the Crown Estate and the Countryside Council for Wales. The overarching aim of the research is to examine the role of science within coastal decision making.

Flood and Coastal Erosion Risk Management (F&CERM) is an important activity on the coast which interfaces with several other coastal activities and sectors, for example, development control, leisure and recreation and nature conservation. Underpinning the decision making within F&CERM are the principles of sound science and good governance; it is for these reasons that this area has been chosen to provide a focal point for the research. This research uses F&CERM to explore coastal decision making processes, including prominent issues in regards to the way in which scientific information, evidence and advice is utilised.

The research project is utilising two case study areas: the North West of England and Wales (extending from Great Orme, Llandudno to the Solway Firth) and Northern Ireland. More specific objectives of the research related to North West case study include:

An examination of the interface between F&CERM and coastal development, this includes identifying and examining:

- F&CERM activities being undertaken by various organisations and bodies
- Local Authority management practices in relation to their coastal frontages
- Local Authority approaches towards natural coastal change information management and integration
- Shoreline Management Plan documents and policies
- Coastal planning authorities development plan documents within the North West
- Networks of coastal research scientists in the North West

Research Methods:

The methods that will be utilised to collect the above information include:

- A desktop review of key documents and publications, such as, government policy documents relating to coastal planning, flood risk management and shoreline management. Additional documents that may assist and further this review may be requested, either prior to the interview or after.
- A series of semi-structured interviews with selected stakeholders and actors from within selected Case Study areas. This is where your participation through sharing knowledge, experience and views plays an important part of my data collection process.

I am relying on you sharing your knowledge, experience and personal views with me. There are no correct or incorrect answers in this interview. The interview should take approximately 45mins – 1hr. I will be making notes during our discussion, however, I would like your permission to tape record the interview; this is to provide me with the opportunity to go over our discussion at a later stage and make sure that I have correctly noted and interpreted your comments and our discussion. All information gathered will be handled with confidentiality; care will be taken so that personal views cannot be attributed to you or your organisation.

Wendy Dodds, Doctoral Researcher
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Interview Questions: Local Authority Planner (Planning Policy)

Personal:

How long has the interviewee been with the LA? E.g. 1-5 years
Determine what their coastal defence remit within the authority is? e.g. development control, 1/5 of their role deals with development proposals in the coastal zone
What is their training and qualification background? E.g. certified with RTPI and undertaken CPD e.g. flood defence foundation course
What is their experience in coastal defence /shorefront planning (regeneration projects, planning applications)? e.g. redevelopment of a brownfield site, different scales of project
What is their experience in flood risk planning and management? e.g. development of policies for UDP
Who do they report to? e.g. Director of Planning
Were they involved in any way with SMP1? E.g. yes / no, if yes, at what stage of the process, in what capacity

Local Authority Context:

Length of coastal frontage? Habitats? Nature conservation designations? Land owners?
Coastal frontage usage? E.g. recreation/*residential, infrastructure, business, tourist facilities*
Structure of the planning department within the authority
How is work on coastal issues organised with their department?

Land Use Planning Policy and shoreline management planning:

Is the coastal zone defined by the authority and or are they aware of the boundaries? E.g. "area of land that extends from MLW up to 2-3kms inshore"
Awareness of shoreline management planning as a LA activity, how peripheral an activity? e.g. High, moderate, low, (capital schemes and operational revenue)
Are they familiar with the content of the authorities HLT1 policy statement? e.g. yes/no, involved in drafting it, was it formally adopted by the council?
How is this used / implemented? e.g. do they use it as a guidance tool in conjunction with UDP policies relating to coastal defence and flood risk
How will current UDP policies relating to coastal defence and flood risk be transferred into the LDF? e.g. straight lifting of policies or will policies be reviewed in light of best practice, lessons learnt, would HLT1 policies on flood and coast be written in
How will SMP2 / Strategic Flood Risk Assessment / or river catchment plans policies be fed into the next LDF core strategy? e.g. will the LDF assimilate these policies into the LDF or would they remain external and used as guidance in addition to the LDF
Do they know if the Annual Monitoring Report (as part of the LDF portfolio) will deal with any matters related to flood and coastal erosion risk management? e.g. numbers of planning applications that were ranted in he coastal zone against the advice of the Environment Agency
Is the LA involved in any coastal management-related initiatives or partnerships?
e.g. does the LA fund any voluntary coastal partnership initiatives

Interface with engineering and information issues

What types and levels of natural coastal change information for F&CERM do they, as planners, need? e.g. coastal evolution map with indicative lines showing scenarios of change, climate change impact predictions
Where is this information sourced? e.g. In-house (electronic data set provided by LA engineers, non-technical documents prepared by engineers, verbal advice from engineers) consultants (have they commissioned any)
How do they deal with the integration of different information sets / are they using any data management systems such as Northgate M3? e.g. coastal characteristics (physical and environmental resources), social data, economic and financial data, legislation, conservation and heritage issues
How do they deal with uncertainty or gaps in natural coastal change information? e.g. awareness of uncertainty and risk, adoption of precautionary principle
Have there been any cases where a planning application in the coastal zone has highlighted a lack of knowledge/expertise either within the authority or EA? If yes, was the precautionary principle applied, was permission granted?
Do they utilise the precautionary principle when dealing with aspects of strategic planning in the coastal zone? e.g. development of policies which advise the use of this principle, such as "where a development proposal would have a significant and uncertain environmental impact it should be refused in the absence of information which proves beyond doubt that the impact can be negated or mitigated"
Are they aware of what protection schemes the authority has in place? e.g. examples
Do they understand the levels of protection that certain defence measure affords, are they able to determine if the risk of flooding is low (e.g. 1 in 200 yr event)?

What forms and levels does the planning dept engage with the engineering dept on the matter of flood risk and coastal erosion? e.g. do they seek advice from coastal engineers within their LA on planning applications in the coastal zone? What mechanisms for communication and collaboration, frequency of this liaison?
Are they satisfied with the levels of planner-engineer interaction? e.g. close, effective, limited, poor, satisfactory when necessary, needs improvement, why? e.g. a history of working together, person and situation dependent
Are they satisfied with the levels of communication between strategic/forward planning and development control within the authority? e.g. close, effective, limited, poor, satisfactory when necessary, needs improvement, why? e.g. a history of working together, person and situation dependent
Are they satisfied with the capacity of their team to deal with flood and coastal erosion risk management? e.g. adequate resources (financial and social)

Interview Questions: Local Authority Engineer

Personal Background

What is their training? e.g. civil engineer (geotechnical)
What is their involvement with the Coastal Group? e.g. how long have they been on the group
What experience do they have with coastal engineering projects? E.g. site work, monitoring, modelling, scheme commissioning and overseeing
Were they involved in SMP1? E.g. strong familiarity with content and coastal issues, where they involved in dealing with the consultants
What level of seniority do they have? e.g. how many levels down from the director are they?

