UNIVERSITY OF SOUTHAMPTON

FACULTY OF ENGINEERING AND THE ENVIRONMENT

Civil, Maritime and Environmental Engineering and Science Academic Unit

Environmental Conflict and Decision-Making

The Case of Hydroelectric Power

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ABSTRACT

FACULTY OF ENGINEERING AND THE ENVIRONMENT

CIVIL, MARITIME AND ENVIRONMENTAL ENGINEERING
AND SCIENCE ACADEMIC UNIT

Doctor of Philosophy

UNDERSTANDING THE ROLE OF STAKEHOLDERS IN ENVIRONMENTAL CONFLICTS AND ITS IMPACT ON SUSTAINABLE DECISION-MAKING: THE CASE OF HYDROELECTRIC POWER

By Laura Jane Watkin

As management of the environment becomes more complex and the number of potentially conflicting issues to be balanced expands, there will be increasing and more intense debates about the course(s) of action(s) to be taken. Navigation of conflict determines trade-offs established and decisions taken, and will become progressively important, as the need to unify incompatible uses grows. Both definition and management of environmental conflict is ambiguous, lacking in understanding and mechanisms to effectively handle disputes. Interdisciplinary consideration of conflict highlights its potential to yield functional and dysfunctional aspects, recognising dispute is not inherently negative. Framing environmental debates as conflict situations may yield substantial management benefits.

Using case studies (UK), this research identifies the impact of stakeholder conflict on achieving sustainable decision-making, and, seeks to develop conceptual tools to aid exploration of disputes, using the issue of hydropower development. Growing environment awareness has simultaneously emphasised the benefits of hydroelectric power and its environmental costs. In a changing policy climate, where renewable energy generation potential and environmental protection are needed, conflict between stakeholders is considerable. To meet practitioner's needs, an understanding of conflict is needed.

Findings highlight the existence and nature of stakeholder conflict. Environmental conflict is epitomized by: parameters of the problem, characteristics of the stakeholders and dispute process. Conflict is recognised as a platform for expression which may yield functional or dysfunctional consequences for decision-making. The impact of the individual is significant; variables such as perceptions, behaviours and personalities, alongside facets of the problem, characterise disputes. Assessment of conflict at a range of spatial and temporal scales, established capacity for escalation, stagnation and the development of impasses, each with differential impacts on decision-making.

A conceptual framework illustrating the impact of conflict on decision-making, and role in the facilitation of change is generated. Conflict is recognised as a critical management point for facilitating sustainable decisions. From a management perspective, it is important to manage conflict at this critical point to achieve the best decision. This research outlines an alternative approach to the conceptualisation and management of environmental conflict, and highlights the significant impact of the individuals involved. The identification, application and further development of methodologies have yielded a number of conceptual tools for conflict management. Recognising the important role of conflict as a mechanism for change may be crucial for the future of environmental management.

Keywords: Conflict, Environmental decision-making, Environmental management, Sustainable development.

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Declaration of Authorship

I, Laura Jane Watkin declare that the thesis entitled 'Understanding the Role of Stakeholders in Environmental Conflicts: The Case of Hydroelectric Power` and the work presented in the thesis are both my own, and have been generated by me as the result of my own original research. I confirm that:

- This work was done wholly or mainly while in candidature for a research degree at this University;
- Where any part of this thesis has been previously submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
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- Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
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List of Acronyms and Abbreviations

BHA- British Hydropower Association.

CAR – Controlled Activities Regulations.

CATWOE- Customer, Actor, Transformation, Worldview, Owner, Environment.

CRESS- Centre for River Eco-System Science.

DECC-Department for Energy and Climate Change.

FFA- Force Field Analysis.

ICER- International Centre for Ecohydraulics

NIMBY- Not in My Back Yard

RSPB- Royal Society for the Protection of Birds.

SAC- Special Area of Conservation.

SDC- Sustainable Development Commission

SEPA- Scottish Environmental Protection Area.

SFB- Spey Fisheries Board.

SHE- Scottish Hydro Electric.

SNH- Scottish Natural Heritage.

SSM- Soft Systems Methodology.

TDSFB- Tay District Salmon Fisheries Board

UNCHS- United Nations Commission on Human Settlement.

UKTAG- United Kingdom Technical Advisory Group.

WCD- World Commission on Dams.

WFD- Water Framework Directive.

Chapter 1 Introduction

1.1 Background

From global policy on sustainable use of the world's resources, to appropriate consumption by industry and society, there will be extensive discussions before acceptable solutions are generated. Although legislation and societal dissatisfaction with environmentally damaging practices are significant drivers for change, delivery of sustainable solutions remains the subject of substantial debate (Redclift and Benton, 1994). Those responsible for management of the environment face significant future challenges, to achieve sustainable development against a backdrop of rising population and falling resources. Traditional approaches such as conservation, prescribed management and restoration, which historically focused on biophysical elements, have been adapted to consider anthropogenic activities within the environment. But another dimension to consider is the social role that humans play on behalf of the environment via decision-making; each decision taken shapes the course of management and determines the future of resources. As decisions relating to the environment are undertaken by people, objectives are inevitably traded off with other anthropogenic interests (Grumbine, 1994). Highly integrated with multiple human systems, it is possible for a single resource to have conflicting anthropogenic functions; environmental management is therefore a complex balance of these activities. As natural resources increasingly come under pressure and the need for change becomes apparent, their incompatibility becomes explicit making action difficult to facilitate.

Establishing management practices that use the environment sustainably will not allow all current activities to continue as they are. However, change cannot be realised without acceptance of potentially negative consequences across economic, political and social dimensions, which may be equally as important as environmental protection. The result is that the 'best' environmental solution is often traded off with other anthropogenic concerns to lessen adverse consequences, but determining the nature of tradeoffs is complex. When establishing trade-offs, there are inevitable tensions between benefits derived and adverse consequences, and associated advantages or disadvantages for stakeholders (Carroll and Buchholtz, 2008). As stakeholders become aware of incompatibilities, they debate to ensure any actions taken meet their individual needs. For the purpose of this study, this process is labelled as "conflict" and is a distinct feature of environmental decision-making. The term conflict is largely perceived to be negative as it is frequently associated with war and violence, and some would hesitate to state that environmental decision-making processes involve dispute(s). But given the complexity of environmental management and the often large number of stakeholders involved, reaching unified decisions without conflict is unlikely. While an ambiguous concept, conflict can be broadly described as the "awareness on the part of the parties involved of discrepancies, incompatible wishes, or irreconcilable desires" (Boulding, 1963). While this description was developed in the context of war, it provides an equally accurate depiction of environmental decision-making processes. Formally labelling such situations as conflicts may considerably enhance understanding of these unspecified processes and their potentially significantly impact on decision-making. The purpose of assessing conflict within environmental decision-making is to explore whether a conflict-based approach may yield benefits and facilitate real change towards sustainable development. It has become evident that changes in human use of the environment will be required due to ecological and economic pressures. Strategies to achieve this change are the focus of considerable research, but translation into tangible solutions remains the product of interactions between people. Understanding the importance of conflict within decision-making may yield insights about how to achieve and implement better and more sustainable solutions to environmental problems.

1.1.1 The Challenge of Sustainable Development

Sustainable development represents an area where conflict is prevalent. The concept was adopted following the World Commission on Environment and Development (1987), where it was recognised that economic development and population growth were placing unprecedented demands on the planet's natural resources and could not continue indefinitely. Sustainable development is widely recognised as a key guiding principle for policy in the twenty first century, but translating it into tangible management strategies is difficult. While the ideology of sustainable development is simple, providing viable solutions to long-standing debates over the use of the environment where resources have multiple users with varied requirements presents a significant challenge. Historically, the environment has been perceived to be external to humanity, a resource to be exploited. Economics are a dominating issue in the relationship between society and the environment, with increasing production the main priority regardless of impact (Douthwaite, 1992). This pattern of growth has damaged the environment on which global economies, industries and societies depend and change is required to 'meet the needs of the present without compromising the ability of future generations to meet their needs` (World Commission on Environment and Development, 1987). Needs are often defined from a human perspective not an environmental one; sustainable development is therefore an unashamedly anthropocentric concept (Lee, 2000).

The widespread interest in and support for sustainable development is an important shift in the relationship between society and the environment (Giddings *et al.*, 2002). From a policy perspective, the appeal of sustainable development is in the provision of practical objectives for environmental management. In reality, its practicality depends on a range of factors, including appropriate economic and industrial systems, robust social and legal institutions and the practices of individuals. While the philosophy of sustainable development is simple, providing viable solutions to long-standing debates over the environmental and socio-economic issues it raises presents a significant challenge. At the heart of the debate is a lack of definition; while the concept is clearly defined, what sustainable development actually requires is largely open to interpretation, and has been represented as meaningless political jargon through to an indicator of real change. It is embraced by governments, social reformers and environmental activists alike, all with their own interpretations (Giddings *et al.*, 2002). Over 200 of the world's major companies in mining, logging, oil and gas, chemicals, banking and finance, electricity generation and biotechnology are members of the World Business Council for Sustainable Development (2011). In the UK, the main political parties (Labour, Conservatives and the Liberal Democrats) all support sustainable development, alongside environmental groups such as Greenpeace and Friends of the Earth who are committed to its principles. Yet all have significantly different views of how it should be achieved. Ambiguity has led to multiple conflicting interpretations, which in turn has led to a differential understanding of what sustainable development should be. The extent of the gap between the ideology of sustainable development and its realisation will be dependent on how it is applied and by whom.

That so many different interpretations of the original Bruntland (1987) definition exist makes action difficult. Wackernagel and Rees (1996) argued that the report purposely left a certain amount of ambiguity to allow flexibility, while others (Rees, 1998) have argued that its lack of meaning allows business and governments to favour sustainability without any real change to their present position. Giddings *et al*., (2002) noted that while no single unified philosophy of sustainable development exists, most people debate within their existing political and philosophical outlooks. These underlying worldviews influence which issues are prioritised and which policies implemented, and are clearly important in contested strategic decision-making. McNeil (2000) suggests that by definition, sustainable development has conflict at its core, and this explains its contested status. This conflict can manifest as between the interests of present and future generations, humans and nature, rich and poor, and local and global environments. Such conflicts arise from the recognition that growth in material wealth has adverse implications for the environment; protection of natural systems will have socioeconomic consequences. Thus a trade-off between activities is needed. The nature of the trade-off an individual favours is influenced strongly by their perspective (McNeil, 2000). With sustainable development characterised by multiple perspectives, the generation of feasible solutions will face not only conflicts of interests, but also conflict of values and ideologies. With no agreed course, navigation of isolated conflicts will yield a spectrum of actions labelled as sustainable development; the extent of their success subjective. Aristotle presumed that the goal of every debate was to eventually arrive at truth, which by its nature would satisfy all involved. In the case of sustainable development, there is no truth, it is an ideology rather than an actuality, and thus movement towards realisation will be dependent on the people striving to achieve it.

Transferring sustainable development from an ideology into tangible environmental solutions will require transition through a period of debate and conflict. It will occur at multiple levels; in the political arena where strategy and policy decisions are made and at an operational level where policies are transformed into tangible solutions and balanced with other concerns. The outcome will shape the manner in which sustainable development principles are transposed into reality, determining the extent of the gap between theory and practicability, and have consequences for the future of natural resources. Given the importance of such resources, there is a significant need to intervene to prevent conflict escalation, to ensure balanced decisions and achieve real change for the future.

Multiple schools of thought about the issue of sustainable development exist, each with their own understanding of the concept and potential mechanisms for resolution. Mechanisms utilised to address sustainable development conflicts are diverse, including treaties, policies, development of new technologies and voluntary actions. As global resources increasingly come under strain, the urgency and the number of proposed actions are escalating. With considerable research in the field and numerous people engaged, why is it so difficult to find a solution? It is hypothesised that this difficulty stems from an inability to successfully navigate dispute and implement innovative concepts and ideas. It is therefore suggested that focussing on the process of the debate represents an alternative strategy to facilitating sustainable development. Malone (2009) noted that when a solution is unattainable but the issue important, willingness to compromise is crucial to generating action. Achieving compromise enables movement through contentious issues and facilitating it lies in a thorough understanding of the processes involved. The processes involved - conflict and decision-making - represent social systems, but are rarely considered to be a function of interactions. A greater understanding of conflict processes may highlight why solutions to the problems associated with sustainable development remain a challenge, and may suggest mechanisms which can begin to facilitate unified action.

1.2 Conceptualising the Problem

It is hypothesised the nature of conflict during the establishment of tradeoffs has a significant impact on the decisions taken, which in turn has implications for the realisation of sustainable development. A conceptual framework (Figure 1.1) is developed to illustrate this relationship. The conceptual framework depicts the factors which drive change in environmental management, the processes which determine its nature and the implications of the decisions taken. Sustainable development does not feature *per se*; the ideology is represented as pressures for change and the long-term implications of that change. The conceptual framework visually highlights the proposed role that conflict may play; better understanding of its impact may aid progression through the framework and yield improved outcomes. In the conceptual framework there are distinct phases, highlighted as follows:

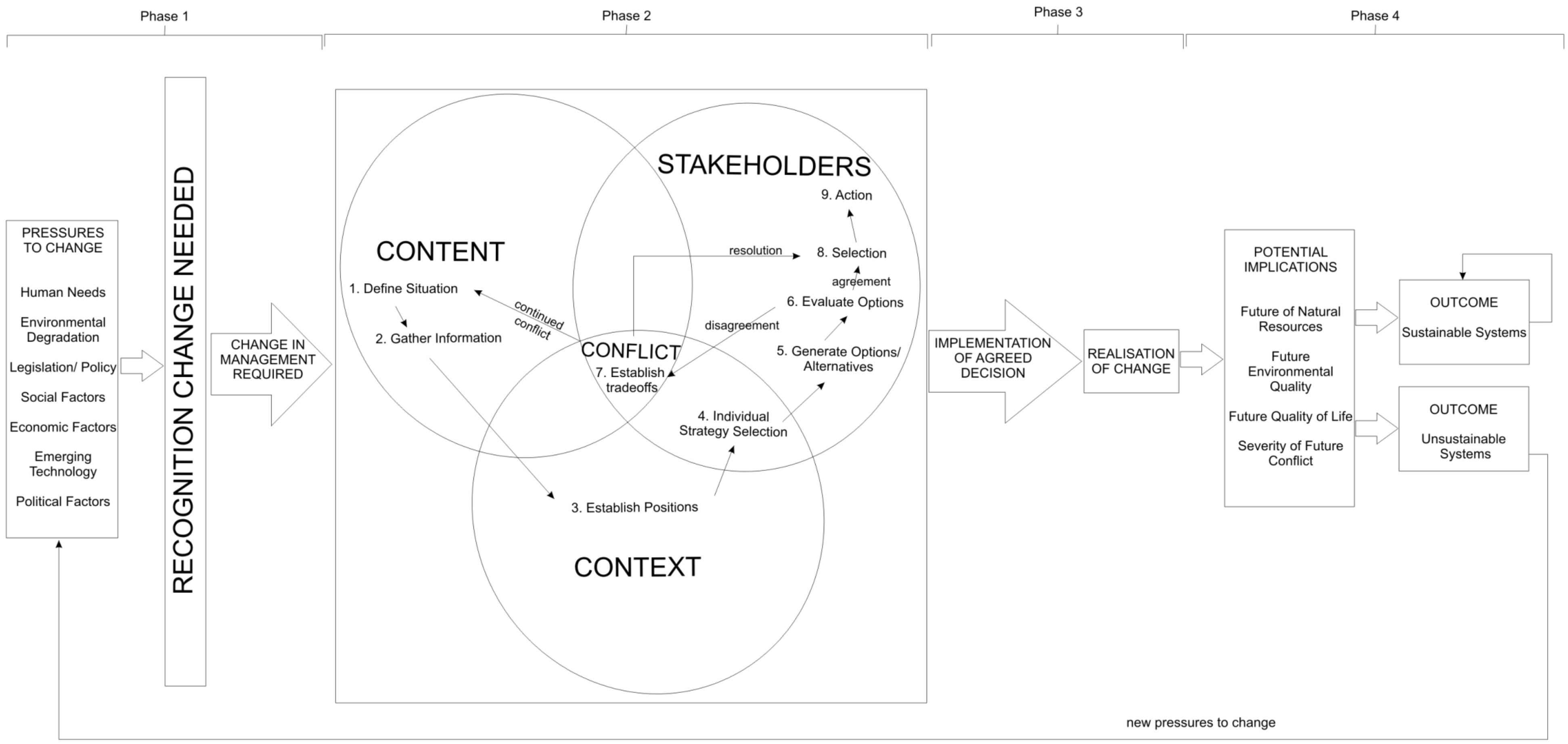


Figure 1.1-Conceptual Framework: Interaction of Factors which Influence the Need for and Realisation of Change in Environmental Management. Sustainable systems are able to evolve indefinitely towards greater human utility and balance with the environment; unsustainable systems are not.

Phase 1: Pressures for Change

These factors create pressure to change and are identified as:

- Human needs.
- Environmental degradation.
- Social factors- *social needs (e.g. recreation, amenities) and social concerns (environmental awareness and attitudes).*
- Economic factors- *direct (associated with a given resource) and indirect (associated with wider concerns e.g. related industries and the economy)*.
- Availability of emerging technologies and knowledge.
- Political factors – local, national and international.

These factors are not mutually exclusive; changes in one will affect others. As pressures intensify they increase in importance; at a critical threshold the need for change to reduce/remove pressures will be recognised. This may be independent (individuals note the need for change) or enforced (required by a governing force). To achieve change, alterations in management are required. Need for change is identified, but there is no discussion as to what factors may be involved.

Phase 2: Decision-Making

Within this phase, decision-making processes determine the exact parameters of change. During decision-making, any changes required are transformed into tangible intentions. Change occurs within three dimensions:

- Content - facts that pertain to the nature of the system, inclusive of socio-economic and biophysical information.
- Context - the circumstances which form the setting for change.
- Stakeholders - the people involved directly or indirectly in change.

In isolation, these dimensions are simple to address, where they overlap, complexity may develop. Within this environment nine systematic stages of decision-making occur, based on a rational decision making model developed by Welch (2002):

1. Define the situation within which change must occur.
2. Gather information to ensure sufficient understanding to make a decision.
3. Establish positions: dependent on context differential interpretations will emerge.
4. Individual strategy selection: stakeholders decide on their approach to the decision.
5. Generation of options as to what actions could be taken to achieve change.
6. Evaluate options: each stakeholder appraises decisions needs.
7. Establish tradeoffs: should stakeholder selections not match, a compromise needs to be found. If stakeholder selections match, this step will not be needed.
8. Selection: an option is selected to fulfil the required change.
9. Action is taken to bring about change.

There is potential for conflict to occur in the course of decision making; once it takes place, it will continue to be a feature of decision-making until resolution is achieved. Conflict management is the only route to selection of an agreed option and implementation.

Conflict Sphere

Activities within the conflict sphere will interact with decision-making; the extent of its impact is unknown. It is proposed that conflict sits at the crux of the model; it will vary in nature dependent on the composition of the problem (based on the three dimensions of the system). The nature of conflict will be variable, changing on a case-by-case basis. While the extent of its influence is unknown, the model recognises conflict as an explicit feature of decision-making. It is hypothesised that this represents a critical point in the system, not only facilitating change and allowing action to occur, but determining parameters of that change and its associated future implications.

Phase 3: Realisation of Change

Having decided on a given course of action, the decisions taken shape the extent to which change is achieved via:

- Implementation of actions, to bring about change.
- Realisation of change, as change takes effect.

Timescales to bring about change will vary from decision to decision.

Phase 4: Implications and Outcomes of Change

Having been realised, the change applied will have associated implications. These implications will determine:

- Future of natural resources (*availability, quality and management*).
- Future environmental quality (*degradation, maintenance or improvement*).
- Future quality of life (*ability of the environment to meet human needs and support economy*).
- Severity of interactions regarding natural resources (*future conflict potential, increased tensions, co-operation, shared resources facilitation*).

The implications of change determine the long-term outcomes. At this point, it is unlikely that a single change in environmental management decisions will have a significant impact. However, the implications of multiple singular actions may have cumulative effects, concentrating or diluting movement towards sustainable development. The outcome of those actions will determine whether resultant systems are sustainable. In the case of unsustainable systems, new pressures to change may develop creating a negative feedback loop to the beginning of the conceptual framework

Examining the conceptual framework as a whole, conflict is recognised as a critical point which determines the nature of outputs. Activities here could have significant implications for the course of environmental management and future conditions. Greater understanding of the role and nature of conflict within environmental decision- making and subsequent management of dispute processes could yield significant long-term benefits. This study therefore focuses on identifying and understanding conflict within environmental decision-making as it has significant potential as a mechanism to facilitate the realisation of sustainable development.

1.3 Parameters of the Study

Conflict between stakeholders therefore has a potentially significant impact on both decision-making and the course of environmental management, and warrants further investigation. Analysing conflict requires a holistic approach that transcends traditional subject boundaries. Attempting to address the concept of sustainable development in its entirety is unfeasible, this study focuses on one area of the debate, highlighting lessons that can be learnt from a conflict based approach.

1.3.1 Sustainable Energy

Access to energy is a fundamental need of modern society, crucial for quality of life and development. Exhaustible fossil fuels represent approximately 80% of the total world energy supply. At constant production and consumption, the known reserves of oil will last approximately 41 years, natural gas 64 years, and coal 155 years (Goldemberg, 2007). Besides resource depletion, fossil fuel consumption generates serious environmental concerns, and financially, increasing production costs are likely as reserves approach exhaustion and expensive technologies are used to locate and extract remaining resources. Global demand for energy is expected to increase by an order of magnitude by 2050 (Dincer, 2000). Simultaneously, concern regarding environmental issues such as acid precipitation, resource depletion and global climate change will increase. In the UK, the energy industry is heavily reliant (75.9% of total electricity) on finite and diminishing fossil fuels and lacks security of supply. The electricity industry is set to undergo a period of rapid change driven by:

- The decommissioning of major plants. It is anticipated that 30-35 GW of new electricity generation capacity will be needed by 2027 to meet the gap from increased demand and expected closures (Department of Trade and Industry, 2007).
- Government policies such as UK Energy White Paper, Renewables Obligation and the Climate Change Levy.
- Technological development improving efficiencies of mature technologies and substantiating the viability of emergent technologies.

In tandem with government carbon emission targets, working towards a 60% reduction by 2050 (Department of Trade and Industry, 2007), there is a need for significant changes in energy strategy. The principles of sustainable development require energy resources which are readily available at a reasonable cost, without causing negative environmental or societal impacts. Current energy systems do not and will not meet these requirements.

The exploitation of renewable energy is thought to be a key component for sustainable development (Dincer, 2000), due to its lesser environmental impacts, security of supply and its support of decentralised energy systems. Renewable energy sources represent approximately 15-20% of the total worldwide energy demand (Painuly, 2001). Its development and deployment is the focus of considerable research globally. However renewable energy technologies face many challenges due to low capture efficiency, disparity between decentralised renewable systems and existing centralised infrastructure (Twidell and Weir, 2006), questioning whether renewable energy can ever replace traditional fossil fuels. Several barriers have prevented penetration of renewable energy technologies into the energy industry (Painuly, 2001). These include cost-effectiveness, technical issues, market barriers (inconsistent pricing structures, institutional, political and regulatory barriers) and social and environmental concerns. Some barriers may be specific to a technology while others may be specific to a country or region. This study focuses on the challenges facing the development of environmentally sustainable hydropower within the UK. Hydropower is selected as it represents a known case where stakeholder conflict is a significant barrier to its current development.

1.3.2 Hydropower

Hydropower represents one of the most established renewable energy technologies. Installations now account for 20% of the world's electricity generation, across more than 150 countries (Twidell and Weir, 2006). One of the strengths of hydropower as a technology is that actual output is close to design output. Unlike most other renewable technologies, hydropower is able to respond to fluctuations in demand as electricity may be stored in the form of water behind impoundments. However, considerable engineering may be required to create suitably high discharge and head differences, generating high costs

(Paish, 2002). Although the longevity of stations allows for payback of initial investments in time, smaller schemes suffer from diseconomies of scale, where by the unit cost per kilowatt produced is significantly increased. Kosnik (2010) highlighted empirically that hydropower suffers from non-linear economies of scale, reducing the attractiveness of small scale developments.

Environmental analysis of hydropower is difficult as it simultaneously reduces dependence on CO_2 emitting fossil fuels, but at a local scale can be detrimental. The environmental impacts of the hydropower industry have been widely investigated (Berry, 1955; Rorslett and Johansen, 1996; Brunke *et al.*, 2000) and as a result numerous structural and operational solutions exist to mitigate potential impacts. Despite this availability of knowledge, the solutions implemented will be the result of a compromise between political, economic, social, and environmental issues. In some situations, it may be the case that conflicts between stakeholders' objectives are so great that movement towards a solution is slowed or, in worst-case scenarios, ceased. With regard to the principles of sustainable development, the best hydropower project is one which satisfies development criteria, while maintaining the quality of the environment. Quality refers to the maintenance of the environment in its natural state as it exists or existed before the hydropower development, and does not refer to the maintenance of a static ecological state, but to the minimization of negative effects to allow ongoing flux between the fluvial environment and its development. This is subsequently referred to as environmentally sustainable hydropower. Accepting such an approach is unlikely to yield a development which all stakeholders find acceptable, they must move through a conflict episode. This study proposes better understanding of these disputes will lead to heightened appreciation of the situation and provide insights into the issue of sustainable hydropower development, while simultaneously enhancing comprehension of the role of conflict within environmental decision-making processes.

1.4 Research Problem

Recognition that climate change is a threat means looking seriously at renewable energy options. The UK has a policy goal of achieving 20% renewable electricity by 2020 and a view to reach 30-40% by 2050 (Department of Trade and Industry, 2003). Currently, renewable sources make up 5.5% of the UK's electricity supply (Department for Energy and Climate Change, 2009a). Considerable investment is therefore required to reach UK policy goals of 15% by 2020 (Department of Trade and Industry, 2007; Department for Energy and Climate Change, 2009a). In terms of potential generation capacity, hydropower is not set to play a major role, providing around 1% of UK electricity generation (Department of Business, 2008). A majority of the UK's large hydro potential has been developed, and with the exception of a few remaining potential sites, such as the Severn Estuary, future development will be predominantly small scale.

Given that electricity gains are small and the decision-making climate complex, it may appear that there is little purpose in navigating such disputes. However, many renewable technologies are still in their infancy and do not yet represent viable nationwide solutions; those that are viable face similar challenges to hydropower. In the UK, wind power is the primary option for achieving energy targets; the UK generates *ca* 3GW of wind energy, enough to supply 1.5 million households with electricity (Department for Energy and Climate Change, 2009b). Consents for additional wind farms to power 5 million more households will ensure that wind energy plays a prominent role in future supply. The Department of Trade and Industry (2003) states that onshore and offshore wind can deliver 30% of the UK's electricity supply by 2020 and should be part of a radical decarbonisation of the economy by 2030. But large-scale onshore development is constrained by planning issues, noise and visual impacts, just as offshore developments are constrained by economic concerns (MacLeay, 2010). It is envisaged that no single technology alone will meet the UK's energy requirements; with a mix of mature and innovative technologies required to meet demand. Furthermore, development of remaining larger schemes could contribute additional generation capacity, up to 5% of UK electricity generation if developed in the case of the Severn Estuary (SDC, 2007). Hydropower must be part of the mix.

The challenge is how to facilitate sustainable hydropower. Interest in hydropower is increasing, 2007 to 2008 hydropower capacity across the UK increased by 98MW (largely due to the Glendoe scheme (Scotland) becoming operational) (MacLeay, 2010). Applications to the Environment Agency for licences have increased rapidly; in the first half of 2010 (Jan-June) 29 licences were issued, with an additional 126 pending (Smith, 2010). Speaking at a conference, Lord Chris Smith, chairman of the Environment Agency, highlighted that in coming years interest in hydropower will accelerate and there was a need to get "the policy, the principle and the method right now, to avoid disaster in the future". Engineering sustainable hydropower facilities is possible. Numerous existing schemes showcase good practice and highlight innovative solutions to the challenges faced. However, in the UK, there are also numerous schemes with poor practices, causing some to question why these decisions are so fundamentally different. It is hypothesised that navigation of conflicts surrounding the issues faced generates this disparity. Differential scales of conflict and resolution result in a spectrum of developments dependent on the decisions taken. To guarantee environmentally sustainable hydropower, tensions must be resolved in a manner which facilitates creation of the best solutions. Malone (2009) suggests that consideration of the processes involved (conflict, argument and decision-making) may hold the key to resolution. Greater understanding of the nature of the processes involved could help identify mechanisms for conflict management, and ensure implementation of the best possible developments.

This will only be realised if findings can be effectively communicated to practitioners, maintaining functionality is therefore key. Greater consideration of how science is used in a real-world context is an increasing feature of modern science, which has in many fields become much more applied. Hessel and van Lente (2008) note that none of these trends have been uncontested, but the most famous description of this shift is the concept of 'Mode 2' knowledge production developed by Gibbons *et al.,* (1994). Gibbons *et al.,* (1994) highlight that while knowledge production occurs within scientific institutions, its output locations are now much more heterogeneous, and research context should therefore be application based. To clarify this, Gibbons *et al.*, (1994) make a distinction between 'Mode 1' or traditional research and 'Mode 2' using five key characteristics (Table 1.2). While much of Gibbons *et al.,* (1994) work looks at the production of knowledge and aims to highlight a "new" research paradigm; the focus of this sections interest is the notion of knowledge generated in the context of application.

Table 1.1-The Key Attributes of Mode 1 and Mode 2 Research Design (after Gibbons *et al.*, 1994).

Mode 1	**Mode 2**
Academic context	Application based context
Disciplinary	Transdiciplinary
Homogenous sites of knowledge generation	Heterogeneous sites of knowledge generation
Autonomy	Social accountability
Traditional quality control (peer review)	New quality control system

The contrast between problem solving which follows the codes of practice relevant to a particular discipline (Mode 1) and that which is organised around a given application (Mode 2) (Gibbons *et al.*, 1994) is clearly highlighted as a fundamental difference between the two and of interest in the context of this study. While it is recognised that ‘Mode 1’ knowledge can result in practical applications, it is a by-product and not the intent of its production (Hessels and Van Lente, 2008). ‘Mode 2’ knowledge is specifically intended to be useful, the outcome of a supply and demand type relationship, in which the demand was an integral part of how research was conducted (Gibbons *et al.*, 1994). The ethos of this study is to advance practical knowledge of environmental conflict; it therefore adopts a ‘Mode 2’ style approach, where such considerations are a key component of research design and analysis.

1.5 Research aims and objectives

The aim of this study is to evaluate the impact of stakeholder conflicts on achieving sustainable decision-making, using the issue of hydropower development as a case study.

A secondary aim is to develop conceptual tools to aid exploration of conflict.

The specific objectives were to evaluate the impact by:

1. Critically reviewing the nature of conflict in environmentally sensitive circumstances and determine its theoretical role on decision-making.

2. Critically examining examples of hydropower conflict using case studies from a range of spatial and temporal scales.

3. Comparing case studies to distil common elements of both hydropower disputes and environmental conflict.

4. Developing and justify a generalised model of conflict to highlight its impact on decision-making.

1.6 Structure of the Report

The study objectives were explored by undertaking several separate research studies, some of which are theoretical (Chapters 2-3) and others empirical (Chapters 5-8). These chapters are presented separately but are interrelated; Chapter 8 brings them together to fulfil the research aims and objectives. Figure 1.2 summarises the relationship between chapters, study aims and the conceptual framework, to highlight how constituent parts fit together.

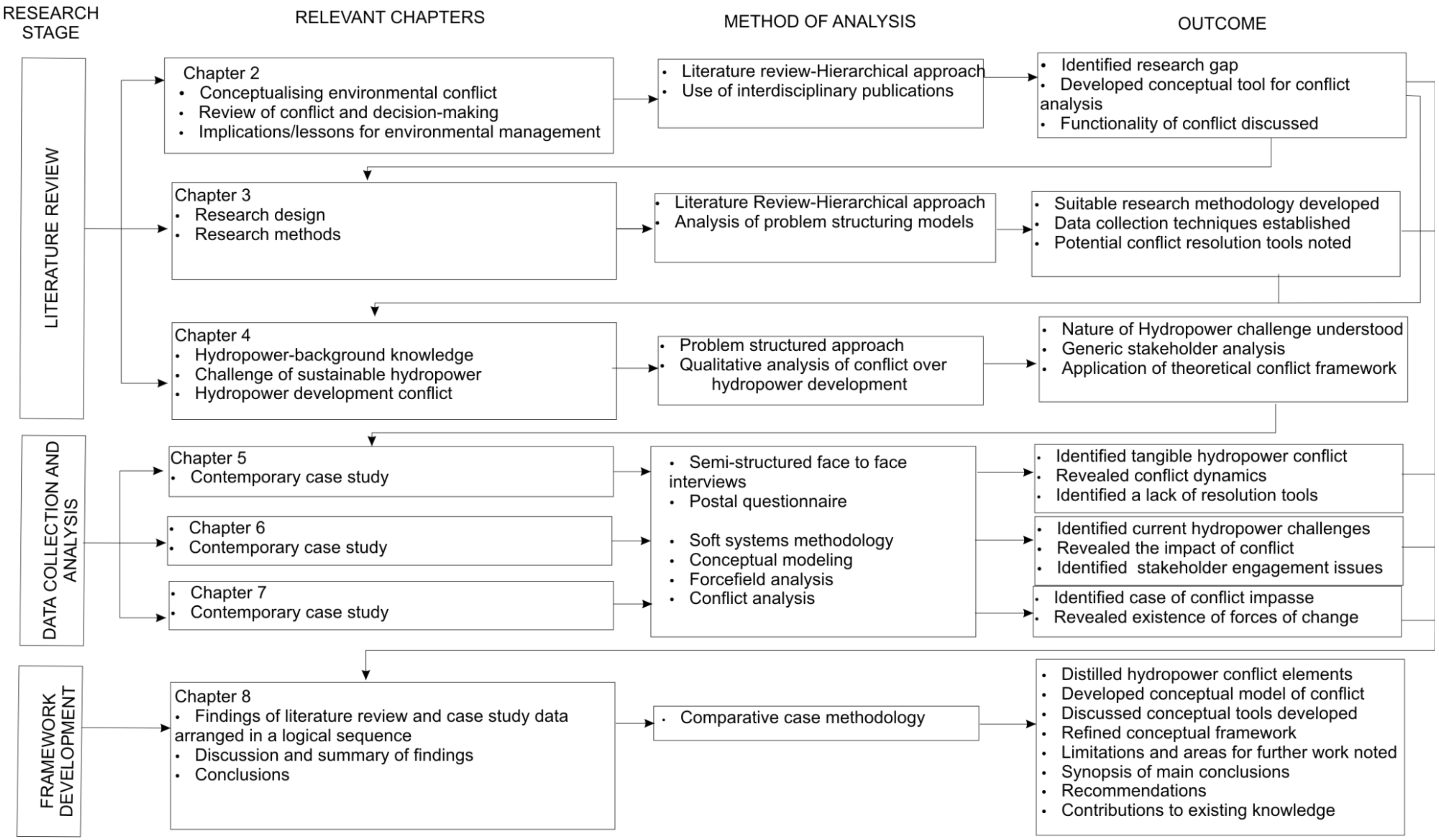


Figure 1.2- Research process: Research stages, analysis methods and outcomes.

Chapter 2 Environmental Conflict and Decision-Making

2.1 Chapter Overview

Following the development of the conceptual framework (Figure 1.1), exploration of the nature of environmental conflict and its role within decision-making is required. This chapter presents the outcomes of an interdisciplinary review of literature on environmental conflict and decision-making. The purpose of this chapter is to develop a holistic understanding of the constituents of conflict, and to further investigate the theoretical impact that conflict has on decision-making in accordance with study objective 1. Further to stated objectives, the need for a practical framework for conflict identification and diagnosis was identified and incorporated into the review. The literature review is presented in three sections for clarity, each focusing on a different aspect of conflict. The chapter opens up discussions around the concept of conflict, prompting a deeper consideration of what is included under the term, and is intended to stimulate further thinking on the impact and potential future role of conflict. Key lessons from an interdisciplinary study of conflict are highlighted and their implications for future environmental management discussed, these points form the foundations of the methodological approach selected (see Chapter 3) and the nature of their implementations (see Chapters 5-7).

2.2 Introduction

Conflict over natural resources, such as land, water and forests is ubiquitous (Ayling and Kelly, 1997), frequently experienced at a range of scales globally. Modern environmental issues (e.g. addressing climate change, achieving biodiversity conservation, facilitating renewable energy production, and sharing resources among a rapidly increasing population) represent significant management challenges where there is no uniform agreement as to the appropriate course of action among stakeholders. Effective management strategies will require the support and co-operation of stakeholders involved; where this is not achieved conflict ensues. The inability to address and resolve conflict therefore could represent a significant barrier to sustainable environmental management.

To move through disputes there is a need to understand what is meant by the term ‘environmental conflict’ and establish its role in decision-making. The aim of this chapter is to critically review the nature of conflict in environmentally sensitive circumstances, and determine its potential role in decision-making, in accordance with study objective 1.

The notion of environmental conflict is highly ambiguous. Many studies on environmental disputes either do not seek to define it beyond generic conflict definitions (e.g. Barrow, 2010), giving no context as to what facets are or should be considered. Other work assumes the term is conceptually distinct (e.g. Peuhkuri, 2002; Bolin *et al.*, 2008; Shmueli, 2008), but do not outline what dimensions are analysed. Where conflicts are explored in more depth, it is usually in reference to a specific case (e.g. Mola-Yudego and Gritten, 2010- forestry; Meier *et al.*, 2007- land use), and thus have limited application beyond the context of that field. The result is a distinct lack of clarity as to what environmental conflict is. Where they exist, definitions of environmental conflict vary, shifting from focus on international armed conflict (Westing, 1986), to tensions over resource scarcity (Homer-Dixon, 1994), to cases of public protest and environmental movements (Rootes, 2009). Therefore when considered in depth, establishing what is an environmental conflict is difficult to concisely answer. It provides an equally valid description of violent cases (e.g. international war, acts of ecotage) as those which are diplomatic, tacit (e.g. tensions over decision-making or policy implementation) and do not conform to traditional stereotypes of conflict. Each conveys a very different understanding of conflict and its parameters. Identifying a holistic definition of environmental conflict, is arguably an important prerequisite for resolution; how can environmental disputes be resolved if they cannot be recognised, and therefore understood, by those who experience them?

Recognition of this ambiguity prompted a broadening of the boundaries of the literature review to consider instead the parameters of conflict *per se*. All individuals have an inherent understanding of conflict, which is a function of their knowledge and experience, but few consider its processes beyond its stereotypical violent connotations. The concept of conflict has evolved over time. March and Simon (1958) refer to conflict as a breakdown in the mechanisms of decision-making. This early view shifted to consider conflict as an incompatibility of goals. Jehn (1997) believed contradictory views on the means to achieve those goals as important, while others have proposed that conflict exists when views are perceived to be incompatible (Kolb and Putnam, 1992). Achieving conceptual clarity is a challenge, Nair (2008) highlights that the definition and meaning of what constitutes conflict has not only changed over time, but still remains vague and contextual. Literature on conflict spans multiple disciplines, such as sociology, game theory, and international relations; each with their own perspective of what conflict is. Consideration of its components varies both across disciplines and by author, requiring a vast amount of research to generate a very simple understanding of conflict. As it is difficult to effectively communicate, conflict may be approached (if at all) from a limited perspective, potentially weakening any solutions generated. In seeking to address this, the review encountered considerable difficulty and complexity in navigating literature and attempting to holistically understand conflict, this in turn raised questions regarding its practical application. It is hypothesised that a highly focused attempt to theoretically understand conflict in academic literature, has left it ineffective to those who are actively engaged in disputes (e.g. environmental managers, regulators, and wider stakeholders- subsequently referred to as practitioners), and suggests the need for the wealth of understanding available to be placed in a context which is more comprehensible. The need for a functional guide to the components of conflict, which can then be applied to environmental disputes, is identified as a significant gap in the literature, and a further objective of this review.

Interdisciplinary consideration of conflict as a concept also synthesised a new perspective on the role that disputes may play within decision-making. As the dimensions of conflict have expanded, the factors involved have shifted from being problem-centric to increasingly people-orientated and social characteristics such as the perceptions and values of stakeholders are recognised to have significant influence(s) on a the course of a dispute. Broader consideration of conflict literature *per se* highlights further dimensions, such as the notions of strategy, tactics and behaviour, which may enhance understanding of the nature and impact of environmental disputes if better understood. Social processes and stakeholder interactions around the issue may significantly affect the nature and course of conflict via the behaviours they exhibit and the choices they make. While recognising that people represent a fundamental part of conflict is perhaps a preliminary observation, its practical significance could be extensive. The social choices that stakeholders make during disputes (consciously or unconsciously) independent of the problem *per se* could significantly alter the nature of conflict and the environment within which decisions are taken. This review therefore also considers the potential theoretical impact of such social processes, drawing on existing concepts from a range of disciplines. The use of tactics, strategies and purposeful behaviour, often associated with the notion of conflict, could have potentially significant effects on the progression of dispute and its subsequent outcomes. It is proposed that by adopting an artificial conflict position in which all parties are assumed to be competing against each other, such interactions may be highlighted. While it is recognised that in reality, stakeholders may occupy a spectrum of positions from fully competing to fully cooperating; assuming this artificial position allows the potentially significant impacts to be more explicitly highlighted. The theoretical investigation of the impact of conflict on decision-making therefore represents a further literature review objective.

Defining the nature of conflict for application in environmental disputes and exploration of its potential impact are identified as two key focus areas which must be addressed to enhance theoretical understanding of disputes and development of appropriate methodologies. A critical review of literature around these two themes is presented in subsequent sections. In the first section, exploring the nature of conflict, the review is presented in the context of the development of a conceptual framework for dispute definition. The section justifies why such a framework is needed for environmental management, outlines the method of development and illustrates its use as a structure for literature categorisation and conflict diagnosis. This approach was utilised to increase the practical function of both the framework and literature review. The second section outlines a theoretical exploration of the potential impact of conflict, considering the nature of its role in decision-making, and the opportunities it may present to stakeholders. This section is intended to synthesise a new perspective on environmental conflict, emphasising the importance of stakeholders and their interactions. It aspires to establish the social context of conflict and highlight the potential implications for environmental management. While presented separately both reviews have subsequent implications for environmental management and, the development of a methodological approach for this research. A discussion of the implications of these factors therefore follows a critical review of literature.

2.3 In the Absence of Definition: A Framework for Understanding Environmental Conflict

The field of natural resource conflict research has expanded rapidly (e.g. Daniels and Walker, 1997; Buckles, 1999; Hellstrom, 2001), as has investigation of case specific ways to manage contentious environmental issues (e.g. Niemela *et al.*, 2005; Murshed-e-Jahan *et al.*, 2009; Marshall *et al.*, 2010). Considerable dispute resolution expertise has been devoted to the subject of environmental conflict in the last thirty years (Bingham, 1986; Susskind and Cruickshank, 1987; Carpenter and Kennedy, 1988; Gray, 1989; Crowfoot and Wondolleck, 1990; Dukes, 2004), yet despite this, conflict remains a practical reality. Environmental issues represent an urgent challenge throughout the world. Air, water, and land pollution continue placing strain on the Earth's capacity to sustain healthy ecosystems and human life (Opotow and Weiss, 2000). Significant problems caused by resource utilization and modern industrial societies cause further strain. Signs of these changes have emerged across the globe, from the drying of the Aral Sea, to the shrinking of glaciers in alpine and polar regions, to the collapse of fisheries. With the world's population expected to reach approximately 8.9 billion in 2050 (Cohen, 2003), from its current (March, 2012) 7.02 billion, there is considerable risk of further degradation and conflict escalation (see Homer-Dixon, 1994) as environmental burdens increase, and thus a significant pressure to resolve these issues now. But attempts to deliver change are frequently met with resistance, and many environmental problems are in a state of impasse where conflict among stakeholders prevents action. Lewicki and Gray (2003) highlight that despite considerable expertise; many environmental conflicts experience this, delayed by controversy and long standing tensions which defy resolution. As environmental conflicts persist, they can increase in intensity and become more complex, but in the meantime degradation continues. As the need to address environmental issues grows, the poor translation of conflict theory into management practices becomes more apparent. This gap raises the question why when so much is known about conflict, is resolution not achieved?

To properly manage conflict it must first be understood. The concept of conflict is ambiguous (Martín-Cantarino, 2010). Researchers have for decades sought to produce an adequate definition, but it remains elusive, creating conceptual and terminological confusion. Early reviews by Fink (1968) and Schmidt and Kochan (1972) note the diversity of empirical and theoretical approaches to the study of conflict; they highlight that without an operational definition, comparison is limited and the findings of multiple studies cannot be drawn together. Although the focus of considerable study since, the ability to produce a comprehensive definition of conflict remains difficult; Infante (1998), in a review of only interpersonal conflict, was able to gather and analyse 78 published definitions, which was not intended to be exhaustive. This overabundance reflects the ambiguity of theoretical approaches and the number of the disciplines involved (Entelman, 2002). The author proposes that this disparity is the product of a lack of conceptual clarity as to what conflict is, which is poorly communicated to practitioners. Limited understanding of conflict in turn restricts the application of dispute management techniques and may account for the resultant gap between the wealth of theoretical knowledge and its lack of practical resolution.

Defining the parameters of conflict is significant not only from a theoretical viewpoint but from a practical one, it is important to consider the conceptual consequences and to find a working definition to aid resolution. The range of study required to gain an understanding of conflict, adequately explore the concept and, select the most appropriate resolution mechanism, is beyond the available time frame of most practitioners. Expecting practitioners to undertake this task is unrealistic, but is an important first step for conflict resolution. It is therefore proposed that considered design of the literature review may simultaneously highlight the nature of conflict and address this gap. This section uses an application-based research approach to design a framework for practitioners which operates as a working definition of environmental conflict in lieu of a concise written one. This framework will be used to organise existing literature and provide a baseline understanding of conflict in place of a definition. In this section and throughout this study, the terms ‘conflict’, ‘dispute’, ‘discussion’, and ‘debate’ are used interchangeably. While the author recognises that these terms may be associated with different scales of impacts and intensities, within this study they are synonymous with conflict.

2.3.1 Why is an Environment Conflict Framework Needed?

Initial exploration and review of literature sought to determine the nature of environmental conflict. Attempts to address this were met with considerable difficulties; the obstacles encountered have subsequently become justifications for the creation of a generalised framework. Each is highlighted and discussed below.

1. As an event, environmental conflict is not easily identifiable nor conceptually distinct.

Investigation of environmental conflict highlighted that the term was applicable to a broad range of events or actions, each providing a different conceptualisation of conflict. Review of the term environmental conflict, primarily yields literature which refers to international armed disputes. Westing (1986) provides twelve examples of what he considers to be environmental conflict; all refer to armed disputes over control of or access to natural resources. Renner *et al.*, (1991) note that throughout history access to, and control of natural resources has been the root of many conflicts and tensions. Studies by Galtung (1982) and Brock (1991) refer to environmental conflict in terms of resources, focusing on the importance of control and desire to increase or maintain allocation. It is possible to identify a number of examples of armed conflict with clear environmental themes; a sample is presented below (see Table 2.1).

Research within the context of war defined conflict as, an awareness on the part of the parties involved of discrepancies, incompatible wishes, or irreconcilable desires (Boulding, 1963). Under such a definition, cases of environmental conflict are not limited to armed disputes but could encompass a broad range of scenarios. Public protests, an emerging function of growing environmental awareness and public interest, also highlight the incompatibilities between campaigners and their target organisations. The actions they utilise, such as eye catching stunts, public demonstrations or violent acts, express their message, making underlying conflict visible. Cases of environmental protest are noted globally, they differ in their goals and severity. Examples include: the destruction of GM crops trials in 1999 (UK), the attempted sabotage of the Ratcliffe-on-Soar coal fired power station (UK), and the use of iconic stunts such as displaying a banner from Christ the Redeemer (Brazil) in 2002. While some protests can be violent, they present a very different conceptualisation of conflict to wars.

Table 2.1-A Sample of Examples of Armed Conflicts over Natural Resources

Resource	Example	Description	Reference
Land	World War II	The policy of 'Lebensraum' or living space was a major driver of World War II, and could be in part viewed as an attempt to increase land resources.	Westing (1986)
Natural Resources	Spratly Islands, South China Sea	A boundary dispute over ownership of the resource rich continental shelf. There are six potential claimants to all or parts of the islands and their natural resources, and it is the subject of ongoing tension.	Denoon *et al.*, (1996)
Sources of Energy	Invasion of Kuwait, 1990	A seven month occupation of Kuwait by Iraq over control of oil supplies. Initial investigation and subsequent UN intervention were linked to the economic importance of oil.	Warbrick (1991)
Food	Cod Wars (1972-1973)	Between Iceland and the UK, disagreements regarding shared fisheries resources led to numerous confrontations between fishing vessels, the British Navy and the Icelandic Coastguard	Westing (1986)
Water Resources	Water Wars Armed tensions over control of or access to water	Israel against Jordan and Palestine Turkey against Syria and Iraq Egypt against Sudan and Ethiopia	Wolf (1995) Kliot (1993) Swain (1997)

Within environmental fields, increased awareness of incompatibilities between different legislative mechanisms are becoming apparent, creating what could be considered environmental policy conflicts. Many studies note tensions between achieving policy goals which coexist in specific cases (e.g. Khazzoom *et al.*, 1990)- transportation and pollution control; (Peterson and Rose, 2006)- climate change and energy production; (Jackson, 2011)-climate change and biodiversity protection). These tensions create legal conflicts which prevent decision-making and action. Other policy disputes arise from the increasingly collaborative nature of environmental decision-making. Ensuring stakeholder consultation is now a formal part of many environmental processes (e.g. Environmental Impact Assessment) facilitating consensus can be challenging, particularly when groups differ in their requirements. Within environmental studies a distinct type of these conflicts has emerged, in the form of not-in-my-backyard (NIMBY) disputes. NIMBY disputes arise from projects which have widely dispersed benefits but concentrated costs. They do not necessarily have to be environmental in nature (e.g. conflict over the site of a prison), but have emerged over the placement of waste management facilities (Andrew, 2001), wind turbines (Wolsink, 2007) and cultivation sites for GM crops (De Cock Buning *et al.*, 2011).

Furthermore, there are environmental scenarios, which although not being labelled as environmental conflicts, could be under Bouldings (1963) definition. Buffel grass (*Cenchrus ciliaris*), is an invasive species in Australia with significant environmental impacts, but one that is highly prized by pastoralists for livestock (Marshall *et al.*, 2010). Both commercially valuable and environmentally damaging, implementation of management strategies is a contentious process (Smyth *et al.*, 2009) due to the differential interests involved, and is a significant challenge to practitioners. Natural resource management often encounters resistance to actions, goals are frequently contested, public dissatisfaction increases and animosity grows (Le Billon, 2001; Jabareen, 2004). Inability to identify such scenarios as conflict, due to limited understanding of the term restricts application of relevant knowledge.

Each of these examples could be defined as an environmental conflict, yet are when compared fundamentally different. Some are highly visible and easily labelled as conflict, where others would not be so readily labelled as such. The inability to determine what conflict is, not only limits identification but also conceptualisation and understanding.

2. Each event type is associated with different causal factors, it is therefore unclear what environmental conflict actually involves.

If environmental conflict is considered as an armed dispute, causal mechanisms may focus on differential resources, economics, security and the potential for future scarcity induced disputes as environmental degradation continues (see Deudney, 1991; Molvær, 1991; Homer-Dixon, 1994; Simon, 1998). As an environmental protest, differential perceptions and values between campaigners and their opponents, their relative power and influence become important. In NIMBY disputes, social relationships are important and yield unexpected responses. For example, public support for renewable energy is high, but placement of wind turbines is much more difficult than statistics suggest, causal mechanisms are attributed to a number of factors but centre on perceptions of risk, a lack of social trust and emotional components (Glickel, 2011). Each type of event therefore generates a very different understanding of what conflict is, when in fact it may include all of these parameters to some extent. Consideration on an event basis, could limit conceptualisation key parameters of conflict may therefore be absent from resolution techniques. A lack of conceptual clarity therefore makes it difficult to identify environmental conflict as an event; but disputes as a process yield further dimensions to consider. Krott (2005) investigate conflicting interests, Nie (2003) values. Other studies consider differing perceptions (Lewicki *et al.*, 2003) or differential problem framing (Gray, 1997). Issues of conflict escalation (Yasmi *et al.*, 2006), conflict dynamics (Pondy, 1967) are also considered, as are the importance of specialised knowledge and stakeholder relationships (Opotow and Weiss, 2000). Furthermore, Libiszewski (1992) highlights environmental disputes manifest themselves as political, social, economic, ethnic, religious, ideological or territorial conflicts, associated with environmental concern or degradation. Such work suggests that to resolve environmental disputes is particularly complex because it requires an understanding of multiple kinds of conflict (Thompson and Gonzalez, 1997), further expanding the diversity of information to be assimilated. With no centralised starting point to highlight all these dimensions and guide further study, what a practitioner considers conflict to be is dependent on the course of their literature search (assuming they conduct one). A practitioner that reads work by Nie (2003) and Lewicki *et al.*, (2003) will have a significantly different understanding of conflict to one who examines work by Pondy (1967) or Yasmi *et al.*, (2006). Inability to clearly identify conflict therefore has subsequent implications for understanding, which in turn restrict its application.