Local Authority Context

Where is the engineering component of the LA contained? e.g. Technical Services
Level of coastal defence activity (schemes and maintenance)?
Is there a coastal defence team within the LA? E.g. how many staff (FT equiv.) work on coastal defence
Do they have any coastal defence along the coastal frontage? Who owns/ has responsibility / maintains? E.g. two sea defences, one owned by EA and the other a private landowner, LA carries out monitoring of the sites via consultants
Patterns of use of consultants for coastal engineering projects? E.g. High levels of outsourcing, frequency, good relationship with consultant

Natural Coastal Change Science Information base

Where is natural coastal change information (coastal forcing, coastal response, coastal characteristic, economics) sourced? E.g. by the authority, commissioned (consultants, other LAs), supplied by the EA, CEH, Met Office, percentages to indicate this
Do they carry out any monitoring of coastal forcing and coastal response? Yes/No, how, how long, frequency? in house /external? E.g. annual dune surveys done in-house
How do they store their natural coastal change information? What data management system do they have in place? E.g. digital format, central computer, backed up, a database maintained by an in-house information officer
How do they QA their data standards? Metadata procedures, ground truthing, EMS, confidence levels,
How do they share data? E.g. how do they deal with limitations, how do they communicate this
How confident are they in their information base for dealing with natural coastal change (and climate change over the next 100 years – as required by SMP2 guidance? E.g. how will they use and create coastal evolution information for management
Do they utilise the precautionary principle when forecasting coastal evolution? Yes/no, if yes is this personal preference or does the LA have a policy on this
Do they use FutureCoast study? When was the last time? Frequency, for what purposes, how useful e.g. for detailed local scale / site specific?
Level of appliance of HLT2- NFCDD? All data requirements met for this HLT2(a-d)?
Learn from lessons learnt and best practice? e.g. do they and if yes how

What level of political support is there within the LA for SMP2? E.g. Strong support by technical officers and their elected members, not significant buy-in from elected members
Will they adopt the plan and make it LA policy and fund its implementation (using grant aid etc from Defra and EA)?

Interface with planning

What forms and levels does the planning dept engage with the engineering dept on the matter of flood risk and coastal erosion? e.g. what mechanisms for communication and collaboration, frequency of this liaison?
Are they satisfied with the levels of planner-engineer interaction? E.g. close, effective, limited, poor, satisfactory when necessary, needs improvement why? e.g. a history of working together, person and situation dependent
Do they understand the needs of planners and what do they perceive this to be? If yes, how, if no, why not
How do they advise planners on matters of flood risk and coastal erosion? E.g. briefing documents / non-technical briefing documents, consultations on planning documents, frequency
Are they satisfied with planners' awareness of coastal defence issues and flood risk? E.g. poor, satisfactory, good, reasons for this
Are they satisfied with the capacity of their team to deal with flood and coastal erosion risk management? e.g. adequate resources (financial and social)

Interview Questions: Consultants (NW Coastal Engineering Consultancies)

Personal background

What is their training? E.g. civil engineer
What type of work were they engaged in with before working with this consultancy?
E.g. Local Authority Officer, Environment Agency, another consultancy
What is their role within the consultancy? E.g. liaising with clients on project design, hand on data collection, modelling, management consideration
How long have they been with this consultancy?

Consultancy background

How long has the consultancy been in operation?
How many members of staff are employed?
How many FTE coastal staff are there within this consultancy firm?
Is this consultancy on the EA's Assessed List of Survey Contractors?
Is the coastal service the core service offered by the consultancy or is it one branch of a wider set of services offered?
Could they indicate the types of coastal services that they provide, e.g. carrying out topographic surveys, visual inspections, management advice
When dealing with project and the management of project, does the consultancy use any ISO QA procedures (ISO 9001 Quality Management System)

Shoreline Management Planning

Was this consultancy firm involved in SMP1? If not, did they tender for SMP1, do they know why they didn't get the project?
Have they tendered for the SMP2?

SMP1 Consultants

Previous experience in the preparation of beach/coastal management plans?
How was the shopping list of information to be collated for each sub cell decided? e.g. lead by consultant or by the client/ Local Authority
Was any primary information collected/undertaken for the SMP at the request of the client?
What were the main sources of information? e.g. EA / LA (which depts)/ Met Office/ Ordnance Survey
Where there issues arising from this? e.g. access issues, QA of standards, costs
How was information assimilated? e.g. GIS developed for storage and analysis
Accessibility- was there an explicit discussion about the ownership of the SMP1 data and information that was collated?

How were issues such as gaps in data and lack of resources to undertake research dealt with? e.g. acknowledged and recommendation of future studies and monitoring put into the SMP plan
How were uncertainties in data sets dealt with? e.g. use of confidence intervals stated

Data and information handover- what was handed over to the clients for each of the sub cells when the plans were completed? e.g. each local Authority presented with raw data sets or the hard copy's of the plan

Has a database of SMP1 information been maintained and added to over the years?
Have any of the data sets from SMP1 been digitised?
How do they perceive that have things changed since SMP1 with regards to dealing with uncertainty and confidence in the evidence base? E.g. now with clients there is always an explicit discussion on this issue

Are they aware of how SMP1 and its outputs e.g. management recommendations, were input/integrated into the Land Use Planning system?

Client base of the consultancy firm
What types of clients does this consultancy have in the North West? e.g. Local Authorities, EA
How significant in financial terms and in the numbers of projects awarded are North West Local Authorities? e.g. they represent a large proportion of the client base, consultancy regularly tenders for coastal Local Authority work
Has this always been the case? E.g. has the level of coastal-related work form Local Authorities been increasing or is it ad hoc and fluctuates yearly

Using the scale provided, are they able to indicate the types of Local Authorities clients that they deal with
A weak client = consultancy provides not only technical guidance but strong steerage/guidance on the process/ designing the project brief, client is dependent on consultancy to advise them on what can be done, no in-house coastal expertise
B moderate client = client has previous experience of tendering coastal projects, client mainly needs technical guidance and outputs
C strong client = consultancy takes the lead from the authority, no steerage on project development or technical outputs, potentially the client could do the project in-house but doesn't not have the time to do it

Are they considered to be a resident consultant for any organisations or groups in the North West? e.g. Coastal Group or Local Authority
If so, how long, does this trust relationship affect the formality of project briefs?
If so, do you re-use data sets
How is this term 'resident' defined? contractually, length of time supplying services, length of time

Legislation and Management

Do they offer guidance or training to clients on the planning system or other statutory requirements such as EU Directives? e.g. the requirements of the SFRA for PPS25
How do they keep up to speed on changes such as new legislation or planning procedures? e.g. CPD training e.g. attending Defra conferences

Interview Questions: Natural England

Personal

What is their personal background / personal training? E.g. ecologist
How long have they been with EN/NE?
What is their current role within NE?
How much of work is coastal-related? E.g. 50% or 1 day a week on average

Natural England coastal policies

What policies direct NE's coastal work? E.g. EN 'Our Coast and Seas' 2005, others more regionally or locally e.g. Sefton Coast Nature Conservation Strategy?
Scale of nature conservation that is coastal in the North West? e.g. how many SAC, SSSI, designated areas that are coastal in the North West?

SMP-specific

Personal involvement with SMPs? E.g. were they involved in SMP1, what capacity, what stage etc
What involvement so far in SMP2? Steering group member, which sub-cell?
How is NE coordinating its involvement with SMP2? e.g. NE representation on the 3 Coastal Groups across the North West
How are NE through the SMP process going to be advocating management as opposed to defence? E.g. identifying potential sites for other then HTL

Other coastal decision making engagement with others in the North West

What other forms are they engaged? E.g. LA legally consulting NE under Habitats Regs's, evidence base used for this? data sets vs local expertise

Natural Coastal Change Information Science

What coastal (natural coastal change) - related research in the North West is NE undertaking? e.g. topographic surveys, hydrology, sediment movement analysis, is research done site specific
Is this research being done in house or external or in partnership with other organisations? (being coordinated through Nature Conservation Strategy)
Use of consultants and outsourcing? Which consultants, frequency of usage? Standard procurement process
Sharing of this research and information? Levels (e.g. often requested, if so by who, LA's)? e.g. promotion of coastal related studies funded by NE to Local Authorities
What areas are they strongest in? (hydrology/coastal BAP species/ biodiversity) and weakest? (coastal processes evolution)
Promotion to public of coastal science? E.g. role of certain habitats and species in coast protection
Confidence in NE's evidence base to deal with advising on coastal evolution based on evidence base and knowledge and understanding?
Frequency and types of consultations? E.g. planning, habitat designations
How are they working with local authorities with regards to the evidence base for erosion-risk management?