3. The field of environmental conflict literature is chaotic and difficult to navigate

Empathising with a practitioner and assuming no previous academic background in conflict, the field lacks a logical starting point for objective consideration, and thus most would start their search based on the type of event they face. An event-based approach would inevitably influence perceptions of what conflict is and thus how to resolve it; key themes may therefore be absent and have significant impacts for resolution. Inability to determine what conflict is, therefore presents a barrier for practitioners. It may prevent both practitioners and fellow authors from labelling events as conflicts, their exploration excluding key studies due to terminological differences.

Furthermore, in seeking to resolve conflict, there are a wide range of solutions available. Since the 1970s, tools have been developed to help settle disputes. They include studies such as those by Fisher *et al.* (1991) on negotiation, Cormick (1986) and Bingham (1986) on mediation, Bacow and Wheeler (1984), and Susskind and Field (1996) on business policies for dealing with conflict. As understanding of conflict has become more complex so too have tools for resolution, including cognitive mapping (Ozesmi and Ozesmi, 2004), collaborative discussions (Crowfoot and Wondolleck, 1990), social learning (Pahl-Wostl, 2006), complex decision support models (Fang *et al.*, 2003), cost-benefit analysis (Ackerman and Heinzerling, 2001), and multi-criteria analysis (Mendoza and Martins, 2006). Selecting appropriate strategies from a seemingly chaotic field of literature based on a partial understanding of conflict is a significant challenge for practitioners. Rauschmayer and Wittmer (2006) note selecting methods and tools for conflict resolution is ill-defined, and may explain why environmental disputes persist.

It may therefore be possible that there is so much information available on the nature and processes of conflict and its resolution, that its volume reduces functionality. Greater consideration of how conflict literature will be used by practitioners, may address this disparity. Borrowing from the notion of 'Mode 2' and conflict based knowledge generation (see Gibbons *et al.*, 1997), there is significant argument for application based approach to a review of conflict. The pursuit of conflict definition over a number of decades presents a wealth of research with clear disciplinary boundaries and a focus on theoretical understanding of its parameters and their validation. Few studies seek to generate practical tools for generic application. The same is true in environmental conflict, in a review of literature, traditional 'Mode 1' theory based research style approaches, which seek to identify, analyse and contribute to understanding, significantly outweighed 'Mode 2' application based approaches whose goal is management (Figure 2.1). Studies were classified as 'Mode 2' if they provided a practical tool for resolution (i.e. research is application based), of the 19 studies highlighted as such, none generated tools which were specifically designed and/or available for practitioners to implement independently, representing a significant barrier.

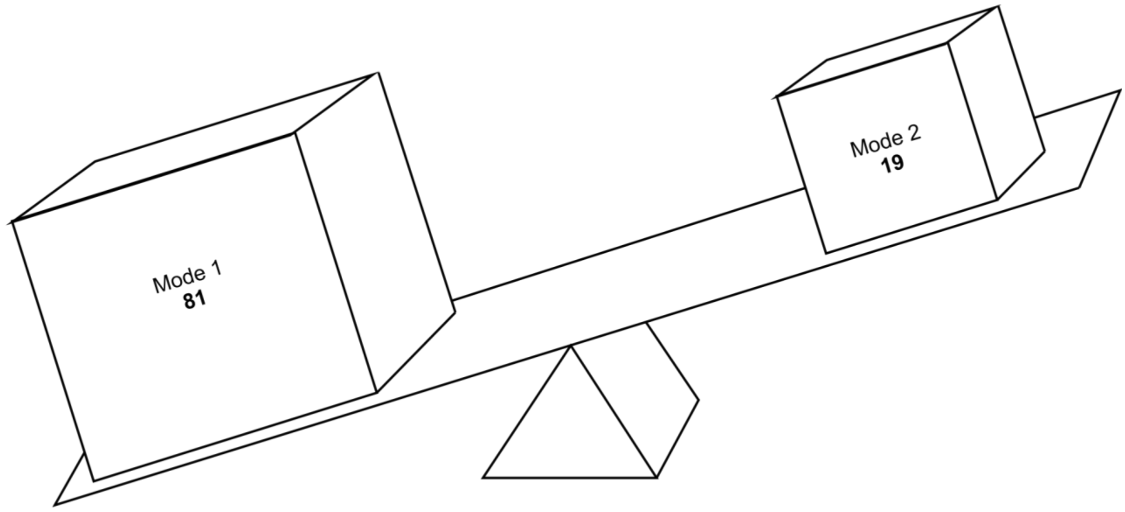


Figure 2.1-Illustration of the prevalence of Modes 1 and 2 within environmental conflict resolution literature.

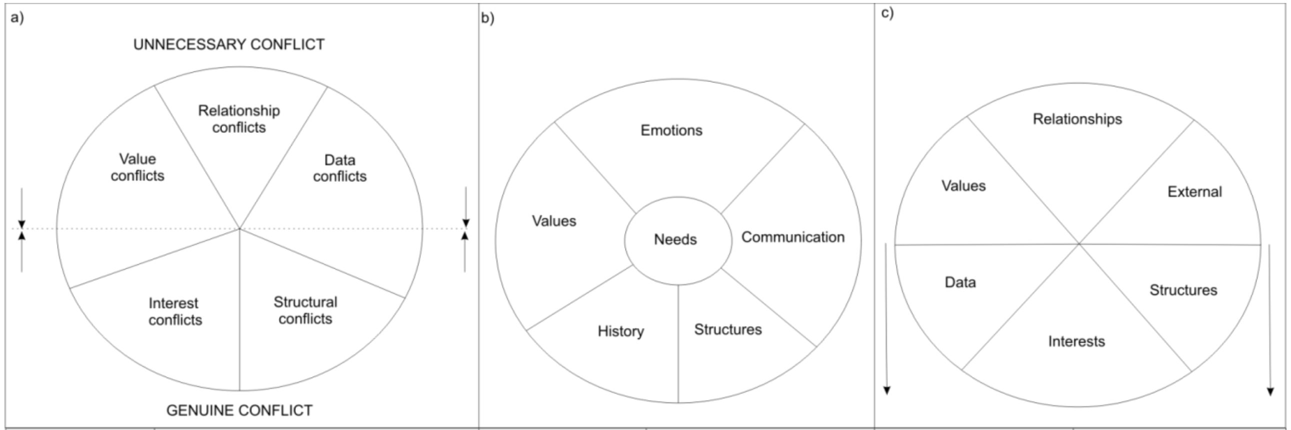
The diagram is based on a review of 100 documents published since 1994 (the establishment of Mode 2), from the following databases: Science Direct/Elsevier, Springer Link and JSTOR. The first unique 33 documents (34 in the Science Direct search) using the search term ‘environmental conflict resolution’ were sampled. Where searches overlapped, additional documents were sought until the total was met. The key attributes of Modes 1 and 2 are listed Table 1.2.

Addressing these obstacles identified and labelling contentious issues, from the major debates (e.g. tackling climate change and deforestation) to the minor management disputes (e.g. cases of invasive species management, or renewable technology development), as environmental conflicts could have significant benefits to practitioners. Framing them as disputes could enhance understanding of the problems experienced and opens a broader framework for action. This only applies if the concept of conflict is understood. There is therefore a significant need to address this issue of conceptual clarity and functionality, in an attempt to cut across these obstacles and present a holistic baseline understanding of environmental conflict. This framework would therefore aim not to communicate all available information on conflict but to convey a purposive sample as a conceptual starting point for dispute exploration and diagnosis. The development of this framework, representing the first of a series of resolution tools which can be applied by practitioners. Using this as a guide, the wealth of traditional disciplinary research can be transformed into a framework which assists practitioners.

2.3.2 Developing a Framework for Practitioners

Furlong (2005) highlights that managing conflict is a two-step process involving how conflict is assessed and the actions (or inactions) which are subsequently implemented. To facilitate resolution, practitioners need to understand the full extent of the problems they face and the causes of conflict; ability to diagnose the situation is therefore crucial. In complex scenarios, theory alone does not lead to adequate diagnosis, there is a need for effective tools to facilitate an accurate analysis (Furlong, 2005). Furlong (2005) illustrates this using the analogy of heart disease. Heart disease has been linked to various factors (e.g. cholesterol, salt intake), complex theories discuss how they contribute to heart attacks, but knowledge of these theories does not aide diagnosis of a patient, a range of tests based on these theories are needed. It is proposed that the same occurs within environmental conflict, theoretical knowledge is a foundation but a tool is needed to apply it. Moore (2003) notes that for practitioners to intervene effectively, they require a conceptual tool that outlines its nature. A model that is frequently used by practitioners in social science to diagnose disputes is the circle of conflict (Moore, 1986), often used in the training of mediators. The circle of conflict is a model which has been utilised by many authors; each has presented slightly different variations of Moore's (1986) original concept (Figure 2.2).

The circle categorises the underlying causes of conflict that a practitioner may face, offers a framework for diagnosis, and (in some versions) strategic direction on ways to move forwards (Moore, 1986). Utilisation of the model allows more objective analysis, and as a tool is aimed at and used by conflict resolution practitioners. Furthermore, the circle of conflict is not limited to any substantive type of dispute, allowing it to potentially be applied to a spectrum of environmental scenarios. Based on these characteristics it represents a functional starting point for a 'Mode 2' exploration of conflict, which has subsequently been further developed into a conceptual framework. Numerous other models of conflict exist; the circle of conflict was selected due to its conceptual clarity and functionality.



Moore (1986; 1996)		Mayer (2000)		Furlong (2008)	
Drivers	Description	Drivers	Description	Drivers	Description
Relationship	Negative behaviour, Misperceptions/ stereotypes, Poor communication, Strong emotions	Emotions	Frustration, Anger, Shame, Guilt	Relationships	Stereotypes, Poor communication, negative behaviour
Value	Day to day values, Self defining values	Values	Beliefs, Core values	Values	Beliefs
Data	Lack of information, Misinformation, Different interpretations	Communication	Lack of information, Perceptions, Misinformation, Stereotypes	Data	Lack or excess of information, misinformation, Data collection problems
Interest	Substantive (physical resources), Procedural Psychological (e.g. trust, fairness, respect)	Needs	Goals that must be met	Interests	Parties wants, needs, desires, concerns
Structural	How situation is set up, Geographic/ physical relationships, Unequal power distributions Unequal control of resources, Time constraints, Role definition	Structures	Distribution of resources, Established procedures, Access, Legal parameters, Political structures	Structures	limitations on resources, geographical constraints, organisational structures
		History	Antecedent conflict conditions, Past interactions	External	Factors unrelated to conflict but affect it e.g. Moods

Figure 2.2-Variations of The Circle of Conflict, associated drivers and their descriptions as depicted by a) (Moore, 1986; Moore, 1996) b) (Mayer, 2000) c) (Furlong, 2005).The circle provides a framework for conflict diagnosis by providing drivers for consideration, each model is slightly different in design. Model a highlights five drivers and divides them into genuine and unnecessary conflict components (indicated by dotted line and arrows). Model b introduces a sixth driver of history, and places needs at the fundamental centre of all conflict, it does not classify components. Model c introduces a further driver of external factors, the author suggest concentrating on reducing drivers bellow the central line (indicated by arrows) and managing those above.

Using the same principles of design as the circles of conflict, functionality and simplicity, a conceptual structural framework of conflict was created (Figure 2.3). Alongside the seven amalgamated categories present in the circles of conflict (Moore, 1986; 1996; Mayer, 2000; Furlong, 2005), additional themes of power and timing are included following exploration of conflict. The framework is depicted as a double helix to convey the notion of structure, based on the analogy of DNA. Just as DNA is made up of different combinations of chemical bases (adenine, guanine, cytosine and thymine) around a sugar back bone; conflict is made up of different categorical drivers (e.g. needs/interests, structures, communication, etc) within the problem situation boundary. The exact combination presented is therefore unique to each case, as with DNA. While all categories interact to create conflicts structure, there are a number of distinctive links between some elements. These elements are therefore presented as 'base pairs' within the conceptual conflict helix, but all categories are interlinked and interactions not limited to within these couples, as with actual DNA bases. Categories have equal weighting; the sequence presented is not representative of importance. As with the circle of conflict, the framework provides strategic direction for conflict resolution.

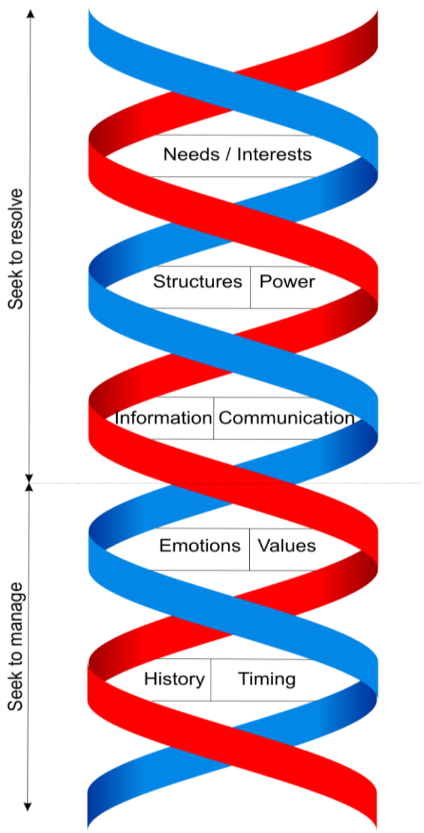


Figure 2.3-Conflict Assessment Helix- A conceptual framework which creates a structural model of conflict definition, based on the analogy of DNA and the double helix.

The framework highlights nine categories (needs/interests, structures, power, information, communication, emotions, values, timing and history) which can then be used to frame an interdisciplinary review of conflict literature to outline the potential dimensions to be considered in each category. It is intended that the framework (Figure 2.3) along with the associated preliminary literature review (see subheadings below), be used as a working definition of conflict, ensuring objective consideration by practitioners. Each subheading provides a short review of interdisciplinary conflict literature, to highlight parameters which may be associated with that category and is intended to broaden understanding of the potential factors which causes disputes.

Needs and Interests

Mayer (2000) notes people's needs are a central driver of their actions, including engagement in conflict. Maslow (1954) differentiates between different types of needs, highlighting that deficiency needs (e.g. physiological, safety) will be addressed prior to growth needs (e.g. cognitive dimensions). Different types of needs can therefore be associated with differential importance. In conflict literature, the terms needs and interests are often used both consecutively and interchangeably, implying that the difference between them is subtle. In general, needs are perceived to be more urgent, required actions and interests as desires. Mayer (2000) proposes that in the practical understanding of conflict it is more useful to think of interests as a category in a continuum of human needs, ranging from survival requirements to interests to identity based concerns. Survival needs are evident in natural resources conflict their distributions among populations and future scarcity are key concerns (Homer-Dixon, 1994; Warner, 2000). Freshwater availability is a prime example, fundamental to human life and with a finite amount available globally the conflict risk is considerable; as economic redistribution is difficult and there is no substitute for water (Wolf, 1998). Interests refer to the practical concerns that drive most conflicts (Mayer, 2000). It is possible to note many different types, which may be short or long term (Thomas, 1992), individual or collaborative (Triandis and Gelfand, 1998), outcome or process based (Mayer, 2000) and conscious and unconscious (Banaji *et al.*, 2003). Moore (1986; 1996) groups interests into substantive (concerned about tangible benefits), procedural (related to interactions, communications or decision-making processes) and psychological (how one is treated by others). Identity based needs, refer to individuals requirements to preserve a sense of who they are and establish their place in the world (Rothman, 1997). Rothman (1997) highlights that these refer to the need to feel connected with groups (community), wanting to feel special or unique (intimacy), developing a sense of independence or individuality (autonomy) and the need for meaning to their actions. In pursuing conflict, people can develop a considerable sense of purpose to their actions. Mayer (2000) notes that for many of the people living in the Israeli-held West Bank the issue is not simply security or economics, it is the meaning the struggle has given their lives; this is one source of intractability in the Middle East. Establishing the needs and interests of various parties is an important starting point when determining the nature of conflict.

Structures and Power

Structures refer to the framework within which interactions takes place (Mayer, 2000). While the structures involved vary dependent on the conflict situation, they may include distribution of resources, established procedures, access to information, legal parameters, and political pressures. Structures influence conflict by enforcing a process that either induces or highlights incompatibilities. In an organisational environment, decision-making processes, time constraints and set communication channels all represent structures, which can enhance disputes amongst co-workers. Within social conflict theory, societal structures are thought to emphasis inequalities between groups, largely due to associated power distributions. Marx *et al*., (1906) viewed capitalism as a system that reinforced socio-economic structures which would inevitably produce tensions that widened class divides. Knapp (1994) suggests that existing structures are a function of differing interests, power distributions and resource availability throughout society. Referring to what he terms the American power elite, (military and industrial interests) that dominate national decision-making, Sears (2005) suggests that the powerful are able to impose their views on others and have them accept discourse, citing the ideology of the American dream as an example. The concept that there are structures within the functioning of society that support on-going disputes has implications for the success of conflict resolution. Existing structures can indirectly reinforce divisions between groups by maintaining existing hierarchies that lead to asymmetries of power between parties involved. There are many different vehicles to exercise power over another; wealth, education, culture, laws and wars (Francis, 2004). Power is used as a tool to amplify arguments and achieve one's goal, and thus can be used to control a conflict regardless of subject. In an attempt to reduce conflict, such structures can be altered to reduce their impact.

Communication and Information

Imperfect communication generates conflict (Mayer, 2000) as a result the role of communication and associated information has been widely studied. Heckathorn's (1980) unified model of decision-making, bargaining and conflict suggests that incomplete information is the central cause of conflict, rendering any decisions made unsuitable. Work by Brito and Intriligator (1985) highlights the role of information in the armed conflict process; in the case of asymmetrical information, the risk of war is enhanced but not definitive, dependent on the nation's response to asymmetry. The advantage of information, does allow deceptive strategies (bluffing) to develop, increasing the resources transfer. The uninformed nation can either accept the bluff (a pooling equilibrium strategy) or call the bluff (a separating equilibrium strategy). The equilibrium selected is based on resources, power and other such strategic elements. The risk of actual war is greatest when the uninformed country has sufficient wealth to adopt a separating equilibrium strategy (Brito and Intriligator, 1985). This model is based on a number of assumptions, such as rationality and desire for a cooperative solution; but highlights the role of human decision-making processes. While not examined in the same manner in the organisational literature, work by Jehn and Bendersky (2003) suggests that informational diversity is an amplifier to conflict, strengthening the relationship between conflict and outcomes, whether that be positive or negative.

Brito and Intriligator (1985) studied solely levels of knowledge but highlighted the strategic dynamic between parties. Earlier work on communication and bargaining in the context of war (Schelling, 1957) examined the phenomenon of tacit co-ordination and how it can impact strategy. Through artificial problem experiments, Schelling (1957) concluded that it was possible for two silent individuals to take the same course if they could read the same message in common situations, to identify the one course of action that their expectations of each other can converge on. Schelling (1957) examined what role tacit bargaining would have where there was a conflict of interest, deducing that without communication, each party is the prisoner or beneficiary of their mutual expectations of each other. While no communication leaves the parties reliant on perceptions of each other, when it does occur, the nature of communication is crucial. Communication can help address informational asymmetries between parties; it is dependent on the nature of the information being shared. Communication of fact regarding the task maybe useful, but communication of opinions or negative emotions may serve to reinforce conflict. The nature of interactions will be dependent on the composition of communication structures and the willingness of the individual to express emotional elements.

Emotions and Values

Emotions are both a cause and the fuel of conflicts (Mayer, 2000); despite this, literature on conflict has largely over looked emotions. Ashforth and Humphrey (1995) define emotionality in rather broad terms as a subjective feeling of state. This definition includes basic emotions (anger, joy, love), social emotions (shame, guilt, jealousy) as well as social constructs (affects, sentiments and moods). Bodker and Jameson (2001) argue that to be in a conflict episode is to be emotionally charged and that it is these emotions which makes one aware of the conflict that one is engaged in. Pondy (1967) distinguishes between perceived conflict and felt conflict, noting that conflict must be felt prior to manifestation. When considered, emotions are often studied as an outcome of conflict (Kolb and Putnam, 1992; Ashkanasy and Daus, 2002; Yang and Mossholder, 2004), rather than as a causal mechanism. There is a bias towards study of negative emotions and the perceptions that result from conflict (Nair, 2008). Jones and Bodker (2001) view emotions as a framer of conflict, posing that emotional and conflict triggers are the same; once engaged, emotional intensity will shape conflict and if not fully resolved have the potential to fuel further conflict. This suggests a cyclical link between emotions and conflict where emotions exist prior to, throughout and after the conflict process. Other models examine their role in conflict intensity. Pruitt *et al.*, (1997) suggest a linear conflict process with a complex interplay of emotions, which form an escalating sequence of behaviour, relative to emotional response. Pruitt *et al.*, (1997) note an inverse relationship between level of emotion expressed and the number of people involved, with only very few people reaching the highest levels of escalation. Jehn (1997) suggests that such highly emotional conflict is harder to resolve, but all focus on negative emotional frames. Positive emotions, such as desire to seek connection, affirmation and acceptance can be important in preventing conflict expression, but are relatively understudied.

Jones and Bodker (2001) propose a link between emotions and values, suggesting that emotional responses are as a result of conceptions of right and wrong. This link is supported by additional work (see Hurley, 2007) arguing that emotions reflect both objective and personal values. Values are the beliefs that shape perceptions and the principles that govern our lives. Conflict defined by contradictory values becomes charged and tenacious, usually due to disputes regarding core beliefs. Some conflicts are unavoidable due to fundamental differences in values; resulting positions are based on perceptions of right or wrong. Such a definition empowers and fortifies an individual's argument and narrows the range of solutions they may find acceptable (Mayer, 2000). In this way, values can add justification to continued conflict, where an individual perceives themselves as honourable and their opponent as malicious and deceitful. Perceived differences in interests, views or goals are central to conflict, with some work (Kolb and Putnam, 1992) suggesting perception of incompatibility is a necessary precondition for conflict to occur. However, others suggest that one party must directly interfere with the aims of another for conflict to exist (Deutsch, 1969; Tjosvold, 1991). Both emotions and the values that shape them have clear links to the behaviours individuals' exhibit.

History and Timing

Mayer (2000) suggests that conflict may have historical context, whereby antecedent conditions and previous resolutions strongly influence current episodes. However, history is not a determinant of conflict; long histories of conflict in the Middle East and Northern Ireland do not mean resolution is not possible, but that current disputes cannot be solved without an understanding of the past. This concept was illustrated by Pondy (1967) describing five stages of conflict (Figure 2.4).

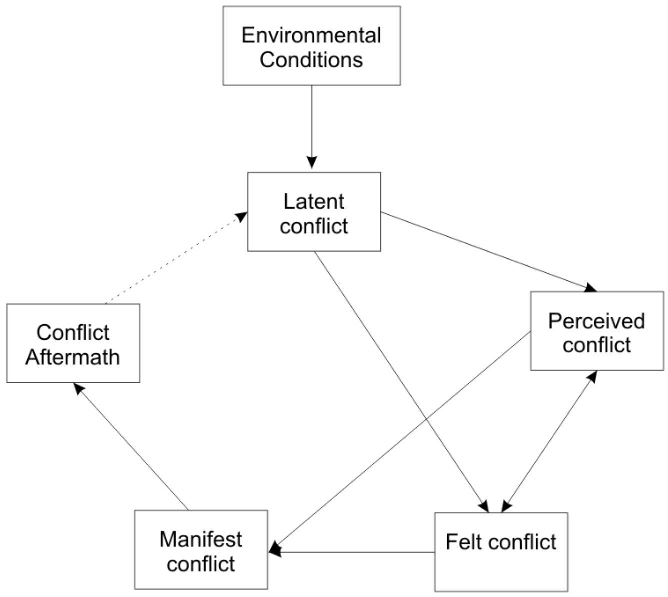


Figure 2.4-The dynamic of a conflict episode (after Pondy, 1967)

The model proposes cyclical stages, which repeat during each conflict episode, highlighting that conflict changes as individuals move through stages and the presence of antecedent conditions which exert an influence. Detusch (1969) suggests as conflict develops it has a tendency to escalate, often leaving the initial cause forgotten. Timing of conflict expression within these cycles can shape its nature; Jehn and Mannix (2001) note temporal patterns to outcomes by conflict type. Process and task conflict are positive attributes at the early stages but became negative if they still exist at execution. Relationship conflict was found to be negative regardless of time. In addition to antecedent elements, future considerations may have a role in understanding current conflict situations. Garfinkel and Skaperdas (2000) suggests there is a relationship between likelihood of war and the importance of a resource in the future. The authors state that war can occur despite short-term incentives to settle peacefully, due to the dependence of tomorrow's resources on today's performance. Fearon (1998) cites the case of Croatian Serbs who decided to fight in 1991 because they feared defeat would put them in a weaker position in the future. The notion that a given conflict can have elements, which extend both into the past and the future, is important to note.

By using the categories highlighted in the conceptual framework (Figure 2.3) existing literature can be presented to practitioners with greater clarity. The simplicity of the framework itself aids initial conception of what conflict broadly is, the associated literature review enhances understanding by elaborating on potential causal mechanisms. This allows practitioners to draw parallels between facets of conflict highlighted in theoretical and empirical research, and factors identified within their own problem scenarios. It is intended that when used by a practitioner (with no or little background in conflict resolution), their understanding of conflict will shift significantly, creating a more objective foundation on which to base problem diagnosis, a fundamental step for achieving conflict resolution.

2.3.3 Discussion

The aim of this section was to design a framework for practitioners which operates as a working understanding of environmental conflict, to organise existing literature and provide a baseline understanding in place of an agreed definition. Prior consideration in the literature presents a chaotic field of research to a practitioner, in which there is a lack of clarity as to what an environmental conflict is. In response a framework was designed, to provide a conceptual structure to existing conflict literature making it more accessible to practitioners. Taking a holistic approach prevents definition within a given problem context and the tendency to assume conflict characteristics based on the nature of the event. The review of conflict literature presented is designed to communicate the findings of a wide range of studies, but is by no means definitive. The established concepts and empirical research findings presented outline areas for consideration, and should be used to frame the issues that practitioners' experience. The purpose of developing the framework was to provide a baseline understanding of the parameters of conflict, allowing practitioners to assess environmental disputes more objectively and subsequently diagnose problems. The framework challenges individual assumptions as to the nature of conflict, providing a broad guide as to what the dimensions of a given dispute may be.