Interview Questions: Environment Agency (Flood Risk)

Personal

What is their personal background / personal training? E.g. ecologist
How long have they been with EA?
What is their current role within EA?
How much of work is coastal-related? E.g. 50% or 1 day a week on average

Flood Defence Activities

Indication of EA flood defence (sea not fluvial) that the EA has in place in the area? e.g. in the North area xxxkm of
How often are the inspected/monitored and by whom? e.g. annual inspections done by consultants
Do they inform others of defence works that they carry out? e.g. informing Local Authorities when they are carrying out works

North West Regional Flood Defence Committee

Do you attend the North West RFDC meetings? If yes, in what capacity e.g. representing the central area
How does the North West Regional Flood Risk Manager communicate with the Area Flood Risk Managers? E.g. regular face to face meetings, regular email contact, pre RFDC meetings
Are they aware of how local councillors who attend the RFDC meetings report back to technical officers within their Local Authorities?
Are they aware of linkages / communication between the North West of England RFDC and the Flood Risk Management Committee in Wales?
What is the flood risk management budget and levy for the North West for 2007/2008?
What is the capital programme of flood risk management works for 2007/2008?
Has there been a positive record of the RFDC approving these budgets and levy proposals?
Has the North West RFDC met to discuss the integration of coastal erosion (role and membership)?
What are the possible changes in the North West from the proposed streamlining of coastal groups under the EA's Strategic Overview? E.g. one coastal group at the same level and geographic size as the North West RFDC
Do they feel that the EA in the North West has the capacity to deal with coast protection if they are given Strategic Overview? E.g. staff with technical expertise, staff with the time to undertake these roles and duties

Natural Coastal Change Information Science

How long have they had a survey archivist in place (responsible for retaining survey information and supplying data on request)?
How useful/ valuable are the flood risk maps to decision makers which ignore the presence of defences? e.g. raise awareness of Local Authority planners, developers and the public of flood risk

Why is this the case? E.g. why don't they show EA defences as this information is known
What climate change scenarios are they using? e.g. Defra guidance, Foresight Future Flooding?
How do the EA deal with the uncertainties of climate change?
How do they communicate this? E.g. how do they show/reflect uncertainties in flood risk maps

NFCDD

Is NFCDD HLT2 appliance by Local Authorities being overseen centrally by EA or at the regional level?
What stage is NFCDD at in the North West?
What issues or problems have they encountered with NFCDD?
How are they going to deal with those Local Authorities who do not have the capacity (technical expertise, time, financial resources) to deal with NFCDD?
How do they feel that NFCDD will add value to their work in the area/ North West region as a whole?
Do they feel that NFCDD will be used by Local Authorities?

Other

Do they feel that SMP2 will introduce sound sustainable coastal policies to be followed by Local Authorities? E.g. will Local Authorities make sustainable coastal defence options and consider fully options such as managed realignment or will they continue to advocate hold the line and not identify areas of relocation of uses within flood zones
Are there plans for a CHaMP for the North West in a similar vein as the the Severn Estuary CHaMP?
How are they working with Local Authorities to improve flood warning systems and strategies
How are they encouraging Local Authority's to develop SFRA's?
Do they have any indication of the numbers of exception tests that will be submitted under PPS25 (to allow development in Flood Zone 3 e.g. areas in Wyre and Conwy)?
How are SFRA and CFMPs being coordinated? e.g. is there not some overlap in both undertaking and collecting up data on flood risks and making assessment of flood risk (probability and consequences)
As SFRAs are being done by consultants for Local Authorities, is the science and technical understanding of flood risk really being integrated into the planning system? (cheap way to get them done, e.g. make LA's pay and then used by EA)
If the North West has SFRAs and CFMPs and SMPs is it likely that new plans would be needed under the EU Floods Directive?

Consultants

How often on flood risk management projects do contract out work to private companies? e.g. regular, ad hoc, infrequently
If so, what types of work (studies, modelling, inspections)
Rough indication of expenditure on consultants for flood risk management in their area
When was the Assessed List of Survey Contractors drawn up?
How many are based/ situated within the North West?

Are they aware that the general pattern of usage of consultants by Local Authorities is in fact occurring due to following the lead taken by EA?

Interview Questions: NW Coastal Group Chairs

Personal
What is their background and training? e.g. trained civil engineer, how long in coastal
How long have they been involved with the Coastal Group?
How long have they been Chair?

Coastal Sediment Cell 11
Overview of the diversity amongst the sub –cells? – geographically
Overview of the diversity amongst the sub –cells? skills capacity

Activities of the Coastal Group
SMP1

What was the procurement process for SMP1? E.g. detailed project brief sent to a number of engineering consultants, expressions of interest or tender received, shortlist drawn up…, xxx consultant commissioned for stage 1 and stage 2 of process, handover of data sets by consultants
How has the group reviewed their first SMP production experience to inform their SMP2 development? E.g. consultants will not be collecting new data, the consultants will be responsible for the consultation process
Has the group considered MAFFs review of SMP1s to identify lessons learnt that can be taken onboard for SMP2? E.g. has there been an explicit discussion on the reviews findings
Has the group looked at other SMP2 experiences? E.g. looking at the Defra's results of the pilots, has meetings with other coastal groups that have done their second SMP
For SMP1 what was the level of support from LA like? E.g. politically amongst elected members, financially
For SMP2, what strategies have you in place to increase the involvement of planners
For SMP2, what strategies have you in place to increase the involvement/awareness/buy-in of elected members? E.g. communication strategy,
What monitoring of SMP1 was carried out? E.g. of the process, the outcomes, the outputs

Interface with planning and other activities

How will the SMP be integrated into the RSS (that is currently in draft form) and how will RSS be integrated into the SMP?
How will Strategic Flood Risk Assessments be considered within SMP2?
How will Catchment Flood Management Plans be considered?

SMP2

What procurement process is planned for SMP2?
Who will be the lead authority for SMP2?
Confidence in the evidence base available to Coastal Group members to take forward and implement the policies in SMP2 that are forecasted for the next 100 years?
Will they be commissioning any data gathering? Or will it be data collation and assimilation by the consultants?

Interview Questions: North West Regional Assembly

Personal Background

What is their role within the North West Regional Assembly?
What is their training and background?
How much of their time to their post is spent on coastal-related matters?

Policy Development

Is there a planning officer who deals exclusively or has responsibility for environment or coast-related policies within the draft RSS?
What was the process of translating the coastal-related policies in RPG13 into (Policy RDf4- The Coast) into the Draft RSS? E.g. was there dialogue and debate with NWCF or GONW or Local Authorities?
There a number of supporting documents listed as footnotes, was any information or evidence commissioned to support the coastal policies in the draft RSS?

Implementation

How do they check / monitor the level of regard given to the RSS within the proposed core strategies of the LDF's?
How does the draft RSS facilitate the coordination and harmonisation between LDF and other coastal-related plans?
How will the NWRA promote integrated planning and management on the ground? E.g. how will they seek to balance areas of intense development, regeneration and urbanisation along with areas of a sensitive environmental nature such as the Dee Estuary
The role of partnerships in the coastal management of the North West is cited frequently, how do these non-statutory partnership have influence in promoting sustainable development in relation to the local planning (policy and development control) being undertaken by Local Planning Authorities and the NWRA (as the regional planning body)
Is the wording in the RSS on flood and coastal erosion risk management strong enough to move the tendency away from continual hard coastal engineering defence strategies?

Natural Coastal Change Information Science

Has the NWRA been involved in the North West Coastal Group's Cell 11 Regional Monitoring Strategy?
Confidence in the numerous coastal-related plans strategies such as SMP2's, CFMP's for the North West to deliver a sustainable coastline/coast?
The Draft RSS explicitly mentions climate change e.g. the implications for the coast of the North West the need to adapt and mitigate, what is the evidence base driving this? e.g. foresight report, stern report,
Precautionary Principle? Uncertainty? Do they have any advice for Local Authorities in who are being advised to consider coastal risk management on a 100yr scale
What is their engagement in SMP2's? e.g. one rep for each cell or each Coastal Group, How have they found engagement in Cell 11a that has a cross national boundary with Wales?

Interview Questions: Higher Education Institution (NW)

Personal

What is their training and background?
How long have they been with the institution?
Have they worked outside academia?
Are they involved in any ICZM groups/networks in the North West? e.g. coastal partnerships
Are they involved in any conservation groups/networks in the North West?
Are they involved in any FCERM-related groups/networks in the North West?
Do they attend North-West based coastal meetings/workshops/conferences?
Do they attend or present UK coastal conferences?

Specific to Institution

What coastal-related science is undertaken by the institution and by them?
What scale is the research? e.g. staff numbers or cost of projects, 20% of their time spent on research
Of this, what amount is specific to the North West?
How long has the institution been involved in this area of research?
What drives the research programme? E.g. personal interest, departmental objective
How is the research funded? E.g. by the institution, partnership – locally, regionally, EU
Does their science have an audience? E.g. other scientists in their field, the wider coastal community, decision makers in the North West
Do they disseminate their North-West related science in the North West?
Are they approached for coastal data or advice by non-HE institutions?
Do they have any links with any non-HE institutions?

North West

In the North West do specific institutions regarded as being experts in certain areas?
What HE networks exist in the North West?
What mechanisms exist to get science out there in the North West? e.g. the Sefton Coast Partnerships research network and the annual conference
What mechanisms exist to facilitate discussions between policy makers and decision makers in the North West to highlight gaps in data and/ or their understanding or to flag up possible projects that could be undertaken?
Do they feel that there are mechanisms in place that allow their science to accessed by decision makers?
Are there are any areas, specific to the North West, in which they feel are lacking in data or understanding?
Do they feel that Local Authorities in the North West have the knowledge base to take forward FCERM in light of climate change and the extended planning timescales of SMP2s?

Interviewee Code	Interviewee Profile
Planner A	Qualified town planner, currently with authority 16 months, after a gap from planning to raise a family, over 10 years experience
Planner B	Qualified town planner Head of Regeneration Strategy, with current authority 14 years
Planner C	Qualified town planner, MSc, Senior Planner 19 years in local government planning, currently Senior Planner
Planner D	Qualified town planner, Principal Planner Officer, 15 years in local government planning
Planner F	Qualified town planner, over 20 years in local government, previously Bradford (not coastal)
Planner H	Qualified town planner, MSc, Strategic Team Leader, 18 years in local government planning
Planner I	Qualified town planner, 7 years in local government planning, previously consultancy
Planner J	Qualified town planner, 5 years in local government planning, previously development control, now planning policy
Planner K	Qualified town planner, Head of Strategy Planning, 17 years in local government both development control and planning policy
Engineer A	Civil Engineer and Architecture, Principal Engineer, with current authority for 8 ½ years, previously consultancy engineering
Engineer B	No training in engineering, in post 14 months, previously Environment Agency as an Environmental Officer
Engineer C & GC	Civil Engineer, been with authority for 25 years, of which 23 years in coast protection, Chair of North West Coastal Group
Engineer D	Principal Engineer, degree in Land Survey, been in coast protection with authority for 15 years,
Engineer E	Principal Drainage Officer, 10 years in land drainage in authority
Engineer F	Civil Engineer, previously Highways Agency, now 13 years in local government, currently in P
Engineer G	Civil Engineer, 15 years local government Engineers Department, last 4 yrs private consultancy on behalf of authority
Engineer H & GC	Civil Engineer, MSc, coastal defence role in authority for 10 years, Chair of Liverpool Bay Coastal Group
Engineer I	Civil Engineer, MSc, 20 years in local government previously land drainage
Engineer J	Chartered Civil Engineer, 11 years in local government, previously Highways Agency
Engineer K	Civil Engineer, 15 years experience in local government , of which 10 years in Engineering Group
Engineer L & GC	Chair of Tidal Dee Users Group, now private consultant in fisheries, previously with Environment Agency for 26 years
Higher Education	Reader, PhD in Environmental Change,
Statutory Agency A	Flood Risk Management, PhD, been with organisation 2 ¾ years, previously had an academic career
Statutory Agency B	Been with organisation for 5 years -conservation-related work in the region
Statutory Agency C	Been with organisation for 4 years in ICZM
Consultant A	Chartered Civil Engineer, PhD, 19 years in local government, followed by 16 years (and ongoing) in private consultancy
Consultancy B	Civil Engineer, 13 years in local government, followed by 20 years (and ongoing) in private consultancy
Consultancy C	Civil Engineer, MSc, 11 years in private consultancy

Appendix A2

Case Study Two Semi-Structured Interview Schedule Documentation

Telephone Interview Questions: Department of the Environment

Department Background & General Coastal Questions

What divisions do DoE oversee and how is it managed? E.g. are there any cross-departmental working groups between EHS and Planning Service?
Do they liaise with the Planning Service on any strategic planning-related matters?
Who address strategic tourism interests in Northern Ireland? E.g. Planning Service, Local Authorities, DoE
Who writes the Planning Policy Statements? E.g. is it DRD or Planning Service
What are the most significant coastal issues in Northern Ireland? E.g. second homes
Is there a national ICZM strategy or ICZM partnerships?
Are there any national environmental forums in Northern Ireland?
Is there a climate change strategy being developed?

Coastal Defence in Northern Ireland

Which government department or division oversees coastal defence in Northern Ireland? E.g. does any have strategic overview or policy responsibility
As there is no coastal defence legislation in place in Northern Ireland how is coastal defence organised?
Are they aware of how much of the coast is artificially defended?
Are they aware of the coastal hazards and risk along the Northern Ireland coastline?
How confident are they to deal with increasing coastal hazards and their associated risks in Northern Ireland?

Natural Coastal Change Information Science

What types of coastal data sets do they have access to? E.g. cross-department
Where do they source their coastal-related information? e.g. in house / externally
Do they have access to Defra / EA information?
What climate change scenarios are they using? E.g. what sea level rise predictions do ethey use
The EU Floods Directive appears to be acting as a catalyst for developing flood risk mapping? Why? How funded? Who is overseeing this?

Telephone Interview Questions: Rivers Agency

Work areas and responsibility

Coast Protection:
Do they know how much of the NI coastline that receives protection, in addition to the 26km (designated coastal flood protection defences) which the agency is responsible for?
Are they satisfied with the current organisational arrangements that delivers erosion protection based on the coastal assets at risk? (e.g. Roads Service if coastal roads)
Do they have a strategic vision in relation to coast protection? e,g shoreline wide basis?
Has the agency considered the merits of developing Shoreline Management Plans for the NI coast?