It is recognised that the framework presented (Figure 2.3) represents an oversimplification of a very complex process and could be argued by some to be deficient, with some parameters of conflict (e.g. handling modes) absent. Furlong (2005) suggests a successful conflict analysis model will provide a balance between simplicity and complexity, distilling the key points to focus on in a useful manner. Other theorists (e.g. Rummel, 1976) have attempted to provide detailed models for understanding all types of conflict at the cost of functionality- Rummel's (1976) model required a full length book to explain). The framework presented is intended to be useful, Furlong (2005) notes good conflict analysis models focus on whether they are helpful rather than right. In terms of facilitating resolution, the framework remains untested. However, the framework design is based on an established conflict resolution tool (the circle of conflict), it therefore can be used to structure diagnosis of a dispute in the same manner that it organises literature. Furthermore, both Moore (1986; 1996) and Furlong (2005) propose actions relating to diagnosis. They suggest that successful conflict resolution should focus on addressing structural, interests and data categories to yield the best opportunity for collaboration, and seek to manage other components. It is possible to make the same distinctions within the developed framework (see Figure 2.3). These factors strengthen the probability that the framework will provide a functional tool for practitioners. A further assumption of the model is that a lack of conceptual clarity is experienced by all practitioners with no previous background in environmental conflict and its resolution. While this assumption remains untested, it is based on the authors' experience in attempting to find an adequate definition of conflict. If it represents a considerable challenge to academics with available resources to investigate it, that practitioner's face the same issue is a rational assumption.

Inability to define environmental conflict represents a significant problem for resolution, as acceptance of a limiting definition can have serious consequences on conceptualisation and analysis (Tjosvold, 2006). In pursuit of definition, there has been intense focus on determining the full parameters of conflict, a process which has continued iteratively over the last four decades, further expanding understanding but arguably limiting functionality and application. The problems facing environmental disputes cannot wait for a concise definition to become available as action is urgent. To facilitate conflict resolution, concepts must be functional; the current prevalence of disputes suggests that is not the case within environmental conflict. The notion of 'Mode 2' as a theoretical concept forces reassessment of the problem, highlighting the need to support the transition from academic output to practical application, as opposed to assuming its natural progression. It is proposed that a shift to a 'Mode 2' approach may address functionality, representing a fundamental starting point to on the pathway to facilitating tangible conflict resolution within environmental fields. This section of the literature review therefore addresses the first gap identified during the preliminary review and produces the first of conceptual tools developed to aid exploration of conflict, in accordance with study aims.

2.4 What is the Potential Impact of Conflict on Environmental Decision-making?

There is a growing consensus that traditional management approaches (focused on physical elements) are insufficient in addressing the complexity, uncertainty, and controversy that characterise contemporary environmental challenges (Garmendia and Stagls, 2010). Against this background, new integrated and collaborative approaches are encouraged that emphasize participative decision-making among stakeholders (Pahl-Wostl 2006), in an attempt to identify management solutions that exploit synergies and promote debate. In decision-making literature, debate is recognized as a necessary process to synthesise opposite positions into a decision which is superior to initial stances. A number of techniques (e.g. devil's advocacy or dialectic inquiry) exist which are designed to produce a decision from diverse perspectives (Cosier, 1978; Schweiger and Sandberg, 1989; Schwenk, 1990). Effective decision-making will also require consensus to ensure implementation, regardless of the quality of that decision (Child, 1972). Thus decision-making suffers from a paradox, as the need for diversity and interaction is often contrary to consensus. Cognitive diversity is recognized as being important, it provides an assortment of skills which can be drawn on when making complex decisions (Hoffman *et al.*, 1962; Wanous and Youtz, 1986), and generates innovative solutions as views are discussed (Allison and Zelikow, 1971; Mitroff, 1982). However, there is no guarantee these differences can be reduced to a common decision, and the process may simply highlight contradictions and inconsistencies. Conflict therefore sits at the root of the paradox, important for high quality decisions, yet an impediment to consensus if not appropriately resolved. The presence of conflict may therefore have significant impacts on both the decision selected and its successful implementation. Furthermore, it is proposed that the manner of navigation of conflict is crucial, its nature may have significant implications for the decision taken and solution implemented, which will in turn have wider impacts for environmental management.

For the purpose of this study, conflict is considered to be a process, moving from baseline potential conditions, through to manifestation, response and further development. While some may argue that the term conflict refers to an event, a situation within which interests contradict; in the social sciences, many authors (see Pondy, 1967; Rummel, 1976) argue that disputes are dynamic over time. The latter perspective is adopted in the context of this section, debate about a dispute and stakeholder responses to it are therefore considered to be part of the conflict process. This approach is adopted as within environmental fields there exist many examples of long standing conflicts (see Lewicki *et al.*, 2003), characterised by considerable intensities which persist indefinitely (Burgess and Burgess, 1996; Kriesburg 1993). Regarding conflict as a static event is therefore not appropriate in such cases.

Numerous studies (Burroughs, 1999; Duram and Brown, 1999; Brugha and Varvasovsky, 2000; Selin *et al.*, 2000) note that people impact on decision-making processes via the behaviours they choose to exhibit, particularly during the establishment of tradeoffs. Links between decision-making and conflict are noted within organisational studies, particularly within strategic decision-making, which attempts to address complex and ambiguous issues (Mason and Mitroff, 1981). In environmental conflict situations, where stakeholders are attempting to make strategic decisions, the impact of such dimensions may be potentially significant, and warrants further consideration. The aim of this section is to establish conceptually the potentially significant impact that conflict could have on the course of decision-making, using known concepts from the interdisciplinary study of dispute**.** The section begins with a discussion of the role that conflict may play in decision-making, considers the importance of stakeholder interactions in determining the nature of that role, and critically discusses the potential for the dispute process to provide stakeholder with an opportunity to alter the nature of the decision taken. Drawing parallels between the social sciences and environmental disputes may therefore highlight important dimensions which are not currently considered and are absent from analysis and subsequent management techniques.

2.4.1 What is the Role of Conflict on Decision-Making?

Establishing conflict's role has been the subject of much research and discussion within the social sciences, with debate centring on whether it represents a negative or positive force. Before 1990, it was assumed it was counterproductive and detrimental to organisational functioning (Coser, 1956; Pondy, 1967; Thomas, 1976; 1992). In this frame, conflict is predominantly negative and should be immediately resolved. Within certain fields, conflict is habitually considered to be negative; warfare is perceived as undesirable and disruptive (Schelling, 1957; Boulding, 1963), legally it represents violation of a contract, and in family studies it denotes arguments, abuse or distress. Despite this, there is sizeable support for circumstances where conflict may lead to positive outcomes, in particular improved decision-making and innovation. Coser (1956) suggested that social conflict may have a functional purpose; he argued it serves to establish group identity and boundaries, increases in-group cohesion and determines the balance of power. Deutsch (1969) argued that it enhances creativity by motivating people to solve a problem, while others have noted that conflict surrounding tasks can lead to strategic decisions and better group performance (Schweiger *et al.*, 1989; Amason and Schweiger, 1994; Jehn, 1995). There are numerous studies which suggest that conflict leads to improved decisions, as problems are considered from multiple perspectives and superior decisions are generated (Nemeth, 1987; Tjosvold, 1991; Jehn, 1994; 1995; Jehn and Mannix, 2001). All of which suggests that conflict has the potential to be a positive force.

Recognising that conflict is not inevitably negative is important. There is a predisposition to associate conflict with negative characteristics, creating an associated hesitancy to label environmental disputes as such. But acceptance of the term and the application of the wealth of knowledge about conflict and conflict management could yield potential benefits. Conflict in the social sciences is therefore recognised to be comprised of functional and dysfunctional elements; functional conflict is often task oriented and generates improved decisions; dysfunctional conflicts tend to be emotional and focus on incompatibilities (Cosier and Rose, 1977; Hammond *et al.*, 1986; Priem and Price, 1991; Jehn, 1992). Both will determine the actions agreed on and the decision implemented, and the net balance between them controls whether conflict is purposeful or unconstructive. The notion of functional and dysfunctional elements is an important step in understanding the dynamics of conflict and recognition within environmental decision-making may be crucial to maximising beneficial aspects.

Within this frame, conflict could yield many of the same potential benefits as highlighted in successful participatory decision-making processes. Social learning, for example, has become popular within natural resources management. Social learning describes a process of communication in which multiple actors collectively learn and develop an understanding of the interests and concerns of others, providing new opportunities to arrive at a shared conception of an environmental situation and agree on interventions (Webler etal., 1995; Pahl-Wostl, 2002; Roling, 2002). It is proposed that such a description is equally applicable to a functional environmental conflict, highlighting the potential (if appropriately managed) for disputes themselves to operate as examples of social learning. However, in reality conflict is not always functional, and the same is true of participatory decision-making processes. The benefits of social learning are not always realised (Muro and Jeffery, 2012); Beierle and Konisksy's (2000) in a meta-analysis of 30 individual participation cases clearly showed that, although some initiatives successfully reduce disputes and increase trust among the involved parties, others had the opposite effect, sometimes deteriorating relationships and increasing the potential for future conflict. Drawing parallels from the field of conflict research could enhance techniques such social learning, while a number of other challenges remain (e.g. stakeholder selection issues) greater understanding of why such techniques fail in some scenarios could have significant practical applications.

While this review is intended to develop understanding of disputes for the subsequent management of environmental conflict situations, it is important to recognise that the difference between the two processes discussed is largely one of framing; participatory decision-making is perceived to be proactive (to avoid dispute), where conflict management as (largely) reactive (following dispute). It is proposed that in the case of environmental conflict, particularly long standing disputes, the distinction is blurred; the baseline conditions of conflict, which may not have yet manifested, must be at least felt to warrant consideration of proactive management strategies. This section considers the potential impact of disputes on decision-making based on existing theories and empirical studies within literature specifically on conflict. However, findings may also be useful within cases of participative decision-making. In recognition of the presence of both functional and dysfunctional conflict elements, it is proposed that the net balance between the two is dependent on the interactions of stakeholders within the process. These interactions determine the character of conflict, and therefore the nature of it impact on decision-making.

2.4.2 How can stakeholders influence the nature of conflict?

Whether conflict is functional or dysfunctional is dependent on the net balance between activities within the conflict process. The expression of conflict is dependent on the people involved within the debate, their interests and desires will inevitably influence interactions and consequently impact on outcomes. Interactions and communication during this process may allow changes in stakeholder relationships, cognitive understanding of the problem (alterations in knowledge or perspective) and in behaviors over time. The ability of these parameters to change is a founding principle of social learning, but it is important to recognize that these changes may be positive or negative. Steiner (2007) noted the importance of the interactions that occur between stakeholders in the production of decisions, suggesting its quality is dependent on the processes they choose to utilize. It is hypothesized that the same processes that are utilized in social learning to enhance collaborative decision-making could equally be used in a conflict situation to alter the nature of interactions. The nature of this change could theoretically be sufficient to alter the course of decision-making.

The fundamental core of any conflict is based on human needs; the conflict process either enables needs to be met or highlights inconsistencies between one's needs and another's, allowing them to factor into any subsequent decisions. This basic understanding of conflict suggests that it serves an individual purpose for stakeholders by highlighting views or concerns which they believe to be relevant and important, and they feel should feature in collective attempts to reach an agreed decision. Glicken (2000) highlights that each stakeholder is fundamental in formulating an endpoint perspective which contributes to overall problem formation, based on their specific interests and values. Each stakeholder is therefore fundamental in developing a holistic understanding of the problem. Work by Harper and Harris (1997) provides an example, their work on Native American tribes, highlights that many lifestyle activities, which are culturally important (e.g. diets composed largely of game and fish) lead to a problem definition which may not be relevant to other communities, and yield different management objectives (e.g. the need for rivers to support fish populations which would sustain the tribe). The requirements of Native American tribes may be significantly different to those of other communities (who may simply require fisheries management for recreational purposes) and may not be relevant to others. Such considerations may not have featured without the involvement of this group of individuals; their inclusion therefore changes the nature of the problem. With two different endpoints to encompass into a management decision, there is a need to select an appropriate course of action from options. In attempting to yield a management decision, a number of dimensions may be considered including legal requirements, cultural values, social importance and economic concerns. Information presented across these dimensions will be stakeholders specific based on the perceptions, worldviews, values and interests they hold regarding the problem. Each individual is therefore important in determining the content of conflict. Furthermore, collaborative interactions, in a functional scenario, allow all to highlight these individual concerns within the context of their given perceptions of the problem and reach an agreed consensus which is subsequently implemented. As social learning attempts to capitalise on this process to enhance the quality of the decision taken; recognition of this is therefore not novel but remains important to note.

However, in recognising that each individual has specific goals which influence the collective issue to be resolved, it is plausible that each stakeholder would seek to pursue their own interests in favour of accepting those of others. Individuals therefore may also influence the nature of conflict by the way that they highlight their concerns. Within environmental conflicts, many disputes are resolved via the development of often complex tradeoffs, whereby the best collaborative solution is selected from among various individual concerns. In establishing these tradeoffs, for the individual there are inevitable tensions between benefits derived and adverse consequences of an activity; each will carry associated advantages or disadvantages. Applying a fully conflicting stakeholder attitude to such a scenario, in which stakeholders are seen to be competing to 'win' the tradeoff; it is possible to conceptualise how the nature of dispute could become subject to complex social processes. If all stakeholders refuse to compromise, the nature of the resultant conflict will be significantly different to one in which all collaborate, which may have in turn significant impact on the resultant decisions taken. While it is recognised, assuming that stakeholders perceive themselves to be 'competing' has potentially negative connotations; adopting such an artificial position is used to explicitly highlight potential underlying impacts of the conflict process which often remain tacit. In reality, where the actions of a stakeholder sit on a spectrum of response, ranging from fully cooperating to fully competing, is dependent on the nature of their personality; a further impact of the individual. This in turn has impacts for collective processes.

Schelling (1957) suggested that to study conflict, disputes must be examined as bargaining situations, in which the ability of one participant to achieve gains is dependent on the choices of the others. Actions are interdependent; behaviours selected by one individual will alter the debate, affecting input stimuli and inducing further behavioural changes in themselves and others. Within game theory, multiple equilibrium equations exist which examine different elements of strategy, all based on the assumption that players are rational. Rationality refers to the assumption that players will constantly pursue their own objectives, to maximise their payoff (Bernoulli, 1954; Von Neumann *et al.*, 2007). A tendency to assume rationality in the study of behaviour is noted across numerous fields, while this may be due to the ease and accuracy of reproduction for modelling, it is indicative of a human behaviour within conflict scenarios. It stands to reason that this would also be a feature of environmental conflict; that individuals will show an inherent preference for the features of a debate they associate with and actively seek to achieve them. Stakeholders could therefore theoretically use the conflict process to pursue their own objectives, as a tool to reduce the difference between a group's outcome and individual concerns via the behaviours they exhibit. If so, then this would in turn influence collective outcomes and impact on decisions taken.

Assuming that stakeholders in environmental scenarios are rational and seek to achieve their specific interests when establishing tradeoffs, there would be a tendency towards conflict over collaboration, as co-operation would carry the risk of losing vital interests. As the actions of stakeholders are therefore not independent, there is the potential for 'social dilemmas' (Wüstenhagen *et al.*, 2003; Rasmussen, 1989). Social dilemmas occur if the actions of two actors depend on each other, and if both select a sub-optimal strategy to minimise their potential losses. In a simple theoretical hydropower strategy game, Truffer *et al.*, (2004) noted that an equilibrium is reached when both parties maintain their position; the relative potential losses in this scenario are smaller than if a party should cooperate and their opponent not. While this strategy minimises individual risk, a defensive optimal strategy is inferior to the desired collective solution that allows positive change. The choices that stakeholders make based on their individual contexts, can therefore have a significant impact on the collective decision taken. It is therefore possible to note that in addition to conflict having functional and dysfunctional elements, it has both individual and collaborative functions which will further influence its nature and impact on decisions taken (see Table 2.1). Interestingly, such consideration notes that it is possible for conflict to simultaneously be functional for an individual but dysfunctional for the collective, and vice versa. This is the result of potentially significant differences between an individual's optimum solution and that of the collective.

Table 2.2- Functional and Dysfunctional Conflict Elements at the Collective and Individual Level

	Functional	**Dysfunctional**
Collective	Increased informational diversity. Increased innovation. Increased group understanding. Increased availability of skills/tools Increased quality of decisions. Establishment of agreed tradeoffs.	Increased awareness of incompatibilities. Reinforcement of negative perceptions. Increased emotions. Increased ambiguity. Allows individualistic behaviour. Process stagnation.
Individual	Highlights needs/concerns. Highlights goals of others. Justifies decisions. Decreases uncertainty and perceived risks. Provides the opportunity to pursue own goals.	Negative emotions: tensions, anxiety, stress. Reduced trust. Validation of entrenched position. Justification of continuation of obstructive strategies.

Engaging in conflict processes potentially reduces uncertainty and risk, allowing informed individual decisions to be formed and the reselection of more suitable strategies. This may serve to yield benefits, allowing the opportunity to view proposed changes, what it is likely to involve and to understand the motivations behind it. Social learning techniques are based on this assumption. However it is possible for rational stakeholders pursuing given goals, to use this information to develop better strategies and/or tactics to reach a given goal, further reinforcing tensions. The impact of conflict on the decision taken will therefore be dependent on the degree to which the conflict is resolvable given the issues stakeholders presents, and whether stakeholders cooperate and do not continue to pursue their own goals above collective objective. Each individual can therefore influence the course and nature of conflict, not only via the interests they present but via the behaviours they choose to utilise. Behaviour refers to detectable external changes in stakeholders' actions in relation to an evolving environmental decision-making conflict. Behaviour can be classified into two categories: passive, in response to input stimuli (i.e. changes in the debate), or active where the object is the source of the given reaction (i.e. stakeholder generated) (Rosenbleuth et al, 1943). Active behaviour is of interest, and can be sub-divided into random and purposeful. Purposeful behaviour may be interpreted as directed to the attainment of a goal, whereas random cannot. The concept of purpose behind actions is of interest; in performing voluntary actions, an individual selects of their own accord a specific aim. It is proposed that in assuming rationality, individuals may enter conflict scenarios with such aims and act accordingly. In doing so to what extent could they actively direct the decision-making process should they choose to do so?

2.4.3 The Impact of Behaviour on Decision-Making?

Collective decision-making often involves strategic behaviour, where decisions are contingent upon the choices and actions of others. Strategy is a consciously intended course of action to achieve a goal. To achieve the optimum outcome, each individual must make the best possible case for their preferred solution, and move the opponent away from his/her own. Such requirements may encourage the use of influential tactics to gain the others' compliance (Lewicki, 1983). It is proposed that engaging in the conflict process allows the potential utilisation of such actions, providing an opportunity to influence decision-making, by altering perception of the problem via the manipulation of other stakeholders. The following section provides a range of examples which highlight how different social interactions which could occur in environmental scenarios might influence the nature of conflict and its outcomes, all of which are potentially possible within an environmental dispute scenario.

Within conflict, where asymmetries between parties exist, information can be source of power (alongside other examples such as regulatory controls), particularly when establishing trade-offs (Raven, 1993), where arguably stakeholders are engaged in negotiations. Informational control enhances an individual's power (Pfeffer, 1993), communicating facts in a persuasive manner provides an opportunity to influence the understanding of other parties (Lewicki, 1983). The impact of misinformation is to eliminate or obscure an opponent's choices or to manipulate the perceived costs and benefits of particular options; this can be achieved by misrepresentation, bluffing and falsification of information. Another method to gather support is persuasion via the arguments presented. The aim of an argument is to convince the audience that something requires their attention and generate importance around the issue (Bitzer, 1992). By simply raising an issue, an individual generates urgency, via the suggestion that someone should act on the information they present.

Along with the facts presented in arguments, there may also be cognitive dimensions to consider which influence the manner in which they are received. Malone (2009) suggested that a number of factors separate from the content of the debate that shape the arguments presented. For example, how much authority is claimed by or granted to an individual is important for how much weight their argument will carry with others (Malone, 2009), this may be linked to their position or the extent of their knowledge. Whether this authority is capitalised on depends on the importance of the content of the debate to the individual. A highly respected individual may not care sufficiently to make a strong argument. An impassioned individual with little authority may argue convincingly. All elements of argument are shaped by the speakers' worldviews; the assumptions they hold about how the world works. Worldviews form the basis of beliefs, values and perceptions and alter the problem conception. An anthropocentric view, believes the environment is a resource to be maximised for human gains, while a cautious one would advocate not disturbing the environment unless the full effect of action are known; they would accept very different solutions. Presentation of scientific fact is relatively easy to communicate, but fundamentally different perceptions are not. The worldview of the speaker will influence the arguments they choose to present; the relative worldviews of the recipients will determine the extent of their ability to identify with their case. Speakers may tailor arguments towards the perceived requirements or known values of others. In negotiation, it is customary to offer actions which appeal to all parties to increase the likelihood of acceptance. These offers are strategic, appealing to known preferences of other actors or based on perceptions of opposition.

Perceptions not of the problem, but of other stakeholders, become an active feature of strategy inclusive of unconscious stereotypes, attitudes and prejudice. Prejudice is rooted in the fundamental mechanics of thought (Banaji, Bazerman and Chugh, 2003); as such individuals perceive and associate objects implying a given meaning (e.g. thunder with rain; grey hair with old age) but they are an approximation of truth, not always applicable. Often unconscious, these prejudices may explain why people harbour biases and act accordingly. These prejudices are not conscious like racism or sexism, people can believe they are unprejudiced but have been shown to harbour underlying thoughts they would not ordinarily admit to (Banaji, Bazerman and Chugh, 2003). In environmental decision-making, underlying prejudices are often noted; stereotypical perceptions may label non-governmental organisations as eco-freaks, industrial interest as profit-orientated corporate giants and regulators as bureaucrats (Optow and Weiss, 2000). These labels, alongside factors such as age, gender and reputation, may influence perceptions, which in turn may determine the strategy adopted against such opponents.

The ‘sizing up’ of rivals represents another key part of negotiation strategy, and is something that regularly occurs within competitive situations. Opponents seek information on each other to appraise strengths and weakness and determine strategy accordingly. In the case of decision-making, this occurs based on the impression that actor’s project and perceive. Impressions are rarely formulated from scratch; they are built on the foundation of stereotype based on the attributes of an individual, and then corrected based on new information. In a situation where opponents are interdependent (such as environmental decision-making) individuals pay increased attention to the attributes of others (Berscheid *et al*., 1976; Neuberg and Fiske, 1987), allowing them to formulate more accurate impressions and alter strategy accordingly. Ruscher and Fiske (1990) suggested that ‘sizing up’ is an adaptive strategy, highlighting empirically that interdependent individuals focus more on information which does not match their preconceived stereotype, rather than data which verifies it. Engaging in conflict allows access to this information. Ruscher and Fiske (1990) suggested that better attention to the specific behaviours and attributes of others allows greater ability to predict and control the achievement of one’s own outcomes. While environmental decision-making disputes are not competitions where one party wins, they are conflicts where individuals debate, and thus some parallels can be drawn. The impressions formed of an individual will influence interactions, affecting the strategies employed against them and influencing perceptions of their behaviour. If an individual gives the impression of weakness, an opponent may fight more vigorously for a solution which meets a greater proportion of their individual needs. An individual, whose demands are impassioned, could give the impression of difficulty, and have their actions disregarded as extreme despite their validity; they would lose authority and consequently power to influence the decision, based not on the points raised but the impression given. Another individual in their place, who is received differently, could potentially lead to an entirely different conflict process and subsequent decision.

There are therefore multiple avenues for an individual to purposefully influence the decisions via the conflict process, the examples highlighted represent but a few to consider. The worldviews held by the individuals involved determine the importance of the issue, which in turn shapes the strategy and tactics they implement and its subsequent success.

Given the right combination of social characteristics, an individual could significantly alter the course, nature and success of the debate; dependent on the strategy they utilise to achieve their needs. Two groups of people faced with the same conflict, assuming they have identical interests and face the same problem, may therefore reach significantly different decisions.

In changing the nature of the debate, subsequent alterations in problem conception and stakeholder relationships, there is the potential for significant change in the decision taken. A different conflict course may yield a differential balance between functional and dysfunctional elements, subsequently altering its role. Whether the changes made are beneficial or detrimental is both subjective and largely speculative, as there is no method to create a representative test scenario. The ability of individuals to potentially significantly influence conflict and the resultant decision implemented is important. It suggests that it is possible for a number of potential scenarios around a singular conflict to exist; each associated with different conflict characteristics and will generate different outcomes dependent on those involved and their behaviour (Figure 2.5). While the importance of individuals has been recognised in other studies (see Glicken, 2000; van den Hove, 2000; Lerner *et al.*, 2011) they do not highlight the same dimension examined in the context of this study, namely that individuals are important as the behaviours they choose to exhibit which are a function of their personalities, can have potentially significant effects. Figure 2.5 highlights the sensitivity of decision-making processes to conflict behaviour, each scenario (1-4) results in different implemented solutions (S_1-S_4), which vary in distance (x_1-x_4) from the a conceptual position which represents the practical realisation of the ideology of sustainable development (a widely accepted goal for environmental management). The variable value of x, means that one scenarios will theoretically deliver a better solution in terms of reaching sustainable development. Understanding how conflict processes influence the proximity of implemented management actions to sustainability, could be key to minimising the value of x and achieving sustainable development. While this model is recognised as an over simplification of a highly complex notion, it clearly highlights the potential impact of conflict on the course of environmental decision-making.