Flood Defence:
How does the Agency assess the validity of the flood risk assessments carried submitted with a planning application by a developer?
What functions does the Flood Liaison Group carry out?
Does the agency collaborate with EHS Water Management Unit?
How well placed is the Agency to lead on the implementation of the EU Floods Directive? E.g. development of flood risk maps and flood risk management plans

Linkages with planning and development control

Strategic Planning:
How do they provide development advice to the Planning Service? E.g. how does the Planning Advisory Unit within the Operations Directorate provide advice
How do they provide input into Area Development plans? e.g. Operations Directorate's Planning Advisory Unit provide expert engineering advice or evidence to the Planning Service,

Case by case planning applications:
How do they advice the planning service? e.g. Area offices supply written reports providing evidence and information to support/justify their decision
How many consultations do they receive a year? how is consultation service staffed? E.g central team, what skills do they have e.g. are they engineers, planners, manager
Do they check that their advice has been taken? e.g. if they recommend that the application be turned down but Planning Service give development consent
Are they satisfied with the capacity of their team to deal with planning applications that have potential flood and coastal erosion risks? E.g. Adequate resources, science
How many advisory case files have been issued that relate to flood and coastal erosion risk?

Natural Coastal Change Information Science

What types of natural coastal change information data sets do they work with? (water related- rain fall, abstraction levels, natural environment- hydrology soils, geomorphological related– coastal processes)

How *do they store natural coastal change information? What data management system do they have in place?* E.g. digital format, central computer system within the Development Directorate, backed up?
How do they QA their information base?
How do they pull in information sets from other organisations collecting information e.g. Met Office
How confident are they in their information base for dealing with natural coastal change? E.g. how will they create and used coastal evolution information for informed management
How are they dealing with climate change? E.g. what scenarios are they using for sea level rise?
Are they using a precautionary approach to deal with issues such as uncertainty?
Does the Risk Register contain zones of risk within the flood plain? E.g. such as in TAN 25 in Wales
Do they have plans to make Flood Risk Maps of Northern Ireland available to the public such as in England and Wales via the Environment Agency?
Do they carry out any coastal monitoring of their coastal flood protection defences?

Telephone Interview Questions: Planning Service

Personal

What is their personal background? E.g. RTPI certified planners
How long have the been with the Planning Service?
What is their coastal-related caseload like?

Strategic Planning

What are the planning limits of the Planning Service? E.g. mean low water
How was planning managed in Northern Ireland before the creation of Town & Country Planning System?
What was the role of Local Authorities within the planning system when the Town & Country Planning System was created in 1973?
Are they aware of the amount of coastline that is developed?
Do they know much of the NI coastline receives protection, in addition to the 26km (designated coastal flood protection defences) which the Rivers Agency is responsible for?
Awareness of the number of planning applications which the Rivers Agency has advised against but planning permission granted in the flood plain?
How do they deal with planning applications for coast protection schemes?
Will future Area Development Plans deal with coastal and flood risk?
Within the Northern Ireland ICZM strategy, under SC1.5, there is reference to developing spatial planning approaches – will this be translated with Area Development Plans that have coastal coverage?
Within the Northern Ireland ICZM strategy there is reference to the fact that the development control function of Planning will become part of the Councils under RPA, more info??
For flood risk assessment that are carried out by applicants under PPS15, how do they verify / QA the information supplied as part of this assessment?

Natural Coastal Change Information Science

What natural coastal change information do they hold?
Do they commission research to gather coastal change information?
What natural coastal change information do they need to inform Area Development Plans that have a coastal extent? e.g. coastal evolution map
What natural coastal change information do they need to inform planning applications that have an identified coastal erosion or flood risk implication?
What other data do they use in conjunction with Rivers Agency advice and development policy in relation to the coast? e.g. social, historic environment, economics, historic environment
Are they utilising the precautionary principle/approach in coastal planning applications?
What coastal data sets do they hold, how are they managed? QA'd? gaps?
Do they commission any external consultants to undertake coastal-related research?

Telephone Interview Questions: Local Authorities

Context

Length of coastal frontage? Approx km's
Length owned by the authority? Landward and seaward
Other landowners along the coast? E.g. National Trust, private home owners
Coastal frontage usage? E.g. ½ agriculture, ¼ amenity/residential, ¼ commerce
How are coastal issues organised within the authority? E.g. overseen by Technical Services or Countryside Division

Coast Protection Activity

Any coast protection schemes currently in place along the coast line of the authority? How many, how much roughly in km
Any future plans for schemes in light of sea level rise and climate change threats?
Shoreline management planning as an authority activity? E.g. How peripheral an activity - High, moderate, low priority within the authority
Does the authority have a policy towards coast protection/shoreline management? Yes/no, if yes…
Do they have an engineering dept that carries out consented schemes or do they use contractors, if in house how many staff (FT equiv.), if outside, do they use the same contractors

Natural Coastal Change Information Science

Does the authority need or use any coastal data (natural coastal change information)? E.g. Coastal evolution maps with indicative lines showing scenarios of change, SLR etc
Does the authority gather any coastal data? E.g. Monitoring of schemes in place, coastal forcing and or response, if yes, how, how long collecting, frequency
Does the authority commission coastal research or seek advice on coastal issues? Yes/No If yes, consultancy or local academics
How do they store natural coastal change information? What data management system do they have in place? E.g. Digital format, central computer, backed up, how do they QA their data standards?
Who within the authority uses this information? E.g. which officers e.g. Engineers, beach manager

Land Use Planning System

Have there been any cases where the council has expressed concern over proposed planning applications on the coast but the Planning Service has consented regardless?
Would the authority welcome greater planning control under the RPA?

Telephone Interview Questions: Environment and Heritage Service

Management of the coast

What are the powers and limits *of the EHS in relation to the coast?* E.g. only oversee nature conservation?
How effective have designation such as AONB's in affording protection to part of the Northern Ireland coast?
Are they aware of how much of the Northern Ireland coast receives coastal protection? If not who?
Does EHS have a policy towards coast protection for maintaining protected sites? E.g. do they protect designated sites from coastal flooding and erosion with coast protection schemes? Can they request the Rivers Agency to provide coast protection schemes for designated sites?
How is priority decided upon e.g. sea defences for coastal infrastructure assets Vs. ASSI/ SAC?
Will the seascape assessment consider coast protection schemes around the coast?
How long has EHS's Enforcement Unit been in place?
Has it had to deal with coast protection matters?

Natural Coastal Change Information Science

What types of natural coastal change information does the EHS currently hold?
What approach will they be taking to collect base line coastal data? (ICZM strategy ENV 1.2)
Will this include Flood and Coastal Defence research referred to in the ICZM strategy (SC1.5)? are there plans to invest in software such as FutureCoast?
Will EHS be commissioning this work or undertaking it in-house?
How will they be developing ICZM maps? What will these contain, what format, availability to others

Telephone Interview Questions: Translink

Coast Protection responsibilities

Under the 'Bateman Formula' Translink have responsibility for coastal infrastructure assets, is this a permissive power or a statutory obligation to protect and defend these assets from coastal risk?
What amount of their assets are coastal?
Does Translink have an agency policy on protecting coastal assets? Or are decisions made on a case by case basis?
Do they know how much of the rail network in Northern Ireland is in the coastal zone?
If they are planning on carrying out protection works, who is notified about this?
Do they have to consult any other land owners, site managers or government departments? e.g. if is part of a designated site
Do they prioritise their protection works?
How frequently do they carry out protection works?
Annual expenditure on protection works?
Are there any future plans to reroute any railway lines due to the significantly high risks from flooding and or erosion?
Are they required to report centrally to DofE on works carried out?

Natural Coastal Change Information Science

What natural coastal change information do they hold? What sources (internally and external) and what management systems do they use?
Do they carry out any monitoring of sites suffering coastal erosion or risk?
Do they monitor sites where coast protection works have been put in place?
Do they have a long term policy for dealing with increased coastal risk due to climate change? What climate change projections do they use?
Do they commission natural coastal change information research?