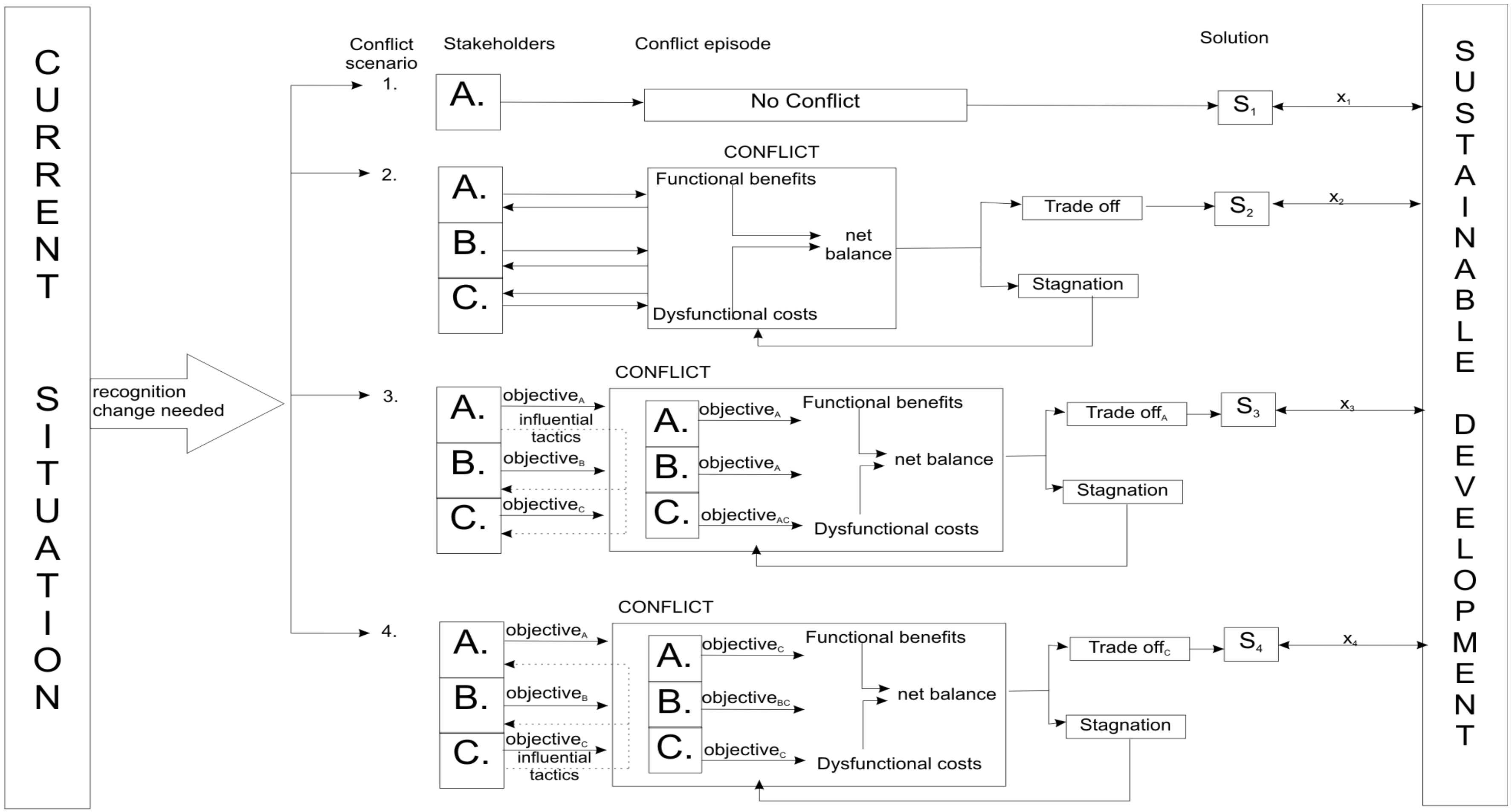


Figure 2.5- Impact of Theoretical Conflict Scenarios on Solutions Implemented and Proximity to the Ideology of Sustainable Development.

Figure 2.5 depicts recognition of the need to change existing management practices and move towards the ideology of sustainable development. It outlines four theoretical conflict scenarios (1-4), each with different episode characteristics, solutions they generate (S_1-S_4) and their proximity to sustainable development (x_1-x_4).

Scenario 1- No Conflict: Stakeholder A undertakes a decision without consulting others, S_1 is limited by A's understanding of the problem.

Scenario 2- Collective Conflict process: Conflict between stakeholders delivers functional and dysfunctional elements. The net balance between them determines whether a trade off can be agreed to or whether the process stagnates. S_2 is likely to be significantly different to S_1, with a different distance (x_2) from the theoretical point of sustainable development than S_1.

Scenario 3- Individualistic behaviour by A: The same processes occurs as in scenario 2, however stakeholders have associated objectives. Stakeholder A chooses to use influential tactics to achieve their goals, as a result B changes their goals, while C combines their original position with As. The trade-off developed is in favour of A, causing S_3 to be different to S_2.

Scenario 4- Individualistic behaviour by C: Influential tactics by C, cause A and B to change or reassess their goals, delivering a trade off in favour of C. S_4 will be significantly from S_2 and S_3.

In each scenario the problem remains the same, different stakeholder combinations and actions create a range of solutions. The distance from sustainability (x_1, x_2, x_3, x_4) therefore varies, which has the smallest value is subjective.

2.4.4 Summary and Conclusions

The aim of this section was to establish conceptually the potentially significant impact that conflict could have on the course of decision-making, using known concepts from the interdisciplinary study of dispute. Following consideration, it is highlighted that conflict as a process has the theoretical potential to significantly alter the course of decision-making via the net balance between functional and dysfunctional conflict elements. It is highlighted that the people involved within a dispute episode will determine the outcome of this balance via their interactions over time. People are therefore recognised as fundamental in determining the impact of conflict. While perhaps a basic observation, it has been demonstrated that this simple notion could have potentially significant implications on the course of decision-making when considered in detail. While this conclusion has been noted in other studies (e.g. Glicken, 2000) which recognise that stakeholders influence problem definition and comprehension; in the context of this study social characteristics and resultant behaviours are noted as further individual-specific parameters which affect collaborative interactions. Changes in collaborative interactions can theoretically significantly alter the balance between functional and dysfunctional elements. Individuals who adopt obstructive behaviours for example, are more likely to provoke negative emotional responses in others, shifting the nature of interaction towards dysfunctionality regardless of other dimensions.

Within a conflict situation, it is a rational assumption that individuals may pursue their own needs, this prompted consideration of how individual behaviours could purposefully influence the nature of interactions, and alter the balance between functional gains and dysfunctional impacts. This section provides numerous examples of how strategic behaviour and influential tactics may theoretically influence the course of decision-making, but the review is not absolute, dimensions cited are intended to promote consideration of social impacts. Via the use of strategic interactions and persuasive arguments, it is theoretically possible for an individual with the inclination or motivation, to impart on a course of action designed to purposefully alter the course of a decision to better suit their needs. While this statement implies malicious intent, such actions may be driven by underlying worldviews and associated values, and are thus intentional but believed to be constructive. They may also be intentional but positive, striving to achieve significant change and a better decision. A further impact of conflict is therefore that it allows stakeholders the opportunity to influence the environment within which a decision is taken; potentially altering problem definition and stakeholder understanding. As the process of decision-making requires the evaluation of different options and often the establishment of tradeoffs, the recognition of potential biases developed by tacit social processes could be potentially significant.

In recognising that the manner, in which conflict is navigated, has theoretically significant impacts for the subsequent decisions made and implemented, it simultaneously emphasises the importance of effective dispute management. While environmental dispute resolution is an area of significant research (see Lewicki and Gray, 2002), conflict remains a practical management reality. The conceptual implications of this section suggest that effective management of conflict should seek to maximise functional benefits and minimise dysfunctional effects to yield significantly better decisions. This should be achieved via a stakeholder orientated approach which considers the processes highlighted. Adopting the view that conflict is not inherently negative, environmental management should not seek to ignore or eliminate conflict but to develop appropriate tools to maximise potential benefits. Conflict has become an important feature of environmental concerns, but further empirical research is needed before firm conclusions about the nature of such disputes can be made and their role of in decision-making substantiated.

The intention of this section was to synthesize a new perspective on environmental conflict, recognising that traditional perceptions may inevitably limit the application of a potentially beneficial conflict-based approach. In considering conflict as a process which has the equal potential to yield benefits as it does detriments, it is possible to note a number of similarities between a dispute-based approach and emerging collaborative decision-making techniques which seek to resolve environmental challenges. It is proposed that using a social science style approach to the navigation of conflict, could potentially yield naturally occurring opportunities for social learning, but one that is potentially more accessible to practitioners, as the notion of conflict is conceptually more familiar. Further investigation is however required before these theoretical claims can be substantiated.

2.5 Implications for Environmental Management

The aim of this chapter was to critically review the nature of conflict in environmentally sensitive circumstances and determine its role in decision-making. In undertaking this task, the need for a functional guide to the components of conflict was identified as a gap in existing literature and addressed by careful structuring of the relevant literature. While defining conflict in the traditional sense remains difficult, the framework developed and associated literature review provide a working description, outlining the fundamental basics of disputes. This framework and literature review provides a baseline understanding of conflict which simultaneously highlights its nature, not only for the context of this research but also as a tangible starting point for practitioners to facilitate resolution. It is therefore recognised as the first of a series of conceptual tools for the exploration of conflict developed in the course of this research. The first step in evolving environmental management is to provide conceptual clarity as to the term environmental conflict. This chapter has attempted to begin this process. Dispelling misconceptions of conflict and fully understanding its dimensions, highlights the theoretical and practical lessons which can be drawn from conflict literature and could advance environmental management techniques. Understanding the concept of conflict, in particular categories for diagnosis (see Figure 2.3) provides a valid conceptualisation of the challenges facing environmental managers. If communicated to practitioners and subsequently embraced, the resultant objective understanding of the nature of the problem allows access to a much greater range of tools for resolution.

Wider consideration of conflict also synthesised a new perspective on the role that conflict plays within environmental decision-making, embracing the notion identified in other research fields, that dispute could have a beneficial function. Perhaps the key point to note is that the impact of conflict is not inherently negative. While the word naturally raises negative connotations, it has been demonstrated that it may yield positive outcomes. Conflict and its associated processes can be functional or dysfunctional, either enhancing or diminishing the quality of decisions made. Whether it is a beneficial process is subjective, dependent on individual perspectives and experiences. Regardless of its nature, it is noted that engaging in conflict will cause change, a decision taken independently will be significantly different to one in which issues have been discussed. It may therefore serve a functional purpose (i.e. it may be useful) within environmental management. Within this frame, environmental management should not seek to ignore or eliminate conflict but to develop appropriate tools to embrace, manage and maximise potential benefits. Mechanisms which manage conflict will guide the nature of change and could potentially be manipulated in an attempt to achieve management goals. This is however dependent on a deeper practical understanding of the conflict process and requires further empirical study.

Drawing parallels between the nature and role of conflict may be an important step in enhancing environmental decision-making. Given the likelihood of increased pressures in the future, there is a need for the principles of sustainable development to be realised. To achieve this requires transition through a conflict situation and thus mechanisms to do so should draw from both a holistic understanding of disputes and established management techniques. Outputs of the literature review, promote the importance of debate, suggesting that fully understanding the nature of stakeholder interactions is a crucial step in the development of mechanisms to bring about change and warrants further study. Conflict has become an important feature of environmental concerns, but further research is needed before firm conclusions about the nature of sustainability conflicts can be made, the role of decision makers within those conflicts, and how recognition of these factors can improve methods to bring about sustainable development. Throughout this chapter, a number of key points are raised. These points should form the foundations of a methodological approach to identify the impact of conflict on environmentally sustainable decision-making and develop conceptual tools. The key points and their potential implications are:

- *There is a lack of appropriate mechanisms to deal with environmental conflict.*

Daniels and Walkers (2001) highlight that conflict resolution remains difficult, due to a lack of formal mechanisms within environmental management. There is a need for mechanisms which create a constructive environment where positive attributes of conflict are emphasised and negative elements reduced. These mechanisms should be flexible in their application and represent accessible tools for the wide range of stakeholders involved.

- *Conflict may have a functional purpose.*

The notion that conflict can yield positive outcomes is important; it suggests that there is potential for dispute to be used to generate better solutions once fully understood. Such concepts suggest there may be a benefit to engaging in conflict, and it may be the case that practitioners should seek to manage conflict, rather than remove it.

- *Worldviews shape an individual's understanding of the problem and acceptance of potential solutions.*

Each participant within conflict has perceptions, values and beliefs which will affect their conception of the problem, the assumptions they make about it and the solutions that they feel are valid. All of these characteristics are the result of an individual's worldview, their understanding of reality. Each individual will interpret new information in light of their preconceptions. Where worldviews clash they cannot be resolved by appealing to facts. For environmental management to appropriately address conflicts, the concept and importance of worldviews needs to be recognized.

- *The impact of individuals on decision outcomes is potentially significant.*

Due to the importance of social characteristics, every individual has the potential to influence the course of conflict and therefore the resultant outcomes, via their perceptions, attitudes, behaviours and actions. If every individual involved is potentially significant then stakeholder selection becomes crucial, not only in terms of those selected but also in terms of those who are absent. Failure to include a particular stakeholder may result in a lack of conflict and a potentially poor decision which is feasible to implement; including them may highlight previously unconsidered themes, but a lack of consensus limit action.

- *The need to reframe approach to resolution*

Environmental conflict, in its many forms, represents a real world problem which is increasing in frequency. In recognition of this, there is a need for a change in approach to environmental conflict resolution, towards practical methodologies which seek to improve conditions and facilitate tangible resolution. Continuing to pursue traditional research which considers and analyses dimensions of conflict does not yield functional solutions for practitioners. There is a need for 'Mode 2' style methodologies, which simultaneously provide insight into the nature of conflict and represent tools which can be utilised to address it in reality.

Chapter 3 Methodological Overview

3.1 Introduction

With the challenge of sustainable environmental management set to become simultaneously more difficult and important, ability to effectively resolve such disputes and facilitate action, represents an urgent issue to be addressed. From a review of conflict literature, it is recognised that dispute is process which is significantly influence by the stakeholders involved and their associated characteristics. Yet current approaches to the management and resolution of environmental issues seek to solve the problem, not manage the people. Failure to recognise this may account for the prevalence of environmental disputes. This research proposes that reconceptualising environmental issues and difficulties and labelling them as conflict situations, enhances understanding of their processes and causal mechanisms. While dependent of the uptake of a holistic understanding of the term, a conflict-based approach to environment management could yield significant benefits and allow the development of improved tools to handle disputes. Following a review of interdisciplinary literature, many hypotheses about the impact and role of stakeholder conflict where proposed, including its potentially significant function within decision-making and the realisation of sustainable development. There is a need to establish empirically whether such processes and potential exist within environmental scenarios. It is proposed that greater understanding of the impact of stakeholder conflict on achieving sustainable decision-making represents a significant first step to their resolution, and thus is a central aim of this research.

A further point highlighted in the literature review was the lack of appropriate mechanisms to deal with environmental conflict. Environmental conflict is a practical, and therefore nor purely academic problem, furthering understanding of its nature and role is ineffective if not successfully communicated, and accessible to those that require it. Research that fails to do this will not facilitate real change. To ensure its functionality, this research adopts a ‘Mode 2’ style approach (see Chapter 1), whereby consideration of the end users (practitioners) and the application of potential findings directly influence the methodological design. Research design is also built on the key findings of the literature review (see Chapter 2).

The aim of this chapter is to develop a methodology which is appropriate to simultaneously highlight and manage environmental conflict, providing potential conceptual tools for practitioners. The challenge of sustainable hydropower development is utilised as a case study, but the methodology is designed to be uniformly applicable to a range of conflict scenarios within a diversity of environmental fields. This chapter presents both a methodological overview and a detailed description of the tools utilised in subsequent chapters. Details of how each of the methods was applied in each specific case are outlined in the relevant chapter.

3.2 Research Design

A key point raised in the review of conflict literature was that dispute was not inherently negative and may have a functional purpose. Theories on conflict methodologies can be divided into two groups: conflict management and conflict resolution (Hamad, 2005). Resolution is the elimination of conflict, while management refers to controlling it. Resolution is the goal of many studies but it is based on negative perceptions of conflict. Similarly, environmental conflicts are often the consequence of different values and interests, presuming to resolve them may be unrealistic. A conflict management approach is therefore selected, aiming to actively manage disputes which may facilitate resolution. In undertaking conflict management, actions should aim to maximise positive elements and minimise negative, to enhance learning and group outcomes (Rahim, 2002). Conflict management does not therefore necessarily imply avoidance, reduction or termination of disputes. The subtle difference between resolution and management has implications for subsequent methodologies selected. Rahim (2002) notes that many utilise a conflict resolution approach when management would be more appropriate. Conflict resolution frames disputes as inherently negative, advocating the use of negotiation, bargaining, mediation and arbitration techniques, to achieve a given goal. These traditional techniques are often used in environmental disputes. Conflict management techniques centre on the process, facilitate collaborative learning. Learning is a significant construct and important in facilitating understanding and group decision-making. While the concept may seem over simplistic, many organisational theorists note that it is not a question of wanting to learn, but that organisations must and should embrace the concept, inclusive of learning how to do so (Senge, 1990; Schein, 1993; Argyris and Schon, 1996). Rahim (2002) suggests that for conflict management strategies to be effective, they should aim to address the following:

- Encourage learning and effectiveness.

  Methods should be designed to enhance learning among parties. To attain this, methods should enhance critical thinking surrounding problems, in addition to enhancing communication and information sharing.

- Identify the needs of stakeholders

  Conflict management strategies should be stakeholder orientated, designed to satisfy needs and expectations and attain balance between them. With the impact of the individual recognised as significant in the literature review, methods which facilitate stakeholder interactions would therefore be appropriate. The challenge of conflict management is to effectively involve these parties in a problem solving process which facilitates learning and discussion.

Unlike conflict resolution there are no defined techniques for achieving conflict management; instead there are various styles which frame the approach taken. Which style is utilised will be dependent on the nature of problem, the people involved and the leadership styles of those involved. Blake and Mouton (1964) developed the first model for classifying modes into five types: forcing, withdrawing, smoothing, compromising and problem solving. These styles represent distinct methods of handling conflict and can be associated with significantly different techniques. Rahim and Bonoma (1979) re-labelled these dimensions as concerns for self and for others, which in turn form the basis of Pruitt’s (1983) dual-concern model consisting of four styles: yielding, problem solving, inaction and contending. Management scholars agree that there is no best approach, however Rahim (2002) indicates integrating or problem solving styles are more appropriate for strategic issue (see Table 3.1). Such styles involve openness, the exchange of information, investigation of alternatives and examination of differences. This style is therefore the most appropriate to adopt for the management of environmental conflicts; a problem solving approach is therefore selected for this study.

Table 3.1- Styles of Handling Conflict and the situation where application is and is not appropriate (Rahim, 2002)

Conflict style	Situations where appropriate	Situations where inappropriate
Integrating/ Problem solving	Issues are complex. Synthesis of ideas is needed. Commitment is needed. Time is available. No one party can resolve alone	Task or problem is simple. Immediate decision required. Others are unconcerned.
Obliging	You believe you may be wrong. Issue is more important to others. You have a weak position. Preserving relationships is important.	Issue is important to you. You believe you are right. The other party is wrong.
Dominating	Issue is trivial. Quick decision needed. Unpopular actions can be implemented. Is necessary to overcome subordinates. Subordinates lack expertise. Issue is important to you.	Issue is complex. Issue is not important. Both parties are powerful. Time is available. Subordinates possess a high degree of competence
Avoiding	Issue is trivial. Dysfunctional effects of confrontation outweigh benefits of resolution.	Issue is important to you. It is your responsibility to make the decision. Prompt action is needed
Compromising	Goals are mutually exclusive. Parties are equally powerful. Consensus cannot be reached Integrating or dominating style is not successful.	One party is more powerful. Problem is complex

3.2.1 Problem Solving Methods

Problem solving is the mental process that attempts to resolve the difference between a current state and a goal state, by carrying out analysis of the situation. Even a simple problem may require a range of related to actions to facilitate the required change. Problem solving methods provide a structure for analysis and action; one method of problem solving is by use of systems thinking. The concept of a 'system' is an heuristic device to aid understanding of the real world by structuring complex situations as an organized whole consisting of inter-related elements (Flood and Carson, 1993). "Systems thinking" is a method that can be implemented to structure problems, while incorporating the requirements of a conflict management approach. Mitroff (1998) suggested thinking systematically is important for avoiding Type III errors[1]. It recognises that complex problems cannot be addressed effectively in a conventional fashion, as problem definition

[1] Type III error is associated with the probability of having solved the wrong problem when one should have solved the right problem

varies so do solutions implemented (Rittel and Webber, 1973). Systems thinking provides a guide to structuring debate, and has been utilised as a problem solving tool in a range of fields including architecture, policy science and urban planning, but is increasingly utilised in natural resources management and environmental policy (Selin and Chevez, 1995; Daniels and Walker, 2001).

Structuring problems to facilitate decision-making is not a novel approach. Initial forms emphasised modelling attributes mathematically, and then reviewing the predicted consequences of different choices. While this allows selection of an optimum solution via logical choice, in some situations this approach is limited (Checkland, 1981). Environmental management represent such a situation, where complex values and relationships cannot easily be quantified, and exclusion would undermine the authenticity of subsequent outputs. Recognition of this unsuitability led to the development of problem structuring methods, which recognise that in some cases the most difficult task will be defining what the problem actually is. Kuhn (1970) labelled these traditional and alternative modelling approaches as competing paradigms. The concept of an alternative paradigm has been the focus of considerable study (Rittel and Webber, 1973; Ackoff, 1979; Eden, 1982; Rosenhead, 1986; Flood and Jackson, 1991); all note that there are certain situations where conventional methods do not adequately handle some problems. While a number of different classifications exist (Table 3.2), each author highlights two fundamentally different problem types. Considering the challenge of environmental conflict management, the nature of the problem falls within the alternative paradigm, representing a ‘mess’, ‘wicked’, ‘practical’ or ‘soft’ problem. Having made this distinction, there is a natural filtration of methods. Within the literature there are clear guidelines for selecting appropriate methodologies.

Table 3.2- Classification of Problem Typologies by Author

Category	Description	Author
Messes and problems	Managers are confronted with situations made of complex systems, these are messes. Problems may be solved; messes must be managed.	(Ackoff, 1979)
Wicked and tame	Tame problems can be specified and agreed upon ahead of analysis. Wicked problems have many explanations, which are selected, will determine the nature of the solution.	(Rittel and Webber, 1973)
Practical and technical	Technical problems have a clear function to be performed, prior to analysis. Practical problems exist as a general purpose to be achieved. They cannot be solved by technical factors.	(Ravetz, 1971)
Soft versus hard	Hard systems assume the world can be objectively modelled. Soft systems accept that the complexity of the world cannot be assumed to be easily modelled.	(Checkland, 1985b)

3.2.2 Selecting an Appropriate Problem Structuring Methodology

Problems may be grouped according to two dimensions: i) systems, elements that make up the situation, and ii) participants, the relationships between parties or individuals who stand to gain from a systems intervention (Flood and Jackson, 1991). Systems can be grouped as a continuum of types, with simple systems at one end and complex at the other (Flood and Jackson, 1991); each has different characteristics (Table 3.3). These definitions operate on the assumption that simple problems will contain relatively simple systems, and that complex systems will manifest difficult problems.

Table 3.3- Characteristics of Simple and Complex Systems (after Flood and Jackson, 1991)

Simple systems	**Complex systems**
Small number of elements.	Large number of elements.
Few interactions.	Many interactions.
Are highly organised.	Are loosely organised.
Well defined laws govern behaviour.	Probabilistic in their behaviour.
System does not evolve over time.	Systems evolve over time.
Sub systems do not pursue their own goals.	Sub systems are purposeful and generate their own goals.
System is unaffected by behavioural influences.	System is subject to behavioural influences.
System is largely closed to the environment.	System is open to the environment.

Systems can also be grouped by the participants involved; the terms unitary, pluralistic and coercive are used to describe the relationships between them (Jackson and Keys, 1984). In a unitary situation, participants share common interests, have highly compatible views and beliefs, participate in decision-making and act with an agreed objectives already in existence. In a pluralistic situation, participants have a basic compatibility of interests but their values and beliefs diverge; they all participate in the decision-making process and act in accordance with agreed objectives. In a coercive situation, participants have conflicting values and beliefs with no common interests; some will coerce others to accept decisions and no agreement is possible over objectives. These two dimensions can then be combined to create a matrix of six system types each with associated methodologies appropriate for problem solving (Table 3.4).

Table 3.4-Matrix of Problem Contexts and Associated Methodologies (after Flood and Jackson 1991)

Problem Context	Methodology	Characteristics
Simple-Unitary	Operational research Systems analysis Systems engineering System dynamics	Assumes the problem solver can easily establish objectives. Assumes there is little or no dispute over the problem.
Complex-Unitary	Viable systems diagnosis General systems theory Socio-technical systems thinking Contingency theory	The system is complex. The system exhibits probabilistic behaviour which is difficult to predict. There is general agreement over goals.
Simple-Pluralistic	Social systems design Strategic assumption, surfacing and testing	Assumes issues are difficult due to disagreements between participants. Assumes that once resolved remaining problems will be easy to address.
Complex-Pluralistic	Interactive planning Soft systems methodology	There is a lack of agreement about goals and objectives among participants. Believes genuine compromise is achievable.
Simple-Coercive	Critical systems heuristics	Suggests how to organise debate on the resolution of conflicts Assumes this task is clear.
Complex-Coercive	N/a	Complexity of the situation hides power of the various participants. At present there are no tools to address such problem contexts.

Sinn (1998) suggested that using such classifications, enables their use in creative ways, with full understanding of the strengths and weaknesses of the different methods and provides those faced with real world constraints (e.g. time and resources) with a framework for making reasonable choices. In the case of environmental conflict, the problem context is complex in its nature, and can be assumed will generate complex systems. Participant characteristics will vary on a case by case basis. However, each situation is likely to be somewhere between pluralistic and coercive, and as no methodology exists for complex-coercive, a complex-pluralistic typology would be appropriate. The complex-pluralistic typology offers two suitable methodologies, interactive planning and soft systems methodology (SSM). Both methods use a comparison process to compare idealized design with reality, and use this process to help participants move towards a shared perception of reality. Despite this, there are a number of differences; perhaps the most relevant in this study are the separate views on conflict. Ackoff (1979) the author of interactive planning, argued that conflict is an illusion, suggesting that competing interests only appear to diverge and that any conflict can be resolved. Flood and Jackson (1991) stated that this worldview is unrealistic; ignoring situations where interests truly diverge and a shared ideal cannot be found (Sinn, 1998)(Sinn, 1998). In contrast, Checkland (1985a) author of SSM, reported that interests can truly diverge and produce real conflict. As a result, SSM requires participants to learn about their assumptions and the problem situation, so that an accommodation can be reached to facilitate action (Checkland and Scholes, 1990). SSM is more appropriate for environmental concerns as it enables action despite conflict, while interactive planning requires consensus prior to progression. SSM also encourages a learning approach which is a criterion of successful conflict management.