Telephone Interview Questions: Roads Service

Coast Protection responsibilities

Under the 'bateman formula' Roads Service has responsibility for coastal infrastructure assets, is this a permissive power or a statutory obligation to protect and defend these assets from coastal risk?
Do they know how much of the road network is in the coastal zone?
Do they know how much of the road network is at risk from coastal flooding or coastal erosion?
Do they know how much sea defences that the Roads Service currently has in place?
Does the Roads Service have a policy on protecting its coastal assets? Or are decisions made on a case by case basis?
If they are planning on carrying out works, who do they have to notify?
Do you have to consult any other land owners, site managers or government departments? e.g. if is part of a designated site
Do they prioritise their protection works?
How frequently do they carry out protection works?
Annual expenditure on protection works?
Are there any future plans to reroute any coastal roads due to the significantly high risks from flooding and or erosion?

Natural Coastal Change Information Science

What natural coastal change information do they hold? What sources (internally and external) and what management systems do they use?
Do they carry out any monitoring of sites suffering coastal erosion or risk?
Do they monitor sites where coast protection works have been put in place?
Do they have a long term policy for dealing with increased coastal risk due to climate change? What climate change projections do they use?
Do they commission natural coastal change information research?

Telephone Interview Questions: Higher Education

Personal

What is their training and background?
How long have they been with the institution?
Have they worked outside academia?
Are they involved in any ICZM groups/networks in Northern Ireland?
Are they involved in any conservation groups/networks in Northern Ireland?
Are they involved in any FCERM-related groups/networks in Northern Ireland?
Do they attend Northern Ireland-based coastal meetings/workshops/conferences?
Do they attend or present UK coastal conferences or international littoral conferences?

Specific to Institution

What coastal-related science is undertaken by the institution and by them?
What scale is the research? e.g. staff numbers or cost of projects, 20% of their time spent on research
Of this, what amount is specific to Northern Ireland?
How long has the institution been involved in this area of research?
What drives the research programme? E.g. personal interest, departmental objective
How is the research funded? E.g. by the institution, partnership – locally, regionally, EU
Does their science have an audience? E.g. other scientists in their field, the wider coastal community, decision makers in Northern Ireland
Do they disseminate their Northern Ireland-related science in the North West?
Are they approached for coastal data or advice by non-HE institutions? e.g. Local Authorities
Do they have any links with any non-HE institutions? e.g. Local Authorities

Northern Ireland

In Northern Ireland do specific institutions regarded as being experts in certain areas?
What HE networks exist in Northern Ireland?
What mechanisms exist to get science out there in Northern Ireland?
What mechanisms exist to facilitate discussions between policy makers and decision makers in Northern Ireland to highlight gaps in data and/ or their understanding or to flag up possible projects that could be undertaken?
Do they feel that there are mechanisms in place that allow their science to accessed by decision makers?
Are there are any areas, specific to Northern Ireland, in which they feel are lacking in data or understanding?

Interviewee Code	Interviewee Profile
Authority 1	Estates Management personnel
Authority 2	Technical Service personnel
Authority 3	Environmental Education Officer
Authority 4	Countryside Recreation Officer
Authority 5	Technical Services Manager
Authority 6	Biodiversity Officer
Authority 7	Technical Service personnel
Authority 8	Technical Service personnel
Authority 9	Regeneration & Tourism Officer
Government Agency 1	Environmental Policy Officer involved in ICZM
Government Agency 2	Planner, with NI government 12 years
Government Agency 3	Environmental Scientist, flooding and land drainage
Government Agency 4	Civil Engineer
Government Agency 5	Civil Engineer
Government Agency 6	Civil Engineer, Flood Risk Management
Academic 1	Professor in Coastal Studies
Academic 2	Lecturer in Coastal Studies

Appendix A3

Case Studies One and Two Planning Document Review Proforma

Proforma -Audit & Review of Planning Documents

===

Name of Planning Body:

Document title and date:

What stage (e.g. approved, adopted, on deposit, draft):

===

Explicit Policies on:-

- Policies which **restrict development** in areas at **risk** (tidal flooding, coastal instability and coastal erosion)
- Policies relating to the need for coastal defence and land drainage **considerations** to be taken into account for development in areas at **risk**
- Policies which include requirements for measure to **mitigate risk**
- Policies which refer specifically to development which may **interfere** with coastal defence work
- Policies which **relate directly** to **proposed coastal defence work**
- Policies which refer to potential **effects** of development on **coastal process**
- Policies which refer to shoreline management plans, catchment flood management plans, coastal habitat management plans

AND / OR policies that refer to:-

- Development and coastal erosion
- Development exacerbating flooding (sea/tidal/river)
- Development in flood risk areas
- Development and coastal / fluvial defences

If Supplementary Planning Guidance exists the above points are to be considered

Other things to be noted:-

- Definition of coastal zone
- Map of coastal zone
- Flood map (indicative flood plain maps)
- Coastal erosion (and erosion risk) maps
- Reference to the Precautionary Principle
- List of supporting technical documents (related to natural coastal change)

Other comments:-

Appendix A4

Case Study Three Review Proforma

Preliminary Assessment Proforma
SCDO Grading Proforma
SCDO Grading Scoring Sheet

Preliminary Assessment Proforma

Plan Overview

State / list the Following:

Coastal Cell Number and location:

SMP Generation Number:

Commissioned Consultant:

Name of Coastal Group:

Lead Local Authority:

List of Local Authorities:

Country:

Dates of Plan (commencement & completion):

Shoreline Divisions:

Document and Volumes Listing:

Comment on the following (if present):

Major Stages of Plan Development:

Size / Scale of coastline (e.g. length in km's):

Dominant geographic coastal characteristics (e.g. estuarine, open coast):

Major strategic coastal issues (e.g. flood risk, coastal erosion):

Adopted:

Regional Observatory or Regional Monitoring in place:

Level of environmental designations:

Coastal Group characteristics:

Other Notes:

Part A: Management Unit Summary (objectives, issues & statutory details)

Issues:

Are coastal issues specific to the management unit relating to coastal processes, natural environment, human and built environment, coastal defence, development presented?

How is this information presented? Tabular form with discursive comments, bullet points, geographical locations given

Is it clear how issues were identified (e.g. contained in tender brief or public consultation)?

Are they referenced to previous Volumes of the plan?

Is it clear how issues are to be considered / carried forward?

Statutory Details:

Are statutory planning policies listed? If yes, what information is presented e.g. plan title, policy numbers, policy content?

What scale are these plans? E.g. local, regional, national

Are non-statutory mgt plans (and their associated policies) made reference to?

Is this section cross-referenced?

Conservation designations:

Are statutory designations identified? types of sites listed e.g. local, national EU

Are non-statutory designations identified? types?

Reference to any possible future designations?

Is this section cross-referenced?

Land ownership / occupation interests:

Does this provide exact details of ownership? e.g. does it indicate management implications and responsibility

Coastal defences:

Current policy stated?

Are existing defences in this management unit presented? If yes, what data is presented? E.g. location, type, defence code, length, standard, operational responsibility, min. residual life, referenced to other Volumes of the plan

Part B: Intervention Appraisal

Shoreline Description

Types of data presented? E.g. geology & geomorphology, level of development, orientation, exposure, defended

Referenced to other Volumes of the Plan?

Land Use information & specific shoreline interests – types of information presented?

Shoreline Evolution

How is information presented? Bullet points, paragraph description, Sub headings

Are the following referred to?

- Geology & evolution
- Coastal processes
- Shoreline movement
- Development at site
- Losses & gains

Referenced to other Volumes of the Plan?

For each bullet point above, please indicate:

- Scale of the data set, has it been taken from a wider data set or is it site specific?
- whether limitations (of data) and uncertainties (in analysis / assessment) is referred to, clearly stated and justified?
- assumptions within the data and knowledge base clearly stated and justified?
- indicate where expert judgement/opinion has been utilised e.g. use of footnotes?