SSM has a flexible approach and can be used to guide general thinking (Sinn, 1998). It has fewer barriers than others and allows a step-by-step approach increasing its chance of initiating action; however it does not address the logistics of change as interactive planning does. Interactive planning requires widespread participation, and thus more individuals have an opportunity to learn. Checkland's (1985a:1985b) papers do not provide a structure to encourage widespread participation and it has been argued that a soft systems methodology primarily serves the "elites" who are invited to participate, and may perpetuate the status quo (Jackson, 1991). However, this can be overcome by careful selection of participants. For the purpose of this study, soft systems methodology will be used to explore environmental conflict.

3.2.3 Soft Systems Methodology

Soft Systems Methodology (SSM) was developed by Checkland in the 1960s at the University of Lancaster. Originally a modelling tool, it was later used for learning development and problem solving. SSM provides a conceptual basis and a set of tools to address problem situations characterized by emergent complexity (Funtowicz and Ravetz, 1993). It is applied to the study of ‘soft’ problems which are typically encountered when addressing situations involving 'real-world' situations. Real-world problems may be perceived differently by different people and, are not constructed by the investigator (Checkland, 1981; Flood and Carson, 1993). Checkland’s (1981) methodology is an example of action research, aiming to contribute to both practical concerns of the people in an immediate problematic situation, and to the goals of social science by collaboration within a mutually acceptable ethical framework (Rapoport, 1970). It therefore fulfils the requirements of this study.

Problem solving consists of defining the desired state (S_1) and the present state (S_0) and selecting the best solution to reduce the difference between them (Checkland and Scholes, 1999). SSM is built on this notion, but allows debate over what S_1 consists of. The soft systems approach allows a thorough examination of the problem situation itself, rather than focus on an optimal solution (Patel and Patel, 2003). The use of the framework is expected to lead both to insights into the problem situation and to a gradual improvement of the framework itself (Checkland and Scholes, 1990). Central within the philosophy of SSM is the notion that individual perceptions of the world inform our conceptualisations of it. Checkland and Scholes (1990) stated that research must deal with an interpreted world and not simply the one experienced. Associated with these interpretations are intentions which may be supported in turn by purposeful actions. People continually take purposeful action related to experiences and situation and the subsequent knowledge that they gather. Exploration allows both questioning and learning, individuals continually negotiate and re-negotiate with others their perceptions and values. Each individual has a perspective in defining, describing and interpreting a problem situation (Lane and Oliva, 1998). This perspective (worldview), forms a key part of the methodology, recognizing that there are multiple possible descriptions of a problem based on different images of the world (Checkland, 1985b). This influences how a problem situation is perceived, actions taken and types of solutions viewed by participants as feasible. By integrating into the methodology variations in worldviews, SSM neither generates a repeatable account of reality nor an optimum solution to the problem. Instead, it generates an understanding of how a problem is perceived by multiple stakeholders, what they may view as desirable and thus how they affect discussion to match their perception of success. As worldviews were identified as a key facet of conflict, this characteristic further justifies the use of SSM.

SSM has evolved through several versions, with Checkland (1985a) the most widely cited. In its classic form, SSM is a seven step process (Figure 3.1), which moves between the ‘real’ and ‘conceptual’ world. The upper half (Stages 1, 2, 5, 6, 7) are activities that take place in the ‘real world’ and therefore should involve the people in the problem situation. The bottom half (Stages 3,4) are ‘systems thinking’ activities which are carried out in the artificial systems world and may or may not involve people in the problem situation, depending on the circumstances of study. The process is iterative - 7 stages are shown in Figure 4.1 and fully described in Appendix 1- and simultaneously operates as a learning cycle, where learning is directed to inform purposeful action in real world situations, this is intended to yield improvements in the problem situation (Checkland and Scholes, 1990). SSM acknowledges that any person’s ability to take in the whole is inevitably constrained by the extent of their knowledge. Participation within SSM generates flows of information via establishing or re-establishing communication channels and allows deeper understanding of an opposing actor’s worldview. By engaging in the process an individual’s worldview inevitably changes, shifting their perception of the problem.

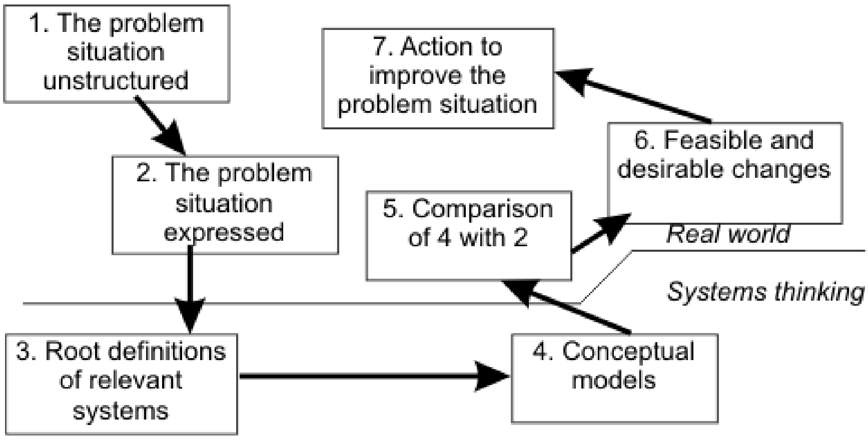


Figure 3.1-The seven stages of soft systems methodology, after Checkland, 1985a

As a conflict management tool, SSM offers a way of representing situations that will enable participants to clarify the issue, converge on a potentially actionable problem and agree strategies which will partially resolve it. SSM does this by enabling alternative perspectives to be highlighted, allowing problem representation and adjustment, and by being cognitively accessible to actors with a range of backgrounds. As a consequence, while it is sophisticated in its philosophy and conceptualisation, SSM is relatively rudimentary in mathematical and statistical output. Despite this, the application of SSM continues to be popular, Rosenhead and Mingers (2001) noted that it is one of the most commonly utilised problem structuring methods, either independently or in combination with other methods. In an empirical review of SSM, Mingers and Taylor (1992) highlighted the wide domain of applications among the users surveyed. Their study assessed the use of SSM in practice, and based on empirical data concluded that it is a practical general purpose methodology that can be successfully used by a wide range of people in their ordinary jobs (Mingers and Taylor, 1992). A number of benefits and limitations were noted. Benefits were grouped into three categories: management of intervention, beneficial thinking processes and those concerning the problem content. Of these benefits, the most frequently cited were benefits from the structure that SSM provided, allowing a more holistic and complete view which lead to a greater understanding of other people’s views and perspectives (Mingers and Taylor, 1992). Of limitations highlighted, the most frequently cited was that SSM is time consuming to undertake, as the method is time-independent, the length of time it takes to complete is dependent on the analyst and therefore can be controlled. It was also identified that SSM requires a reasonable amount of analyst training to be utilised effectively (Mingers and Taylor, 1992). SSM is a sophisticated tool, involving novel terms and an underlying philosophy which are important to grasp. However, the general success of SSM suggests that the skills required can be easily assimilated by lay practitioners (Mingers and Taylor, 1992).

Soft systems methodology was selected as a problem-structuring approach to the analysis of environmental conflicts. The characteristics of SSM fulfil the requirements of a conflict management approach while meeting the criteria of the literature review (Figure 3.2). The principles of SSM therefore form the basis of this study's methodological approach.

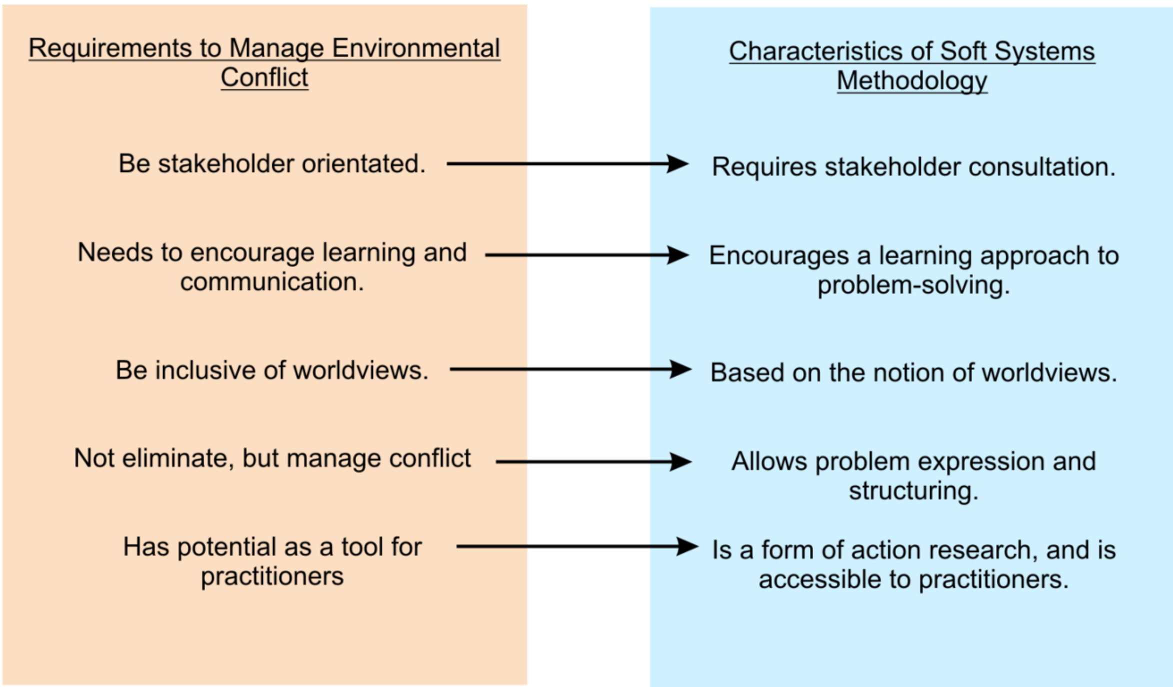


Figure 3.2- Links between Soft Systems Methodology and the Criteria for Environmental Conflict Management

3.2.4 Associated Methodologies

In practice SSM is often used in tandem with other tools to create a multi-methodology. Such an approach draws from multiple tools to adequately explore problem dimensions and does not limit investigation to methodological boundaries supports a

'Mode 2' research ideology. Within this research force field analysis (FFA) is utilised alongside features of SSM. FFA was selected based on emergent properties of the case studies following exploration using SSM.

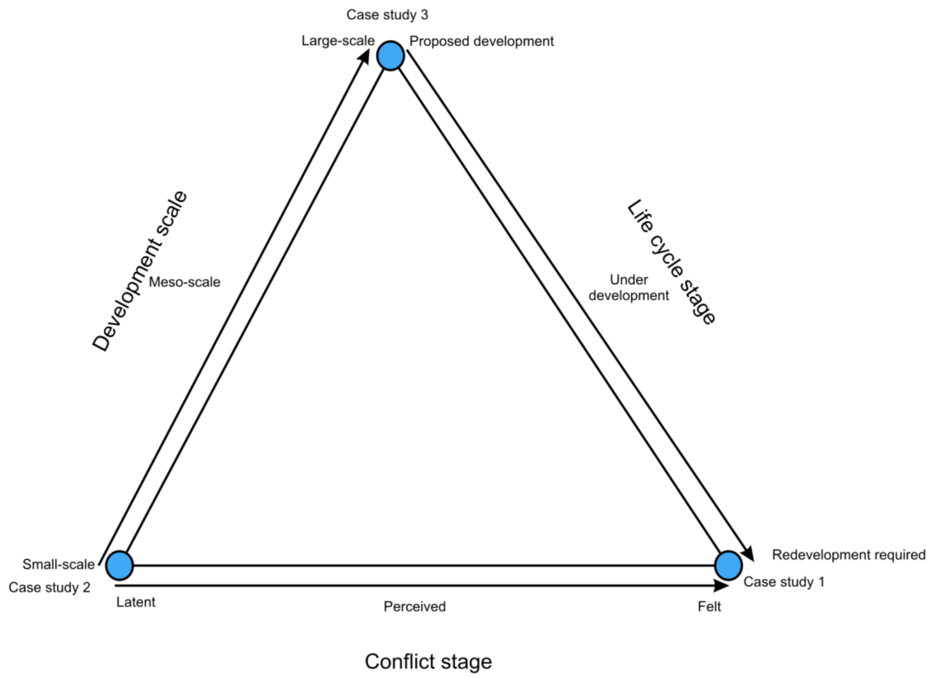
FFA represents a tool for assessing the prospects of change, commonly used with organisational studies, it is derived from Lewin's (1947) field theory. Central to field theory is the conception that stability within social systems is dynamic and not static. The illusion of stability is the result of driving and resisting forces which are continuously operating in equilibrium. Lewin (1947) believed that the field in which these forces exist was in a constant state of adaption and thus referred to them as quasi-stationary equilibrium states. To achieve change the focus should be on disequilibrium, unbalancing the forces to induce movement. Further work by Lewin on group dynamics and action research, noted that to achieve successful change the equilibrium needed to move through three stages; unfreezing (destabilisation of the equilibrium), movement (the direction of change) and a refreeze (stabilisation at a new quasi-stationary equilibrium) (Lewin, 1951). Successful change is recognised to be guided through these three distinct phases (Beer *et al.*, 1990; Kotter, 1996); Hendry (1996) notes the whole theory of change can be reduced to this one idea. Despite this it represents a theory which became unfashionable in the 1990s (Kanter *et al.*, 1992; Dawson, 1994; Hatch, 1997). In the literature review, links between conflict and change were noted; the use of FFA provides a further tool for dispute analysis.

During the movement phase Lewin (1947) notes that it is necessary to take account of all the forces at work and use them to identify and evaluate the choices available. The technique utilised to do this is a force field analysis (FFA). FFA provides a framework for problem-solving and implementation of change. The problem is diagnosed by taking account of opposing forces which exist within the field. Each force is made up of a number of variables identified by critical actors, each assigned a weighting according to their perceived importance. Some variables constitute driving forces, which when increased support planned change; others represent resisting forces which when increased reinforce the status quo. Change will only occur if the forces are modified so the system can move to a new quasi-equilibrium state. FFA provides a visualisation of the force field, allowing identification of which forces need to be strengthened or weakened to achieve this. It enables practitioners to organise information in terms of relevance for change (Brager *et* *al.*, 1992), and therefore represents a further method to identify the impact of stakeholder conflict and potential conceptual tool for its management.

3.3 Research Framework

This research is based on an interpretivist research philosophy, seeking to gain insight into the nature of environmental conflict. It is therefore largely qualititative in its approach aiming to answer the proposed questions through exploration. As a form of qualitative research, case studies can be used to provide an in-depth analysis of the specific problem. In this research, cases of dispute surrounding the development of environmental sustainable hydropower are utilised to highlight the wider dimensions and implications of environmental conflict. Multiple cases are selected to encompass a diversity of conflict scenarios, and strengthen findings. As a result the study naturally adopts a comparative case methodology where multiple case studies can be used to highlight differences and connections between them (Yin, 2008). Comparison of cases selected will allow identification and separation of case specific details and those of the conflict process itself. It is anticipated that similarities between cases despite different problem contexts will highlight important conflict dimensions. This information will be used to evaluate and draw conclusions on the impact of stakeholder conflicts on achieving sustainable decision-making, in accordance with study aims. To highlight the impact of stakeholder conflict on achieving sustainable decision-making, this research uses the dilemma of hydropower development as an example. While a review of hydropower and its associated issues follows in the subsequent chapter, an overview of the cases and how they were selected is presented below.

The problem of environmentally sustainable hydropower development varies on a case by case basis, dependent on the nature of the challenge faced, which in turn is a function of the size of the development and its lifecycle stage. The nature of conflict will also vary over time and therefore is case specific. To ensure sufficient diversity and representation, case studies selected must differ in development scale, lifecycle stage and phase of conflict progression. As each of these criteria has three possible categories and thus 27 possible case study combinations, there is therefore a need to select a representative sample from all permutations. Considering each of these criteria as a spectrum, three end points can be identified (Figure 3.3). Case studies which met these criteria were then selected (Figure 3.3). It is intended that by taking this approach a diversity of problem dimensions and associated conflict elements can be analysed, yielding a broad consideration of the impact of stakeholder conflicts on environmental decision-making.



	Case study	Location	Scale	Lifecycle stage	Conflict stage	Methods used
1	River Garry	Perthshire, Scotland	Meso-scale	Redevelopment	Felt	SSM Change theory Conflict assessment helix
2	Gordleton Mill	Hampshire, England	Small-scale	In development	Latent	SSM
3	Severn Estuary	Gloucester, Somerset, England/ Monmouthshire, Wales	Large-scale	Proposed development	Perceived	Change theory FFA

Figure 3.3- Spectrum End-points selected and Associated Case Studies.

Additional case studies were also investigated. The case of the River Doon, Ayrshire, Scotland was investigated following participation issues with the River Garry (see Chapter 5) as a replacement case study 1. As the River Doon faced similar participation issues it was not pursued. An additional case study at Wood Mill, Hampshire, was also intended to further test the effectiveness of SSM in managing conflicts. As the lead stakeholder withdrew from the study it was not completed and there was not sufficient time to find a replacement case in the course of this research. The focus of this case study was to further advance the methodology developed (see Chapter 8.4); its absence does not therefore detract from the findings from the comparison of cases.

As each of the case studies has different characteristics, different methods are utilised in different combinations to explore the nature and impact of conflict. In case study 1, SSM and Lewins (1951) change theory are used to highlight the progression of conflict over the long time scales involved, while the conflict assessment helix is used to examine its nature and potential causes. Case study 2 examines the impact of stakeholders; SSM is therefore used to make such elements explicit. Although presented differently, this case was the first undertaken and completed; SSM was therefore deployed in its traditional form and independent of other methods. In the final case study the large number of stakeholders involved prevents the use of SSM, change theory and FFA are therefore used to assess how movement from impasse may be achieved. Detailed description of participants in each case, data collection techniques, interview and survey design and specific methods employed are located within the relevant chapters (Chapters 5-7).

Chapter 4 The Case of Hydroelectric Power

4.1 Introduction

To better understand the complexities of disputes within environmental management, and the benefits a conflict based approach could yield, conceptual findings from Chapter 2 and the methodological approach from Chapter 3 are applied to a case study. Environmental resources of key importance, with greatest risk of violent conflict regarding ownership, include energy supplies, availability of freshwater, land for agriculture and fisheries; all of which have been the focus of armed struggles (McMichael, 1993). Demand for these resources is not one dimensional; there are multiple conflicting uses which make allocation difficult. Freshwater availability has high conflict potential; fundamental to human life and finite, the risk of dispute is considerable as economic redistribution is difficult and there is no substitute (Wolf, 1998). Westing (1986) suggests that aside from land, no limited natural resource is more important than freshwater. Imperative for human survival, water is also needed for maintenance of food resources, urban and industrial activities, navigation, recreation, and renewable energy production. Of these activities, renewable energy generation via hydroelectric power presents an environmental challenge. There is considerable interest in renewable energy, the main attractions being security of supply and improved environmental performance compared to fossil fuels. Hydroelectricity is viewed globally as an important source of renewable energy, low carbon and non-exhaustible, it can be economically attractive compared to other options. Also associated with numerous societal benefits, (flood control, water supply, increased recreation opportunities) there is significant interest in its development (Frey and Linke, 2002).

However, there are numerous potential localised impacts associated with hydropower which vary in nature and scale dependent on the type of scheme involved. Tensions between benefits and localised damage are experienced globally. Evaluation of international water disputes (1950-2000) highlights hydropower related events[2] form 10%

[2] Includes only those cases where hydropower is stated as the direct cause of the dispute.

of the database (Yoffe and Larson, 2002). However, while hydropower developments are the fourth largest causes of international water related disputes, interactions are predominantly co-operative (93.1%) and rarely violent. Despite an international tendency to co-operate, at local and national scales the development of hydroelectric power has a history of conflict among stakeholders, throughout the world several projects have been the subject of disputes and sharp resistance (Kaygusuz, 2002; Klimpt *et al.*, 2002). Developing remaining hydroelectric potential, offers many challenges largely due to the numerous contradictory themes involved in the debate.

Due to the technological maturity of hydropower, the environmental impacts have been identified and widely investigated (Berry, 1955; Brunke *et al.*, 2000). Numerous structural and operational solutions exist, ranging from fish screens and passes, through to changes in operational controls. Despite this, solutions implemented will be the result of a compromise between political, economic, social and environmental issues, once legislative requirements have been met. With an ambiguous understanding of the specific parameters of sustainable hydropower, opinions as to the manner in which hydropower should be developed and operated vary considerably. Resolving such issues requires difficult discussions to determine acceptable tradeoffs. During the establishment of these tradeoffs contradictory points are raised and supported by well reasoned arguments, making decision-making difficult. Sustainable hydropower development therefore faces a number of challenges, addressing its complex nature, its associated uncertainties and managing the wide range of people involved. While not labelled as a conflict, achieving sustainable hydropower development retains all the features found to be characteristic of environmental disputes (see Chapter 2). At present the solutions are thought to lie within the provision of better technological solutions. While such actions are needed, they are unlikely to aid the resolution of conflict where stakeholders have fundamentally different views. The aim of this chapter is to explore the full extent of the problem, to establish why sustainable hydropower development is prone to dispute, and the nature of the associated conflict. The chapter is broken down into three sections; the first provides a background to hydropower, outlining its principles, associated technologies and a brief review of environmental concerns and mitigation measures. The second section outlines the challenge of environmentally sustainable hydropower development. The final section discusses hydropower conflicts, considering cases of dispute and diagnosis using the conflict assessment helix developed in Chapter 2. A discussion of the key points follows.

4.2 Hydroelectricity: Background, Scientific Principles and Associated Technology

The use of hydropower across parts of Europe and Asia dates back approximately 2,000 years; by the time of the Industrial Revolution technology had been refined, achieving close to 70% efficiencies (Paish, 2002). As engineering advanced during the 19th century, and demand for electricity grew, modern turbines were developed. As a result in the first half of the twentieth century hydropower expanded rapidly; Europe and North America built numerous dams and hydropower stations, exploiting up to 50% of the technically available potential (Paish, 2002). In Scotland alone, 28,710 MW of hydropower capacity were constructed from 1945-1965 (Bean and Thin, 2008). These schemes were the product of traditional engineering, poorly regulated despite adverse impacts on both freshwater ecology and surrounding landscapes (Johnson, 1994). As hydro schemes began to meet with resistance and more stringent regulation, development costs increased making new hydroelectric facilities only marginally competitive with other conventional technologies. Their development slowed as improvements in coal extraction and the use of nuclear power became more attractive.

A renewed interest in hydropower in the UK (and Europe) is driven by the attractiveness of high efficiencies provided by modern turbines, the ability to meet rapidly peaking energy demands, financial incentives and the requirement to achieve renewable targets. In the UK, the majority of large-scale hydropower potential has been developed, and provides *ca* 2% of total electricity consumption (International Energy Agency, 2006). The majority of generation takes place in Scotland and to a lesser extent Wales, due to favourable climate and topography. England and Northern Ireland have numerous hydroelectric facilities but their total electricity contribution is low, often limited by small rivers, modest flows and low gradients (Johnson, 1994). There are various estimates of the UK's hydropower potential. Müller and Wolter (2004) suggest that there is between 600-1,000MW of unused low-head (1.5–2.5m) potential in the UK, while the International Energy Agency (2006) estimate 750MW in Scotland alone (but do not specify type). In England and Wales, the Environment Agency (2010a) estimates the total small scale potential of 1,178MW based on using existing infrastructure, which if developed could contribute to *ca* 1% of the overall UK projected 2020 electricity demands. However, based on environmental sensitivity criteria, only 4,190 (16.2%) sites represent mutually beneficial situations with high potential feasibility; the remaining are classified by environmental risk into low (4.2%), medium (21.7%) high (46.4%) and unclassified

(11.5%). Dependent on how these risks are considered and dealt with, actual achievable small scale hydropower generation may be as little as 580MW (49.2%)[3]. Establishing exact potential is difficult due to the variety of challenges that hydropower faces.

4.2.1 Guiding Principles

Hydroelectricity is a renewable energy resulting from the stored energy in water that flows from a higher to a lower elevation under the influence of gravity (Tester, 2005). Water moving to sea level is continuously converting a portion of potential energy to kinetic energy in the form of flow velocity. This provides the opportunity to extract energy using hydro turbines to convert water pressure into mechanical shaft power, which in turn drives a generator or other machinery. The power available is proportional to the product of pressure head and volume flow rate, in the general formula:

$$P = \eta \rho g Q H$$

where P is the mechanical power (watts), η is the hydraulic efficiency of the turbine, ρ the density of water (kg/m^3), g the acceleration due to gravity (m/s^2), Q the volume flow rate through the turbine (m^3/s) and H is the effective pressure head of water across the turbine (Paish, 2002).

4.2.2 Types of Facilities

Hydroelectric power schemes can be classified as low (2-30m), medium (30-100 m) or high (100+ m) head dependent on the height difference between intake and turbine (European Small Hydropower Association, 2004), although exact classifications vary with region. Additionally they can be classified according to system design, as run of river, impoundment or pumped storage. Impoundment facilities are the most common, typical of larger hydropower systems. Construction of the dam allows the storage of water, which is released through the turbine (Figure 4.1a). Water may be released either to meet changing electricity needs or maintain a constant reservoir level. Run of river facilities channel a portion of the river through a penstock (Figure 4.1b). The amount of energy generated is a function of natural flow levels. A pumped storage facility allows electricity to be generated

[3] Assuming development of all win-win schemes as a minimum.

by the movement of water between reservoirs (Figure 4.1c). When the demand is low, energy is stored by pumping water from a lower reservoir to an upper reservoir. When required, water is released to the lower reservoir to generate electricity.