Preliminary Economic Assessment

Asset valuation carried out?

Information presented? Preliminary value of assets at risk, tangible, intangible factors affecting evaluation

Cost implications presented?

Economic viability discussed?

Part C: Strategic Policy Appraisal / Screening

Assessment

How is the appraisal information presented? E.g. tabular, matrix

Are all coastal defence options screened/ assessed? E.g. DN, HT existing L, A existing L, R

Is the following considered for each presented coastal defence option?

Are they cross-referenced to objectives?

- effect on coastal processes? e.g. no change, significant
- implications for coastal defences? e.g. none if retreat, significant if hold the line, very significant if advance the line
- sustainability of the scheme? e.g. positive, negative, unknown
- viability (economic / technical)? e.g. viable, not viable
- implications on adjacent management units? e.g. if hold the line, effects likely and studies to be carried out
- climate change implications? e.g. increased SLR and storminess leading to greater erosion if managed retreat
- effect on development and land use? e.g. if hold the line, would this change land use and allow development to occur or do nothing, which would not allow development
- effect on human and built environment? e.g. if retreat, possible relocation of coastal path

Preferred Policy Option

Preferred/ recommended policy:

Is the following considered:

- existing policy? e.g. short term and long term policies given with timescales
- future policy?
- Implementation & timescales?
- Sustainability & viability of future policy? e.g. funding need to purchase land for retreat
- uncertainties? e.g. sea level rise and increased storminess
- existing monitoring? e.g. yes/no, types
- recommended future studies and monitoring?
- opportunities for environmental enhancement?
- Indicative economic assessment

Part A Assessment

Is the information presented clearly? Tabular form, bullet points, long sentences/ paragraphs

What level of detail is provided? Generic discursive statements, bullet points, site specific descriptive

Is information referenced? Citing technical studies, published studies/papers

Is information cross-referenced? To other volumes of the plan

Are any gaps in evidence base, assumptions and uncertainties in analysis indicated in any of the sections?

Part B Assessment

Is the information presented clearly? Tabular form, bullet points, long sentences/ paragraphs

What level of detail is provided? Generic discursive statements, bullet points, site specific descriptive

Is information referenced? Citing technical studies, published studies/papers

Is information cross-referenced? To other volumes of the plan

Are any gaps in evidence base, assumptions and uncertainties in analysis indicated in any of the sections?

Part C Assessment

Does the matrix and screening assessment clearly point towards and justify the preferred policy option? E.g. concordance with objectives, effects on natural environment, coastal processes, development and land use, adjacent management units

Overall Assessment

Does the strategic coastal defence option have a logical structure with a good presentation and layout?

Is it clear where the information presented has derived from? E.g. consultant's knowledge, published studies

Can the information presented be traced to other parts of the plan, e.g. data collation Volumes of the plan

Does it appear that the data collated has been adequately incorporated into the relevant sections?

Are parts A and B similar in information content and presentation?

Assessment Scoring System

A -Strong scientific evidence base that is transparent and supported: Information is well presented, well organised, information is comprehensive, site specific and articulate, explicit reference made to assumptions, limitations and uncertainties, appropriate level of information provided, referenced and cross-referenced. The Strategic Coastal Defence Option exercise could not have been done without the Data Collation exercise of the SMP process.

B -Limited amount of transparent scientific underpinning: Information is presented well, limited amount of detailed site specific information, some sections refer to limited information and understanding that is balanced by the provision in relevant sections of future monitoring and studies information.

C - No visible scientific evidence base and underpinning: Information provided is brief, very generic, not referenced or cross-referenced, no reference made assumptions, limitations and uncertainties, the sources of the information used is not clear, this section could have been written without the data collation exercise of the SMP process

Allocated Score:
Justification:

Additional Comments:

Assessment Guidelines

Data Content & Coverage: range/type of data sets / depth / detail / temporal & spatial

Presentation & Synthesis: clear / well structured / logical presentation & organisation / tables / bullets / lists / maps / wordy paragraphs

Traceability: cross – referencing to other volumes / stages of the SMP

Scrutiny & Quality Assurance: reference to gaps/ uncertainties in data & understanding

Scoring Assessment

Data Content & Coverage:

0 - Very generic brief statements which are often not site specific to the SCDO.
1 - Variable, some sections detailed and site specific; along with some sections that are scarcely populated.
2 – Extensive range of data and information presented. Good level of site detail.

Presentation & Synthesis:

0 – Presentation of lists, numbered points and bullets points with no analysis, integration or synthesis. Use of large paragraphs of text.

1 – Mixture including lists and bullets, often very short descriptive text.

2 – Good presentation of data using tables, matrix. Concise, relevant, organised and structured SCDO. Maps presented in the SCDO are integrated.

Traceability:

0 -No cross-referencing.
1- Limited amounts of cross – referencing.
2- Most sections of the SCDO are cross referenced to various other sections or volumes of the plan.

Scrutiny & Quality Assurance:

0 - No referencing or use of scientific citations within the SCDO. No attempts to indicate data gaps and uncertainties within any sections.
1 –Gaps and uncertainties indicated in some sections. Future studies and monitoring indicated.
2 – Explicit reference made to areas of uncertainty and limitations. Sources of information cited / referenced in relevant sections.

SCDO Grading Proforma Plan ID:		Data Content & Coverage	Presentation & Synthesis	Traceability	Scrutiny & Quality Assurance
Management Unit Details	Statutory Details				
	Shoreline Description/ Evolution				
	Coastal Defence				
	Consultation				
	Land Ownership				
Intervention Screening Appraisal	Policy Screening				
	Future Monitoring & /or Studies				
	Individual Score				
	Weighted Score				
	Total Score				

Screening (Full/Partial/None):
General comments/observations on SCDO (including preferred policy):

SCDO Grading
Scoring Sheet

PART A: Scientific Grading

Data Content & Coverage:

0 - Very generic brief statements which are often not site specific to the SCDO.

1 - Variable, some sections detailed and site specific; along with some sections that are scarcely populated.

2 – Extensive range of data and information presented. Good level of site detail.

Presentation & Synthesis:

0 – Presentation of lists, numbered points and bullets points with no analysis, integration or synthesis. Use of large paragraphs of text. No screening of policy options presented.

1 – Mixture including lists and bullets, often very short descriptive text. Partial screening of all policy options.

2 – Good presentation of data using tables, matrix. Concise, relevant, organised and structured SCDO. Maps presented in the SCDO are integrated. Full policy screening of all policy options.

Traceability:

0 -No cross-referencing.

1- Limited amounts of cross – referencing.

2- Most sections of the SCDO are cross referenced to various other sections or volumes of the SMP.

Scrutiny & Quality Assurance:

0 - No referencing or use of scientific citations within the SCDO. No attempts to indicate data gaps and uncertainties within any sections.

1 –Gaps and uncertainties indicated in some sections. Future studies and monitoring indicated.

2 – Explicit reference made to areas of uncertainty and limitations. Sources of information cited / referenced in relevant sections.

Weighted Scoring System:

Science Themes & Values:

- Data Content & Coverage = 20%
- Presentation & Synthesis = 50%
- Traceability = 20%
- Scrutiny & Quality Assurance = 10%

Worked example:

Plan XYZi:

Individual Score: Data= 1, Presentation =2, Traceability= 2, Scrutiny= 1

Weighted Score: Data= 0.2, Presentation =1, Traceability =0.4, Scrutiny= 0.1

Total: 1.7

Allocation: C

Graded Scoring:

- Grade A Scoring Range = 1.6 - 2
- Grade B Scoring Range = 0.8 – 1.5
- Grad C Scoring Range =0-0.7

Science Grade Meanings:

A-<u>*Strong scientific evidence basis and underpinning*</u>: The SCDO is well presented and organised. Information is comprehensive, site specific and concise. Explicit reference is made to assumptions, limitations and uncertainties, along with referencing/citations and comprehensive cross-referencing. The SCDO could not have been done without the Data Collation stage of the SMP process.