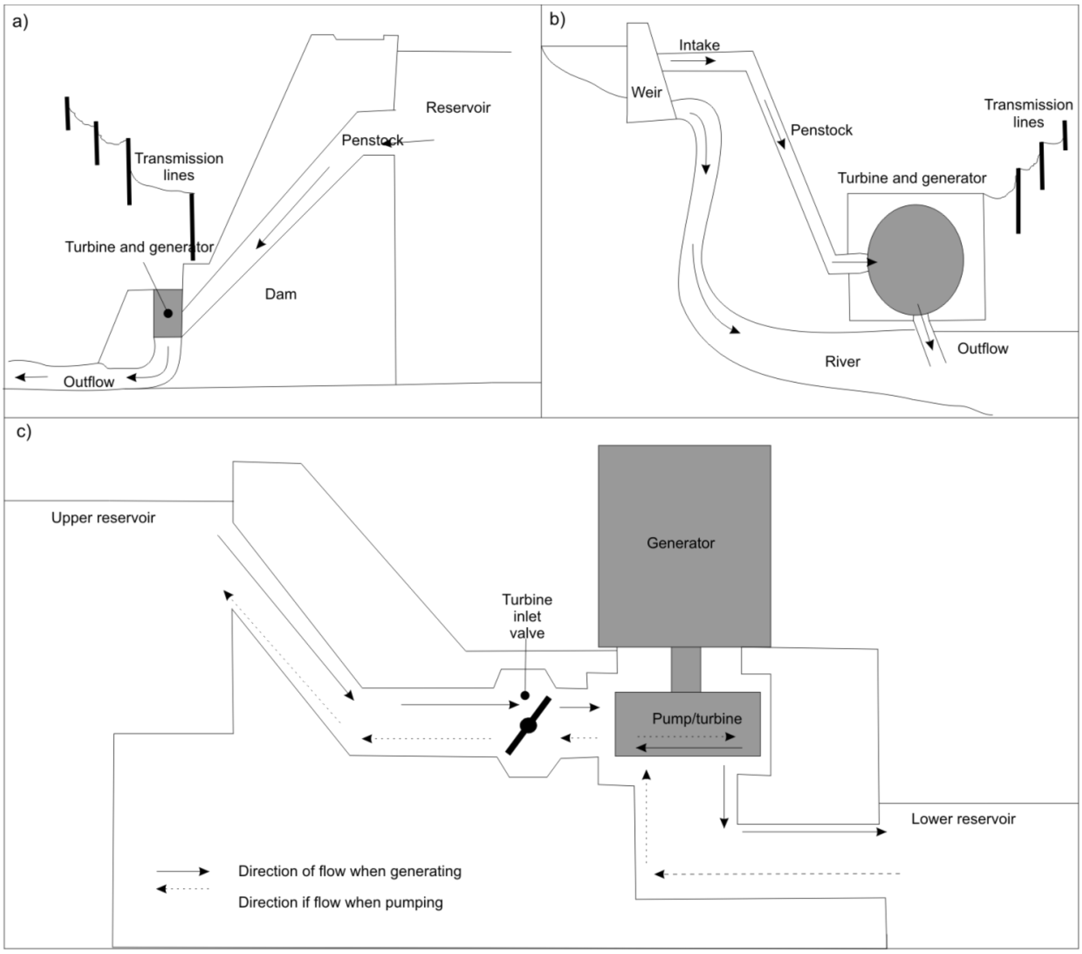


Figure 4.1-Generic schematics of the components of a) an impoundment facility, b) a run of river facility, and c) a pumped storage facility

4.2.3 Technology

The selection of technology for any site depends on its physical characteristics, principally the head and flow available, and the desired running speed of the generator (Paish, 2002). Behaviour of a given technology over a range of flow conditions is usually considered, with particular attention to expected power output under reduced flow conditions. While numerous hydropower technologies exist, the most widely used are turbines. Turbines are classified by their mode of operation, either impulse or reaction, dependent on the position of the runner blades. Reaction turbines are submerged, powered by a pressure drop across the device, while impulse turbines are driven by flowing water in an open environment (Twidell and Weir, 2006). Reaction turbines consist of Kaplan and Francis types. The three main impulse turbines are the Pelton, Turgo and Crossflow. Efficiency of turbine type varies with head and discharge, with Pelton and Turgo wheels being appropriate at the high-head low discharge range, while Kaplan turbines are better suited to low-head high discharge flows (Paish, 2002).

Many other examples of hydropower technologies exist, all aim to provide innovative solutions to the challenges that hydropower faces. Waterwheels remain a viable technology in modern times with two common designs: overshot and undershot. Overshot wheels depend on water flowing into cells at the top, and releasing water at the lowest elevation possible. Modern wheels allow energy conversion efficiencies of up to 80% (Müller and Kauppert, 2002). In an undershot water wheel, the inflowing water contacts the blades below the height of the axial, with head being gradually reduced as water flows through the wheel (Müller and Kauppert, 2002). Traditional waterwheel designs are considered to have a low impact on fish, thus typically requiring fewer mitigation measures (Environment Agency, 2009). However, this is not assumed to be true for modern adaptations to waterwheels (Environment Agency, 2009).

The Archimedean Screw historically used for pumping water has more recently been employed as a low head energy converter, and represents an innovative technology. Comprised of a hollow shaft and a helical vane, design reduces the need for large scale engineering works prior to installation, while ability to pass small debris can reduce the need for screens (Müller and Kauppert, 2002). With slow rotational speeds, no rapid pressure change or hydraulic shear, its low physical impact on fish (<10% of fish were damaged) have been noted (Spah, 2001; Vries, 2007; Kibel *et al.*, 2009). This and other novel technologies are the focus of considerable research, as their potential to address the environmental concerns generated by more traditional technologies is significant.

4.2.4 Environmental Impacts and Mitigations Measures

Hydro-electric power is not clean in the ecological sense (Langford, 1983). Berry (1955) provides one of the first comprehensive assessments of the potential impacts of hydropower, although environmental concerns (particularly those related to fish) predate this study. Berry (1955) highlights issues such as:

- Impact of changes in water levels and flows.
- Change to water chemistry and sediment transport.
- Restricted access to migratory fish.
- Impacts of transmission lines on birds and mammals.

While the exact impact varies dependent on type and scale of facility and manner of its operation, environmental impacts associated with hydropower are extensive and widely studied. Alterations in flow, cause change in the physical characteristics of the river inducing shifts in community structure. Reduction of water can reduce habitat availability for invertebrates (Englund and Malmqvist, 1996; Parasiewicz *et al.*, 1998; Brunke *et al.*, 2000) and fish access to spawning and migratory habitats (Thorstad and Heggberget, 1998; Gibbins *et al.*, 2001). Reduced flow can also induce behavioural response, including increased drift in invertebrates and disruption in migration patterns for fish species such as Atlantic salmon (*Salmo salar*) (Albaster, 1990; Webb, 1990; Smith *et al.*, 1996; Gowans, 1999; Soloman, 1999). Extreme changes in flow caused by hydropeaking[4] regimes create additional issues of invertebrate desiccation (Copestake, 2006) and dislocation (Bean and Thin, 2008); and stranding and delay of migrating fish (Chansou and Larinier, 1999; Saltviet *et al.*, 2001; Halleraker *et al.*, 2003). Changes in flow regime subsequently cause shifts in sediment transfer, increasing deposition of fine particles which smother invertebrate communities (Brunke *et al.*, 2000) and decrease fish recruitment by reducing replenishment of spawning gravels and oxygenation of eggs (Osmundson *et al.*, 2002).

Changes in water chemistry and temperature may occur over time, a function of prolonger impoundment. These factors have been found to affect invertebrate and fish biomass and community structure (Lauters *et al.*, 1996; Lessard and Hayes, 2003; Petts 1984: McDonal and Hyatt, 1973; Kruk and Penczak, 2003). Temperature changes have also been linked to alterations in growth rates of salmon (Jensen, 2003). Negative impacts on other biota such as birds and mammals may also be seen in animals which are dependent on in-stream biota for food (Nilsson and Dynesius, 1994). Disturbance and direct mortality through collision with power lines associated with hydropower represents another impact. Various studies (Miquet, 1990; Lehman, 2001) note the role of power lines in increased mortality of raptors, while Bevanger (1998) highlights that a range of birds

[4] Hydropeaking is the practice of abruptly alternating between a low base and a high peak flow, for electrical power generation during periods of high demand.

may be affected. Modification of riparian habitats may result in sensitive species (e.g. bats, water voles, otters) being killed, disturbed or displaced.

At the hydropower facilities themselves, issues of fish delay and passage are a concern and the main focus of mitigation requirements. Impoundments (including those not associated with hydropower) fragment fluvial systems and can prevent, limit or delay fish movements between rearing and spawning habitats (Lucas and Baras, 2001), thus impacting on both potamodromous (residential) and diadromous/anadromous (migratory) fish. Migratory species often accumulate at dams and weirs, and suffer elevated predation risk, energetic costs and stress (Scruton *et al.*, 2008; Lucas *et al.*, 2009). The appropriate mitigation measure is the provision of a fish pass; numerous designs exist each with different applications. Fish ladders provide a series of stepped pools (Clay, 1995; Armstrong *et al.*, 2004) allowing fish to ascend gradually via the provision of rest areas. More technical fish passes, such as the Larinier pass, are designed based on hydraulic principles (Castros-Santos *et al.*, 2009). These mitigation measures tend to be species specific; as a result multispecies nature-like channels are increasingly being deployed. These mimic natural water courses in both form and function (Larinier, 2002; Santos *et al.*, 2005), and are characterized by low gradients and a heterogeneous structure, creating velocity and depth variation (Aarestrup *et al.*, 2003).

In addition to habitat fragmentation, fish can suffer mortality or injury during passage through systems due to mechanical strike, rapid pressure fluctuations, and shear stresses caused by abrupt changes in velocity (Cada, 2001). Carr (2000) suggests that fish which undergo stressful downstream migration maybe damaged or disorientated increasing probability of mortality or predation. Non-migratory fish may be impacted via entrainment into off-takes or hydro schemes themselves. To prevent access, screening of intakes and outflows is often required, and in the UK is a legislative requirement for waters with migratory salmon and trout populations. An effective screen must consist of either a physical structure or environmental stimuli detectable to the fish, create an approach velocity within the swimming capabilities of the target species, and efficiently divert fish to a preferred alternative route (Turnpenny *et al.*, 1998). Behavioural screens utilise natural fish responses to environmental (e.g. acoustic, light or visual) stimuli to manipulate movement. Behavioural barriers are generally less effective than physical screens, with efficiencies ranging from approximately 40% for bubble curtains to >90% for some acoustic screens (Turnpenny *et al*., 1998).

As a mature technology, the scientific principles of hydropower are well understood and are reflected in a range of technologies which have and continue to evolve to meet the requirements of the industry. These technologies have become increasingly sophisticated, seeking to improve efficiencies and address the socio-economic issues which have and continue to constrain hydropower development. A wealth of literature exists identifying not only the environmental impacts associated with hydro schemes, but testing potential solutions. The science of hydropower is further filtered by socio-economic factors. The scheme applied may not represent the optimum scientific solution, but the feasible option under the given socio-economic constraints. Currently in the UK, hydropower is experiencing resurgence, with applications to the Environment Agency increasing. There is a need to understand how differential socio-economic issues and debate among stakeholders divert developers from the sustainable solutions that science can deliver, to ensure that unsustainable development during a period of resurgence does not yield negative environmental and socio-economic impacts in the future. To do this, the challenge of environmentally sustainable hydropower must first be identified.

4.3 The Challenge of Environmentally Sustainable Hydropower

Hydropower development provides a complex environmental problem, largely due to its dual role as both a source of green energy and a locally destructive force. From an anthropogenic perspective conflict stems from the contradiction between the need for green energy solutions to combat carbon emissions (Department of Trade and Industry, 2007), and the need to maintain high quality freshwater environments for the aquatic flora and fauna, and associated industrial and recreational activities. Climate change is recognised as a serious threat, which demands a global response (Stern *et al.*, 2006). If projected impacts are realised, future generations may have to cope with significantly redistributed freshwater resources, increased ecosystem stress, redistributions in agricultural capacity, and increased weather variability (Solomon and Climático, 2007). The future impact of greenhouse gases on the global climate and associated legislation are considerable drivers for green energy technologies. Hydroelectric power represents a mature technology, with no carbon emissions and low maintenance costs. With the right environmental conditions (suitable rainfall, catchment characteristics and possible water storage), hydropower operation can provide constant green electricity (via base-loading) or meet surges in demand (via operational alterations) (Twidell and Weir, 2006). However modification of freshwater environments for hydroelectric generation can lead to significant changes in the physical and biological systems. Threats to global freshwater biodiversity include: overexploitation; water pollution; flow modification; destruction or degradation of habitat; and invasion by exotic species, further pressures may lead to irreversible damage.

In the past, hydropower stations were products of traditional engineering, built during a period of energy expansion for the purpose of maximising electricity. There was little interest in environmental impacts, largely due to hydropower's commercial and socio-economic advantages (Langford, 1983). The changing value of the environment, and the need to promote socio-economic development while halting environmental degradation, has become a modern challenge for both existing schemes and future developments. The difficulty of sustainable hydropower development is it encapsulates both water and energy policy, both are at the centre of the debate on sustainability (International Hydropower Association, 2003). A well-conceived scheme can address the needs of sustainability, but is difficult to achieve in reality. In the case of hydroelectricity, sustainable development requires the balancing of multiple interrelated, contradictory elements; making feasible solutions difficult due to the disparity between environmental acceptability, economic viability and social concerns.

4.3.1 Environmental Acceptability

Inland waters and freshwater biodiversity constitute a valuable natural resource in economic, cultural, aesthetic, scientific and educational terms. Climate change has been hailed as the biggest threat to humans in the 21st century (Wissenbach, 2010). To address both, hydropower development must mitigate adverse impacts to generate environmentally sustainable solutions. However, reconciling these two environmental goals is a difficult task. On occasions the need to meet these specific ecological objectives will inevitably conflict with the broader concerns of sustainable energy (Reid *et al.*, 2005) creating a discrepancy between two ecosystem services. Hydropower is characterised by a large variety of positive and negative effects it can have on an ecosystem (Frey and Linke, 2002). The nature and magnitude of these impacts are site specific (Trussart *et al.*, 2002), varying significantly from one project to another. Impacts can be broadly grouped by type of scheme (Egre and Milewski, 2002). Run of river facilities tend to have fewer environmental impacts than those that require impoundment however, these schemes create reservoirs, and provide the highest levels of electricity supply (providing energy storage and the ability to respond to changing demand). Thus there is considerable debate over the manner of hydropower development both in terms of type and scale. A single large project of 800MW could theoretically be less environmentally damaging than 100 small hydro projects of 8MW capacity, depending on which projects are analysed. This results in an inability for policy makers to specify a certain type or size of project as acceptable. Each scheme features a unique set of site conditions, requiring considerable planning and research prior to each individual scheme (Oud, 2002).

Environmental impacts are a major part of modern design criteria, failure to appropriately consider them can result in project refusal (Therrien and Bourgeois, 2000). In response, a wide variety of environmental measures for hydro-electric schemes exist. These actions may be avoidance measures implemented at the planning stages (related to site, type and scale of the scheme), mitigation or compensation methods to eliminate, reduce or compensate for impacts (fish passes, compensation flows), or an enhancement processes which improves existing conditions (Trussart *et al.*, 2002). Although there is a long list of particular environmental issues that may affect an individual site (see Trussart *et al.*, 2002); the most common mitigation needs relate to the provision of fish passage and flow releases, largely due to the socio-economic importance of fish (National Hydropower Association, 2010). Fish mitigation needs to address issues of upstream and downstream movement, possible entrainment and increased mortality risk. The focus of considerable research, numerous solutions exist. The solution required will depend on the species present and the nature of the hydro scheme; the solution implemented will depend on economic appraisal, availability of technical knowledge and legislative requirements. Issues related to flow are also challenging. Maintaining an appropriate flow of water is fundamental to both the success of a hydropower scheme and the natural environment; but the pattern of use varies significantly. Permissions are required to take and discharge waters and will include a number of restrictions regarding amount of abstraction, seasonality and timings of release (Reid *et al.*, 2005). Whilst broadly accepted as a mitigation strategy, determining actual quantitative levels, and therefore the amount of power generated is again a function of socio-economics.

4.3.2 Economic viability

Economic appraisal of hydropower is difficult. Hydropower schemes are robust, high-efficiency, long-term investments with lifetimes of 50-100 years (International Hydropower Association, 2003). But economic risk in hydropower projects can be large, as they are capital intensive and incur considerable planning costs, which vary significantly from scheme to scheme (Oud, 2002). Uncertainty with regards to future power prices and energy markets makes it difficult to assess the long term financial success of a project. Hydropower also, suffers greatly from economies of scale (Paish, 2002), larger plants are significantly more cost effective, but are often rejected on environmental and social grounds. In light of this, hydropower (under 5MW) is included in the Feed-In Tariffs (FITs) scheme launched by the UK government in 2010. The scheme provides financial support per GW of energy produced to the supplier. These subsidies allow a largely economically unviable sector to undergo significant recent growth. Developing remaining hydroelectric potential offers many challenges. On the basis of the polluter-pays principle, project design and operation should be optimised to minimise environmental and social impacts. This can incur significant costs, effecting the economic viability of the scheme. However, the fluvial environment itself is a resource with an economic value; one estimate puts the global annual ecosystems value of rivers at $1.7 trillion (Costanza *et al.*, 1997). While the actual figure is method dependent, fluvial environments have strong links to both industry and the economy. There is therefore disparity among themes, with one ecosystem services (energy provision) impacting on others (water and fisheries), adding further complexity to the economic arguments associated within hydropower. Determination of economic viability also varies significantly dependent on the scale of analysis. Hanley and Black (2006) note that while a cost-benefit analysis of integrating the Water Framework Directive in Scotland yields a positive outcome (benefit to cost ratio, 1.69-1), at the micro-scale imposing good ecological status may outweigh the benefits.

A review of best practices highlights that hydropower projects can only be truly sustainable when they internalise their environmental and social costs (Klimpt *et al.*, 2002). Such an approach is limited by competition with other electricity producers; if competing power generation options (coal, gas, oil) are not required to fully internalise their impacts, there is no direct economic advantage to being sustainable. Due to the role of the private sector in hydropower developments, there is increasing emphasis on financial efficiency (Oud, 2002), to meet corporate targets. Modern corporations increasingly exhibit 'shades of green', varying considerably in environmental performance; from those who fail to meet even minimal standards, through to those who go substantially beyond compliance (Gunningham *et al.*, 2003). Several studies have identified motives for green approaches, such as regulatory compliance, competitive advantages, stakeholder pressures, ethical concerns, critical events and top management initiative (Lampe *et al.*, 1991; Dillon and Fischer, 1992; Vredenburg and Westley, 1993; Lawrence and Morell, 1995; Winn, 1995). Green practices can yield economic opportunities via revenue increases from green marketing (Cordano, 1993) and improvements to corporate reputation (Hart, 1995; Russo and Fouts, 1997). The presence and ability to capitalise on these elements is a factor of socio-environmental conditions.

4.3.3 Social concerns

The ability of hydropower to meet multiple societal need strengthens its sustainability, as due to their longevity they enhance equity between generations (International Hydropower Association, 2003). However in delivering these goals there is potential for numerous negative impacts on local communities, such as resettlement, changes in land use, landscape and amenity impacts; dependent on scale, location and presence of mitigation measures. As with environmental impacts, social concerns must be addressed on a case-by-case basis.

In the UK, public concern regarding hydropower is less apparent, perhaps as there have been few large-scale hydro developments in recent years. However in the past, hydropower development in Scotland had a significant impact on the local population (Miller, 2002). The main social concerns documented refer to discontent over negative aesthetic impacts. Over an initial 20 year period, the North of Scotland Hydro Board built 56 dams, 54 power stations, 600km of road, 350km of rock tunnel, 350km of aqueducts and *ca.* 35,000km of transmission cable (Payne, 1988). Such intrusions were unpopular and thought to have impacted on tourism and cultural heritage. Large influxes of migrant workers into remote areas were unpopular with local communities, and social issues existed between the two groups (Wood, 2002). Unaesthetic development eventually slowed; social unrest generated political and economic pressures for change (Langford, 2008). While such schemes would not be allowed under modern legislation, such cases highlight the nature of social opposition to unpopular schemes.

Today social concerns are the result of rising environmental expectations. During the last 20 years, public environmental awareness has increased; creating controversy over large scale projects, including hydropower developments (Berube and Villeneuve, 2002). As a result, public expectations regarding environmental and social performance have increased; communicated through protest and dispute. These disputes call for a more sustainable approach to hydropower and often involve the formation of interest groups. Developers or operators, who favour technical solutions based on economic decision-making, often take an opposing stance. Oud (2002) notes that this triggers interest groups to become more 'fanatic' in their opposition; often catching the interest of the media. The results of such social pressures can be both positive and negative; in some cases they force wider consideration and action regarding social and environmental concerns. In others, opposition causes projects to stall during the planning process, or results in withdrawal of the development and its potential benefits (Oud, 2002)

4.3.4 Stakeholder Perspectives

Outlining the problem as it is perceived to exist, is not representative of it in reality. There are many cases where initiatives fail because they do not adequately address the interests and characteristics of stakeholders (Grimble and Wellard, 1997) and therefore not the actual problem but the perceived one. Stakeholder analysis allows enhanced understanding of environmental systems by identifying those who have a stake (Grimble and Wellard, 1997). A stakeholder can be defined as an individual or group that has one or more stakes in an undertaking; where a stake can range from an interest through to a legal claim of ownership (Carroll and Buchholtz, 2008). This stake will determine the underlying requirements that an individual or group expect from the hydropower development, and therefore to understand the full extent of the challenge to be addressed, these stakes must be identified and considered.

Within any given market place, there are three main stakeholder groups, government, industry and society (Hawkins, 2006). The relationship between these groups is dynamic, with each group exerting a degree of influence over the other two. Within industry, recognition of such interactions and their centrality to strategic planning has resulted in considerable interest in stakeholder theory (Freeman, 1984). Stakeholder theory, applied to the concept of hydropower development, results in a complex model of factors (Figure 4.2). For each stakeholder, objectives and pressures are significantly different, and places hydropower in its wider context.

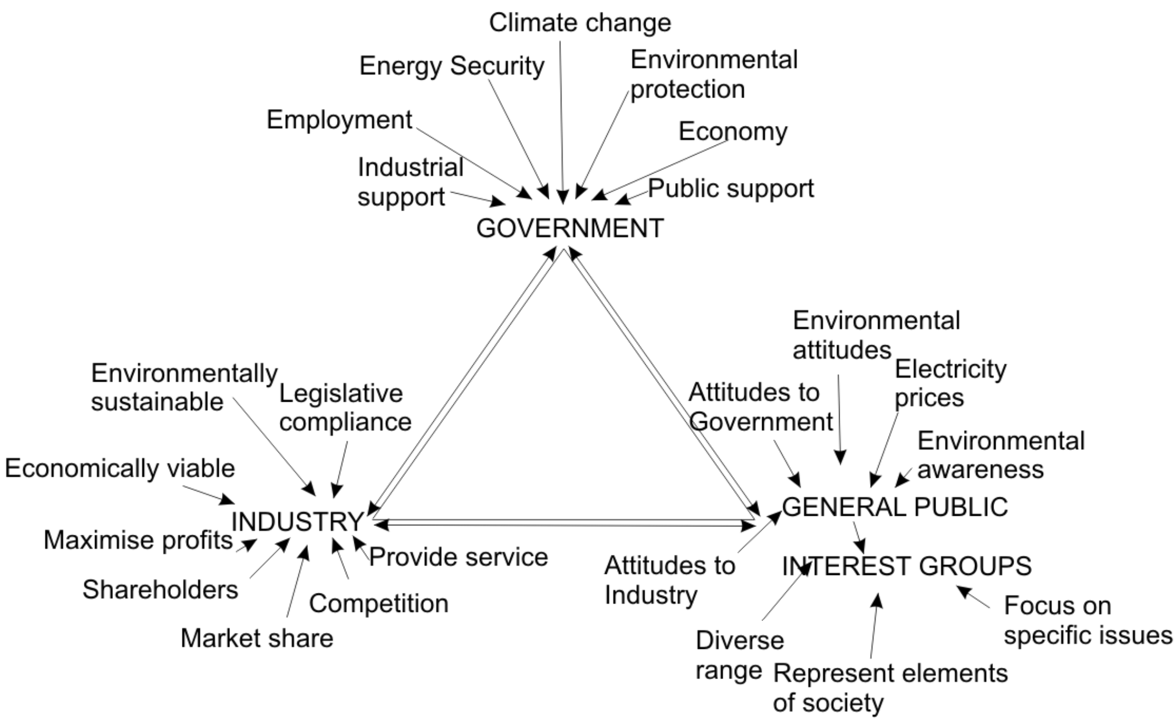


Figure 4.2-Stakeholders and their Associated Hydropower Pressures (adapted from Carroll and Bucholtz, 2008)

For government stakeholders, contradictory pressure to address future energy and environmental issues, while delivering short term policy goals is a concern. Division of responsibility across numerous government bodies increases risk of internal disagreement, intensifying conflict potential. This is further complicated by external pressures from society and industry. A tendency to focus on the achievement of short-term goals over movement towards a long-term solution has the potential to weaken political will to act. Cortner (2000) when examining the role of the Environmental Protection Agency in the US, notes similar issues arising from the need to implement multiple environmental statutes, in addition to poor institutional capacity.

There is an increasing pressure for industry to maintain or develop hydropower which is both environmentally sustainable and economically viable. Growing consumer awareness drives the inclusion of environmental issues, and consideration of long-term impacts of business practices. However, there remains continual short-term pressure to deliver acceptable results to shareholders, and maintain market share against competitors. Difficulties in achieving both short and long-term objectives could potentially generate conflict, enhanced by changing societal expectations of industry. Corporate social responsibility (CSR) and green ethics have become a facet of modern business, but create a complex trading environment forcing industry to react and comply, rather than proactively respond.

As consumers, society expects electricity supply to match their demand and to be fairly priced. However, green considerations may enter into electricity selection criteria and individuals may experience conflicts of choice. Sufficient demand for such a product would represent a persuasive argument for government and industry to provide such a service, but is dependent on public awareness and willingness to pay. Society can exert its influence via the formation of interest groups to wield more targeted pressure. Fluvial environments have a diverse range of such groups (see Appendix 2), many of which provide both support and opposition for hydropower development. Achieving a solution which meets the criteria of all three groups is difficult, with a number of contradictory pressures identified. With stakeholders exposed to differential pressures, many of which external to the issue of hydropower *per se*, there may be factors beyond the boundaries of the hydropower debate, which will determine the nature of its development. More detailed consideration of the problem as it is experienced by stakeholders is needed.