B- <u>*Limited amount of scientific evidence basis and underpinning*</u>: The SCDO is clearly presented. There is a notable mixture of data content and coverage within the various sections of the SCDO. Some sections contain significant site-specific information, whilst others are scarcely populated. Future monitoring and studies information is provided . Attempts are made to disclose areas of uncertainty and limitations.

C- *<u>No visible scientific evidence base and underpinning:</u>* The majority of the information provided is brief and generic. No attempt is made to indicate areas of uncertainty or limitations with no referencing or cross-referencing, therefore the sources of the information is unclear. The SCDO could have been done without the Data Collation stage of the SMP and been informed purely on site visits and coastal / shoreline management expertise.

Part B: Decision Making Transparency and Justification Grading

0 = The SCDO does not present a policy screening or intervention appraisal &/or
The justification of the preferred policy option is not clear OR the preferred policy option is pre-determined based on economics or other factors that override the SCDO screening approach.

1 = The SCDO presents a partial screening of policy options &/or
The preferred policy option is marginally justified by screening and intervention appraisal.

2 = The SCDO presents a full screening of policy options with detailed a detailed technical, economic and environmental appraisal &/or
Well justified and clear decision making of the preferred policy option.

Publications

Dodds, W. (2006) *Coastal Policy Making in the UK: From Guidelines to Practice.* Abstract of Paper present to the Royal Geographic Society – Institute of British Geographers Annual Conference, London, 30 August – 1 September 2006.

Dodds. W. (2007) *Examining the science – management interface between coastal planning and flood and coastal erosion- risk management: A North West Case Study.* Abstract of Paper present to the Royal Geographic Society – Institute of British Geographers Annual Conference, London, 28 – 31 August 2007.

Ball, I., Stojanovic, T., Ballinger, R., Lymbrey, G. and **Dodds, W**. (2009) The Role of Research Networks for Science-Policy Collaboration in Coastal Areas. *Marine Policy.* Vol. 33. No.6. pp. 901-911.

Dodds, W., Cooper, J.A.G. and Mckenna, J (xxxx) Flood & Coastal Erosion Risk Management Policy Evolution in Northern Ireland: "Incremental or Leapfrogging?"

Paper submitted to *Ocean and Coastal Management* Interreg IIIB COREPOINT Special Issue.

Coastal Policy Making in the UK: From Guidelines to Practice

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Abstract

The policy making arena in the UK is becoming increasingly complex. In response to this, and in line with the Modernising Government initiative, a number of guidelines and documents have been produced on professional policy making, better policy making and scientific analysis in policy making (Cabinet Office, 1999; Bullock *et. al.*; 2001; OST, 2005). The drive behind these documents is the move towards the government's vision of innovative, inclusive and evidence-based policy making.

Many of the policy areas that address the coastal environment, such as conservation, development planning and coastal defence, require multi-disciplinary science and public participation. The question therefore arises as to whether the numerous guidelines are being translated into UK coastal policy making processes? This paper will examine some of the realities, opportunities and challenges facing coastal policy making in the UK, with insights from the shoreline management planning process.

Key words: Policy making, coastal, shoreline management planning.

Examining the science-management interface between coastal planning and Flood and Coastal Erosion-Risk Management:

A North West Case Study

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Abstract

Sustainable coastal management requires decision-making to be informed by sound science on natural coastal change. However, the complex task of managing the coast is exacerbated by the levels of uncertainty associated with the knowledge base and issues related to the transfer of knowledge from the scientific community to decision makers.

This presentation presents the results of research examining the interface between Flood and Coastal Erosion Risk Management (FCERM) and coastal planning by Local Authorities along the North West coast of England and Wales. Funded by the Crown Estate, the research methodology utilised personal interviews with Local Authority Planning Officers and Coastal Engineers, statutory agencies, coastal consultancies and other practitioners. Additionally, policy analysis of the legislative framework in place was undertaken, along with an audit and review of planning documents in the North West.

The relationship between FCERM and coastal planning activities is critically examined, both internally within Local Authorities and externally across the North West region. This includes an overview of the mechanisms by which natural coastal change information is sourced, handled and integrated by Local Authorities. The findings of this research provide insights into knowledge-transfer issues and the challenges facing Local Authorities charged with managing their coasts and dealing with coastal risk. In doing so, the presentation highlights both best practice and current practice in the North West and the contributions made to coastal risk management.

Key words: FCERM, science, management.

The Role of Research Networks for Science-Policy Collaboration in Coastal Areas
Paper for Marine Policy COREPOINT Special Edition

Ball, I., Stojanovic, T., Ballinger, R.C., Lymbrey, G. and Dodds.W.

Abstract
This paper reviews the approach taken by several coastal partnerships in developing research strategies and programmes. It reports on the status of these research initiatives in the UK and describes how they have sought to influence the co-ordination and communication of scientific research through active partnerships with universities and the wider research community. Results of semi-structured interviews are followed by in depth case study of initiatives on the Sefton coast and Severn Estuary *(focusing on Climate Change Impacts?)* (funded under the INTERREG IIIB COREPOINT project) which reveal the constraints and opportunities in bringing together the great variety of knowledge holders in the coastal zone. The paper identifies successful elements of these initiatives and highlights lessons that can be applied to the development of other research initiatives in order to achieve science supported ecosystem based management.

Key words: ICZM, UK, science-policy, research.

Flood & Coastal Erosion Risk Management Policy Evolution in Northern Ireland: "Incremental or Leapfrogging?"

Dodds, W. [a*], *Cooper, J.A.G.* [b] *and McKenna, J.* [b]
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Abstract

Climate change poses perhaps the most significant challenge for the future of Northern Ireland's coast due to impacts that include, *inter alia*, mean sea level rise of between 13cm to 74cm by 2050. Whilst flooding is regarded as being a major natural hazard in the United Kingdom (UK), to date Northern Ireland's experiences of coastal flooding incidents have been infrequent and less severe and catastrophic in comparison to historic and recent flooding events, for example, in England and Wales. In the case of coastal erosion, this issue is increasingly receiving more and more attention around many parts of the UK, for example, along the East Anglian coast. In Northern Ireland, coastal erosion has historically been, and remains, only a minor concern. Government administrative arrangements for Flood and Coastal Erosion Risk Management in Northern Ireland currently operate in the absence of a number of areas, most notably, statutory provision in relation to coastal erosion, formal or strategic shoreline management planning or an integrated flood and coastal erosion risk management policy.

Environmental laws and policies in Northern Ireland have developed rapidly to satisfy and appease European Union (EU) legislation and policy. EU legislation in the form of a Floods Directive has acted as a significant catalyst to revise the situation with regards to the management of flooding. The current government landscape is in flux, thus presenting an opportunity to examine the vicissitude of policy and approach pertaining to Flood and Coastal Erosion Risk Management (FCERM) in Northern Ireland. In comparison to the incremental approach to FCERM policy evolution that has been documented in England and Wales, the situation in Northern Ireland can be best described as leapfrogging, due in part to legislative and policy gaps, and current directions. This paper provides a commentary on Northern Ireland's approach in comparison with its UK counterparts, highlighting both congruence and divergence in policy evolution and development.

Key words: Northern Ireland; coastal defence; flood risk management.