Using a generalised case of hydropower development, potential stakeholders can be identified using the first level of a three tiered analysis outlined by Freeman (1984). This first tier assesses rationale; who the stakeholders are and highlights their perceived stakes. Identification is undertaken by producing a generic stakeholder map (Figure 4.3), and a chart of specific stakeholders and their perceived stakes (see Appendix 2) based on these categories. This highlights the complex web of stakeholders involved (Figure 4.3), with 10 categories and 48 stakeholder types identified; some participants may play multiple roles. The exact number of individuals involved is highly case specific. Conceptual consideration highlights a broad range of potential stakeholders with differential levels of involvement, understanding and ability to act. Their associated stakes are diverse, simultaneously expanding problem dimensions and the complexity of the debate. Consideration of their individual stakes (summarised in Appendix 3) introduces numerous potential themes which may feature in the debate, inclusive of:

- Flood defence
- Tourism
- Recreation
- Fisheries
- Biodiversity and conservation
- Geology
- Forestry
- Water resources management
- Engineering
- Technology
- Legislation
- Archaeology
- Consumer demands
- Profits
- Market trends
- Financial institutions
- Planning
- Sustainable development

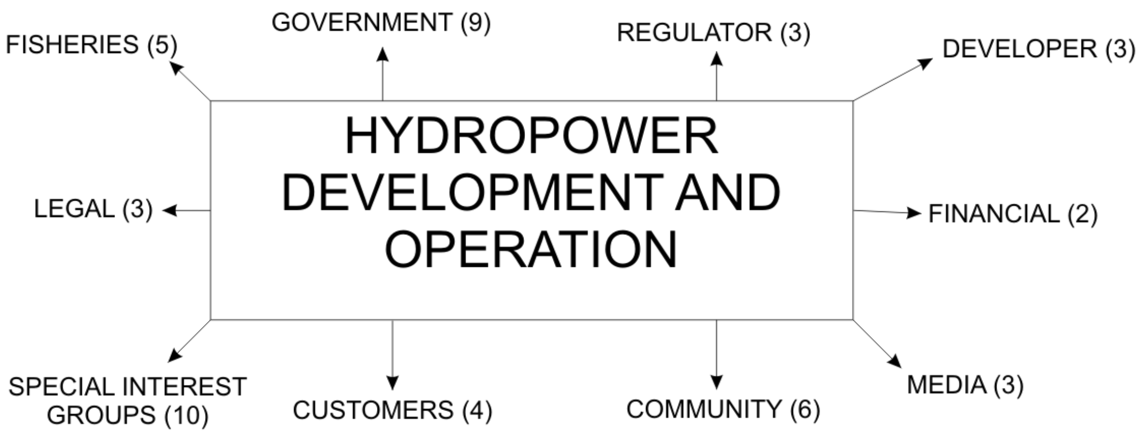


Figure 4.3-Potential Stakeholder Map for Hydropower Development and Operation– Identified Groups and the Number of Individuals included

Finding a solution that meets all stakeholders' goals is unlikely, as any decision has differential impacts across groups. Due to the multi-functionality of freshwater environments, pursuing the maximisation of one ecosystem service (electricity) can impact negatively on other needs of equal importance (water resources, recreation, food, wealth). Establishing which needs are more important and should be addressed at the expense of others is a significant challenge and is subjective. As more stakeholders are engaged, they bring additional themes and criteria, creating a complex problem. Selecting an appropriate course for development and operation of hydropower is difficult, governed by multiple external pressures and not solely a drive to achieve sustainable development.

4.3.5 The Hydropower Debate and Decision-Making

The issue of hydropower development is subject to significant debate. During the post-war period hydropower development was considered to be a good strategy, widely accepted and applied internationally, but today perceptions are much more differentiated, recognising that there are associated advantages and disadvantages. This shift in the perception of hydropower is the result of evolving values and increasing awareness across environmental, social, economic and political dimensions. Consideration across these expanded dimensions has created contentious international debate over the nature of hydropower development; raising a number of questions which have no definitive answers. These questions form a fundamental basis of decision-making and include dilemmas such as:

- *Given the issues surrounding its development, should hydropower be part of strategic plans to address climate change?*

Hydropower is not the only option for deployment of renewable technologies, there is considerable interest in other tools which deliver low carbon energy. As hydropower is only estimated to contribute approximately 1% of the UKs electricity generation (Department of Business, 2008), it has been questioned whether options which do not face such complex difficulties be should instead be deployed. Focus on less controversial technologies, would allow green energy strategies which are clear cut. This in turn raises the question:

- *Is it irresponsible to not exploit hydropower opportunities?*

In the face of rising energy demands and diminishing supply of traditional fossil fuels it may be considered reckless to reject opportunities to deploy mature technologies, such as hydropower. Rejecting them entirely may seem rash, but determining the extent of the weight such arguments carry is difficult. It should not provide validation for extensive development. Although international debate on hydropower is ongoing, there is a consensus that the question is not whether to develop hydropower but how (Koch, 2002). This raises a perhaps more moral question:

- *Is the potential damage to local environments associated with hydropower development justifiable?*

The potential impacts of hydropower on the local environment can be considerable, but it may be that to some negative impacts are seemingly justifiable, dependent on your perspective and interests. Work by Rolston (1975) on the value of species, argues that it would be morally wrong to eliminate a rare species, to increase the value of a collectors specimens, and many would agree. Such an example highlights a case whereby an action is economically justifiable, but morally questionably. These actions occur in reality, in 2009 it was highlighted that Mitsubishis' fishing fleet were freezing catches of blue fin tuna (the world's most endangered fish). While the action was undertaken to smooth issues of supply, as blue fin tuna becomes extinct (predicted for 2012), the value of the stockpile will increase and allows Mitsubishi greater control of the market. In this case to Mitsubishi, species loss for economic gain is profitable. As long as the perceived overall benefits outweigh the damage caused then the decision is justified despite moral concerns. The same may be true of hydropower development, if the benefits can be demonstrated as enough, they may overshadow negative consequences. If this is the case, then:

- *How should decisions be taken?*

Weighing the advantages against the disadvantages and reaching a decision is challenging, as many factors are not quantifiable or comparable. Advantages gained in energy production, CO_2 reductions or flood control, do not directly offset social disruption or localised environmental damage. As a result most decision makers would seek to attribute some form of common value to all aspects of the decision to allow comparison. Most decision makers analyse the problem on a cost-benefit basis, which is easily adopted for economic concerns but less transferable to social and environmental dimensions. Attributing value to nature is one of the fundamental issues of environmental decision-making, and is separated into intrinsic and inherent values. Those that believe natural objects have their own value, struggle to support their arguments, as it is difficult to quantify the grounds of this value and communicate it. The value of landscapes for example is difficult to determine; areas such as the Scottish Highlands, Snowdonia, and the Lake District in the UK, would be believed by many to have a high value, not in terms of its resources, but of aesthetics. While recognised as high, determining an exact figure and justifying it would be difficult, and thus it may not form an explicit part of the decision, despite its importance. Consideration of the non-instrumental value of the environment is subjective. In the case of landscapes, it is possible for one individual to value a cityscape over one of natural beauty. It is also possible for an individual to recognise the beauty of a valley, but still support flooding it to supply a city with water. It may be the case that the instrumental value of a consistent water supply is more than the non-instrumental value of the landscape. Thus raising the question:

- *Who should make decisions?*

Placing all these factors in context and then deciding whether or not a project should go ahead and under what conditions is a challenge for policy and politics. Located at the interface of multiple policy issues which are not complimentary, and hampered by its case specific nature, decisions regarding hydropower will fall within a continuum of good and bad practices. Determining who should decide when all place hydropower within the context of individual objectives is difficult. The people involved will ultimately decide what is socially and environmentally acceptable, and economically feasible. The boundaries of these dimensions will determine the nature of the scheme implemented.

There are no definitive answers to these questions; it is possible to highlight contradictory arguments or opinions as to what the solutions may be. These arguments would be well reasoned and supported with considerable evidence. The debate over hydropower centres on whether sustainability is to be seen as an absolute concept, or whether it has a more flexible definition (Frey and Linke, 2002). While not environmentally benign, hydropower developments can be multi-purpose meeting numerous societal needs. If the costs of acquiring social and potential economic benefits, involve changes in the natural environment; then the decision of whether this is acceptable is a societal one, based on human value systems (Frey and Linke, 2002). Thus the people involved in the debate will shape its outcome. There are persuasive environmental arguments on either side, with hydropower development at the interface of two significant global issues. Numerous environmental mitigation strategies and legislative protocols exist; but are affected by economic viability and social acceptability. As a result the issue of hydropower development becomes not an issue of right or wrong, but what is acceptable for all involved. The concept of acceptability is subjective; its proximity to a truly sustainable solution is dependent on the people involved. Located at the crux of two environmental problems, which occur at differential scales, hydropower represents a highly complex problem with no single solution. At policy level, the nature of hydropower development remains the subject of disagreement, characterised by diverse worldviews and conflict. With no centralised agreement, hydropower must be addressed on a case-by-case basis, via verbal exchange between stakeholders involved; their desires for a given development will determine the nature of its national development, and its proximity to a sustainable resource. With tensions regarding the nature of hydropower development emerging, there is a need for enhanced understanding and appropriate mechanisms to manage these conflicts and allow sustainable solutions to emerge. The case of hydroelectric power therefore provides an area where a greater understanding of conflict could yield significant benefits.

4.4 Hydropower and Conflict

Considering the challenge it faces, debate and conflict are likely to be a significant feature of hydropower development both broadly at the policy level and locally establishing case-specific criteria. No single stakeholder is adequately equipped to make informed balanced decisions regarding hydropower, requiring collaborative decision-making processes and navigation of conflict. While research in the field is active and there is significant work aimed at producing better guidelines, underlying tensions remain. This section aims to highlight the existence of conflict within the hydropower development industry and explore its theoretical dimensions. It takes a conflict-based approach to the issue of sustainable hydropower development, applying the conflict assessment helix model developed in Chapter 2 to diagnose potential causal parameters of disputes.

4.4.1 Cases of Hydropower Conflict

Providing evidence of conflict over hydropower development is difficult as many elements remain tacit reflecting the experiences of those involved and are not frequently documented. Occasionally some may make their views explicit but not all stakeholders will be able to do so, creating an inevitable bias towards those who are more vocal. To begin to understand the nature of hydropower conflicts, this section examines the opinions expressed at a conference discussing the challenges facing development, and the disputes that arose over proposed changes in legislation associated with hydropower.

At a recent conference (June, 2010) entitled ‘Hydropower: Opportunities, Challenges and Sharing Best Practices’, a number of points were raised which indicate the issues that practitioners experience. The conference was jointly hosted by the Environment Agency and CIWEM, its purpose to discuss environmental and fisheries concerns associated with the newly developed Hydropower Good Practice Guidelines, to better understand key issues and actions to resolve them. Both speakers and attendees represented a mix of private developers, engineers, academics, fisheries, industrial and governmental representatives. Speakers highlighted a lack of evidence to support policy or guidance decisions and the imbalanced influence of stakeholders (Roger Furniss, Angling Trust and Fish Legal), inconsistencies in advice and lengthy development processes (Paul Southall, National Trust) and the overuse (Oliver Paish, Derwent Hydro) and under-use (Roger Furniss, Angling Trust and Fish legal) of the precautionary principle. Discussion centred on formal procedures, hydropower policy and the provision of suitable guidance. The need to for clarity was noted “*We can no longer make decisions on whether an action “may” lead to, “could possibly” cause or “could allow” something to occur*” (Williams, 2010). Such phrases are common within technical reports relating to hydropower, and weaken decision-making. During the course of the conference it became apparent that there was a significant gap between the balanced approach discussed and what was practically experienced; “*there is much talk of balance, but it has to be real balance not one in which opposed parties can merely stick to their own principles and ignore each other’s aims and needs*” (Williams, 2010).

Within the hydropower debate stakeholders inevitably base arguments on their own objectives and beliefs. Many have strong beliefs as to what the problems are and how they should be resolved, which can be linked to their role. A key observation by a prominent developer (Derwent Hydro) was that projects are often delayed or stagnated by “*the over use of the precautionary principle, misuse of legal frameworks and the seeking out of problems of any size*” (Paish, 2010), and these were the problems to be addressed. These issues significantly impact on project completion, and have subsequent financial implications. At the same event, the Angling Trust stated there was a need to improve current practice by “*better application of the precautionary principle, more attention to the* *no deterioration clause in the Water Framework Directive*" (Furniss, 2010). Such a stance would prevent uncertain development when impact on fish populations is unknown, and their position is understandable within the context of their goals. But the two suggested courses directly oppose each other, creating an impasse.

The need for collaborative approaches was clearly observed, but fundamental differences in stakeholder views were also apparent. For example, despite advocating a multiparty approach during their presentation, the representative from the Angling Trust was later questioned as to how such collaborations would be possible when the Trust published antagonistic documents (see Figure 4.4). Such actions suggest that the true nature of hydropower is not transparent in such settings, and there is a discrepancy between the problem stated and that experienced. Of further interest was the response of the organisers to this question, who intervened and suggested that such discussion should be conducted in private. This action demonstrated an unwillingness to discuss underlying dimensions of the hydropower. Discussion of issues like this would have educational benefits to all the practitioners in the room, but was not allowed despite being a significant part of the challenge hydropower faces and the purpose of the conference. Failure to recognise and address such issues further exacerbates conflict. Adoption of collaborative approaches was the solution advocated by many groups, but how such interactions should take place and who would be involved and to what extent was notably absent.

Figure 4.4-Angling Trust Anti-Hydropower Campaign Poster (distributed May 2010)

The impact of conflict on the course of hydropower development is considerable, and is best highlighted by the case of the proposed Free Passage of Fish Order (2009). It is estimated that there are 26 000 obstacles for fish across England and Wales, (Environment Agency, 2010a), although actual numbers may be more due to the difficulties in assessment (Kemp and O'Hanley, 2010). To provide better protection for fisheries, extensions to existing fish passage requirements were proposed, to include non-salmonid migratory and coarse fish. If enforced, such criteria would have considerable impact on the hydropower industry; and was met with an industrial backlash to “sweeping” legislation which would greatly weaken the economic viability of smaller hydroelectric schemes (British Hydropower Association, 2009). The focus of the industry’s argument was that this would force potential schemes to be rejected, resulting in a loss of potential renewable energy generation. During the course of the ensuing debate, conflicting goals between EU energy and water legislation were noted, and were used differentially. Coinciding with a recession, economic arguments were persuasive, and as a result the implementation of the Free Passage of Fish Order was postponed until May 2011, due to recognition that costs would be significant for some developments (Moghraby, 2008). While it may be felt that operators resisted to protect profit margins; the hydropower industry is not dominated by large scale generators. Approximately 57% of installations are owned by small-scale producers (Department for Energy and Climate Change, 2009) who are unlikely to be able to absorb such costs. In this case divergent views championed by prominent stakeholders altered the course of proposed legislation, identified by regulatory bodies as important for protection of an economically valuable environmental resource. To date (June, 2012) proposed legislative changes have not been readdressed.

The issue sparked further debate in the House of Lords (3rd November 2009) highlighting that the delay was regrettable, and made it far more difficult to achieve the Water Framework Directive’s objectives. In the course of his address Lord Dear (Crossbench Peer), identified that difficulty may stem from a conflict of interest within the Environment Agency, as a protector of the environment and promoter of renewable energy. Lord Greaves (Liberal Democrat) suggested that such a conflict is not limited to the Environment Agency or to hydropower alone:

“There are two sides to this and two arguments, and the position that each of the two sides would end up on is rather different. Where people think that the desirable balance would occur is different if you are a passionate believer in hydropower or, on the other hand, if your main concern is the preservation of fish stocks. It is not possible, in my view

or the view of my party, to take an extreme view on this; there must be balance and compromise".

His argument goes onto highlight where synergistic developments cannot occur it is a case of acceptability and cost, and the Environment Agency needs a collaborative approach which achieves balance and compromise.

These two cases highlight the existence of conflict within hydropower development. Conflict is often only documented in situations where there is a need to express a position and therefore is difficult to highlight explicitly. The visible expression of conflict represents a small portion of the feelings, values and perceptions that lead an individual to the position they express. While the reasons behind a given position may not be divulged, the existence of conflict can be established and is noted in the case of hydropower.

4.4.2 Causes of Hydropower Conflict

While each hydropower conflict will be case specific there are a number of generic themes which make them prone to debate. To establish what causes hydropower disputes, the conflict assessment helix (developed in Chapter 2) is applied as a guide to consideration.

Structures of Hydropower Conflict

Consideration of infrastructure may highlight why hydropower conflicts develop. There are multiple structures within the debate; in this section legislative frameworks and the permitting procedure (inclusive of recent modifications) are examined, to further enhancing understanding of hydropower conflict.

Legislative Frameworks

Requirements to increase renewable energy provision and protect and enhance aquatic environments, contradict in the case of hydropower across Europe. Contradictory legislation creates a conflict structure; which may influence and promote dispute (Mayer, 2000). Due to the multi-functionality of river systems there are numerous legislative mechanisms (international and national) which can influence hydropower development (Figure 4.5 and Appendix 4). The combination of legislative pressure impacting a scheme will vary from case to case, but all hydropower developments across Europe are affected by the disparity between the Water Framework Directive (WFD) and the Renewables Directive.

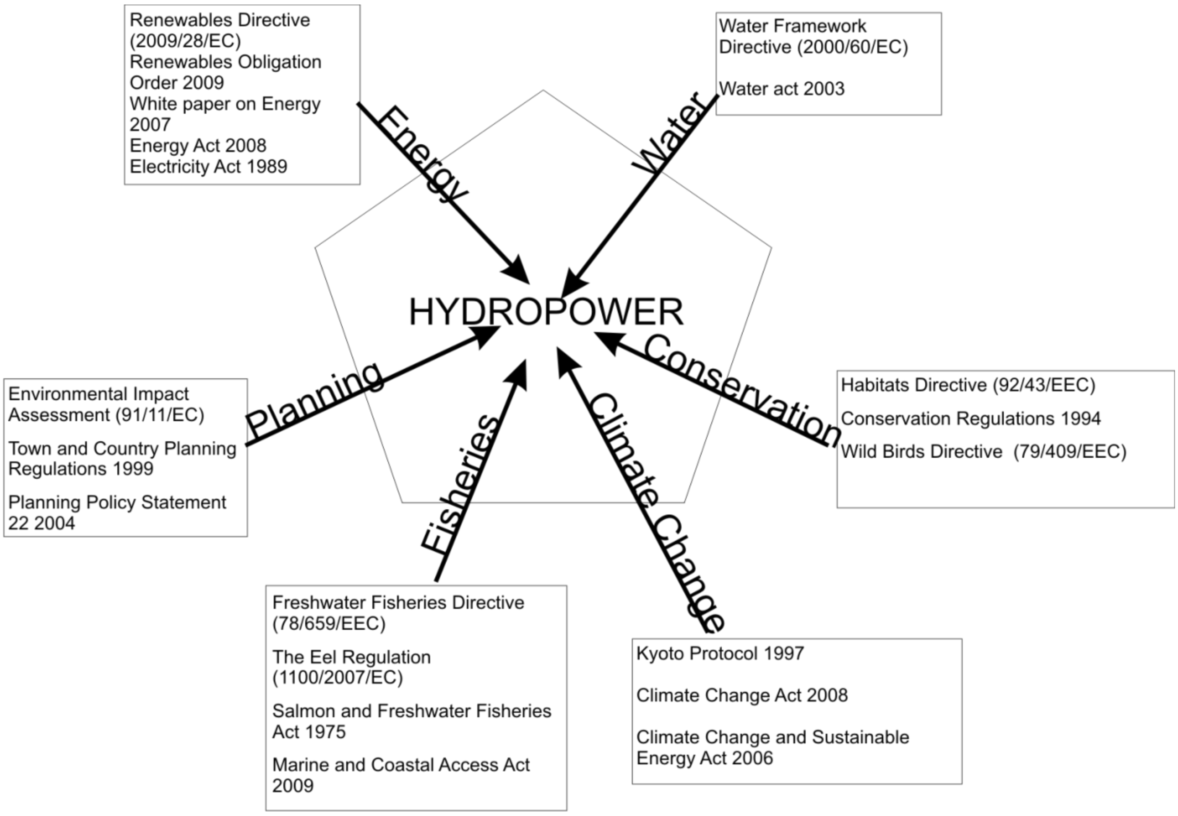


Figure 4.5- Legislative Pressures on Hydropower by Theme.

A detailed legislation register, presented in Appendix 4, highlights key parameters of each and their relevance to hydropower development

The Renewable Energy Directive establishes a common framework for the promotion of renewable energy by ensuring increased market penetration. The Directive seeks to integrate environmental concerns into Member State's energy policies to "decouple" the economic activity from environmental deterioration (von Homeyer and Knoblauch, 2008). The Community target is to achieve a minimum of 20% of energy from renewable sources by 2020. Each Member State must ensure that it meets its national target by 2020 (UK target - 15%). In the Directive hydropower is named as a renewable resource, and may be utilised to achieve these targets. The Directive notes "coherence between the objectives of this Directive and the Community's other environmental legislation should be ensured. In particular during the assessment, planning or licensing procedures for renewable energy installations" (European Commision, 2009 paragraph 44). This requirement is hard to fulfil in the case of hydropower due to potential incompatibilities with the WFD.

The WFD is designed to improve and integrate water management throughout Europe and establishes the basic principles of sustainable water policy; while simultaneously protecting and improving aquatic environments via provision of chemical and ecological targets (Rahaman and Varis, 2005). For hydropower, the requirement to prevent deterioration of the ecological status of inland waters; and protect, enhance and restore all surface waters including all artificial and heavily modified bodies of water (European Commision, 2000) makes development difficult. However, achieving the environmental goals of the WFD would have impacted on sectors closely integrated with river systems (transport, industry, fisheries); and while these anthropogenic uses cause morphological, chemical and biological modification (Panariti *et al.*, 2009) they represent important policy objectives for national government. As a result the WFD takes socio-economic factors into consideration allowing a number of exemptions (Acreman and Ferguson, 2010). These exemptions generate ambiguity. While the WFD does not prohibit development of hydropower; it requires the minimisation of its impacts to at least be investigated. Such mitigation requirements may incur significant costs in terms of initial capital outlay, ongoing maintenance costs and further financial losses from decreased availability (MacLeod *et al.*, 2006). The Directive states that members may be exempt from achieving good ecological status if mitigation is not possible due to technical feasibility or very high costs (Article 4, para.3 (b)). Furthermore, under Article 4.7, deterioration in status may be permitted if it can be demonstrated that all practicable mitigation steps have been taken, and that the benefits of actions outweigh those of maintaining current status (European Commision, 2000). The WFD implies that every new hydropower facility project must be evaluated against other technical solutions, which do not harm the environment and might be more profitable.

As a result there is a conflict which emerges when analyzing the Directives. Under the Renewable Energy Directive, hydropower facilities represent an important instrument for achieving renewable energy objectives, providing incentives for the construction of new facilities and the refurbishment of old sites. Conversely, hydropower facilities represent an environmental pressure; therefore under the WFD, the construction of new facilities needs to be limited. Abazaj (2010) notes that the WFD never mentions directly the term hydropower, referring instead only to power generation. Although the Common Implementation Strategy for the WFD addresses the issue of hydropower, the lack of an appropriate and clear definition is at the root of conflict and will continue to generate uncertainties if not addressed (Abazaj, 2010).

Hydropower Permitting Framework

The hydropower development application process is another structure which influences and promotes conflict. The permitting of hydropower is complex as exact requirements vary from scheme to scheme. To apply for a licence, a developer had to submit detailed information regarding the proposed development (Table 4.1). Further licences and consents were required from various departments within the Environment Agency; these include water resource permits (impoundment and abstraction licences), flood defence consent, and planning permission from the relevant Local Authority. This process required the developer to submit up to 4 applications per scheme to different people. Recognition that this could be simplified was noted by numerous organisations (Blueprint for Water, 2010; British Hydropower Association, 2010), and in response the Environment Agency reviewed and streamlined the process. During the review change was strongly supported; of the 53 responses publically available 67.9% supported a simplified process. Via the consultation it was possible to identify how the original framework influenced conflict. Most frequently cited were inappropriate timescales and stakeholder exclusion. The period of time taken to gain the appropriate permission under the previous system was lengthy with an average industry identified timescale of 9-25 months from pre-application to determination (British Hydropower Association, 2010). Exact timescales vary significantly with one record highlighting a period of nearly 4 years (Environment Agency, 2010b record 73). Impacts such as loss of negotiation time on competing applications submitted simultaneously (Environment Agency, 2010b record 72), and inability to adequately advertise a proposal prior to completion (Environment Agency, 2010b record 60) were noted. Limited stakeholder involvement was widely cited, with lack of involvement in the pre-application stage and poor advertising of formal applications recognised (Blueprint for Water, 2010). This limits consultation with non-governmental organisations and provides only a limited period to discover, research and provide feedback on cases possibly biasing the process in favour of the applicant.

Table 4.1- Data required for pre-application stages of a hydropower proposal

Information Required for Permitting
Detailed description of the scheme design
Scheme location
Scheme generating capacity
Volume of water abstracted to generate power (minimum and maximum)
Impact on wildlife, river bed and river navigation
Plans to reduce negative impacts on fish migration

In October 2010, the Environment Agency adopted a new approach to the management of hydropower permitting. Concluding that existing legal frameworks were not a barrier, the changes streamline permitting into a single decision process, aiming to deliver a more consistent and robust assessment of the environmental impacts of hydropower (Environment Agency, 2010b). Each application is allocated a single Environment Agency account manager that handles the scheme from inquiry to decision, across divisions. Recognising the individual nature of hydropower schemes, each permit is bespoke but the process is standard, separated into two stages. At the pre-application stage developers are required to read the Environment Agency Good Practice Guidelines (GPGs), fill out an environmental site audit checklist (WR325) alongside the pre-application form (WR315) itself. The WR315 requires over 40 individual details pertaining to site details, scheme details, water resources, fisheries resources, flood risk and planning, prompting broad consideration of the scheme. Both the new permitting process and the GPGs advise early discussions with potential affected parties to reduce time spent on inappropriate proposals. Examination of structures in more detail (Figure 4.6) highlights limited opportunities (indicated by dotted lines) for affected parties to raise objections. Developers are encouraged to consult stakeholders, but not required. Where consulted there are no mechanisms to facilitate resolution should conflict occur, similarly there is no need to recognise conflict and respond to it, unless it contradicts the aims of the Environment Agency. At the formal application stages, affected parties have the opportunity, (a 28 day period) to respond to proposed schemes. While the advertisement of applications is publically available, opportunity to comment must be actively sought out independently by potential stakeholders; they are not invited to comment. Therefore, despite changes to the permitting process there remains no formal mechanism for stakeholder involvement, no guidelines on stakeholder identification and while views may be submitted there is no guarantee of action. While there exist legal mechanisms which could be evoked, their complexity and the amount of information required to prosecute is substantial and ability to use them limited.

The ill-defined and ambiguous issue of stakeholder identification and consultation seems contrary to the clarity of the highly structured application stages, and is potentially a significant gap in the process, which if not appropriately addressed may increase both costs and time taken to gain approval. Given the long history of hydropower conflicts and its current contentious status, a process which neither recognises nor addresses dispute may be limited. The lack of formal consultation and guidelines as to how to undertake stakeholder consultation, signify potentially poor communication among parties in the early stages. While most developers will undertake some form of consultation, without guidelines to structure application, impact is differential. A structure that recognizes the important role of stakeholders and manages or minimizes conflict would be appropriate. Currently poor practices encourage stakeholders to express their views in a negative manner (as formal objections) and exclusion may warrant negative perceptions of the developer, which will influence later stages of conflict.

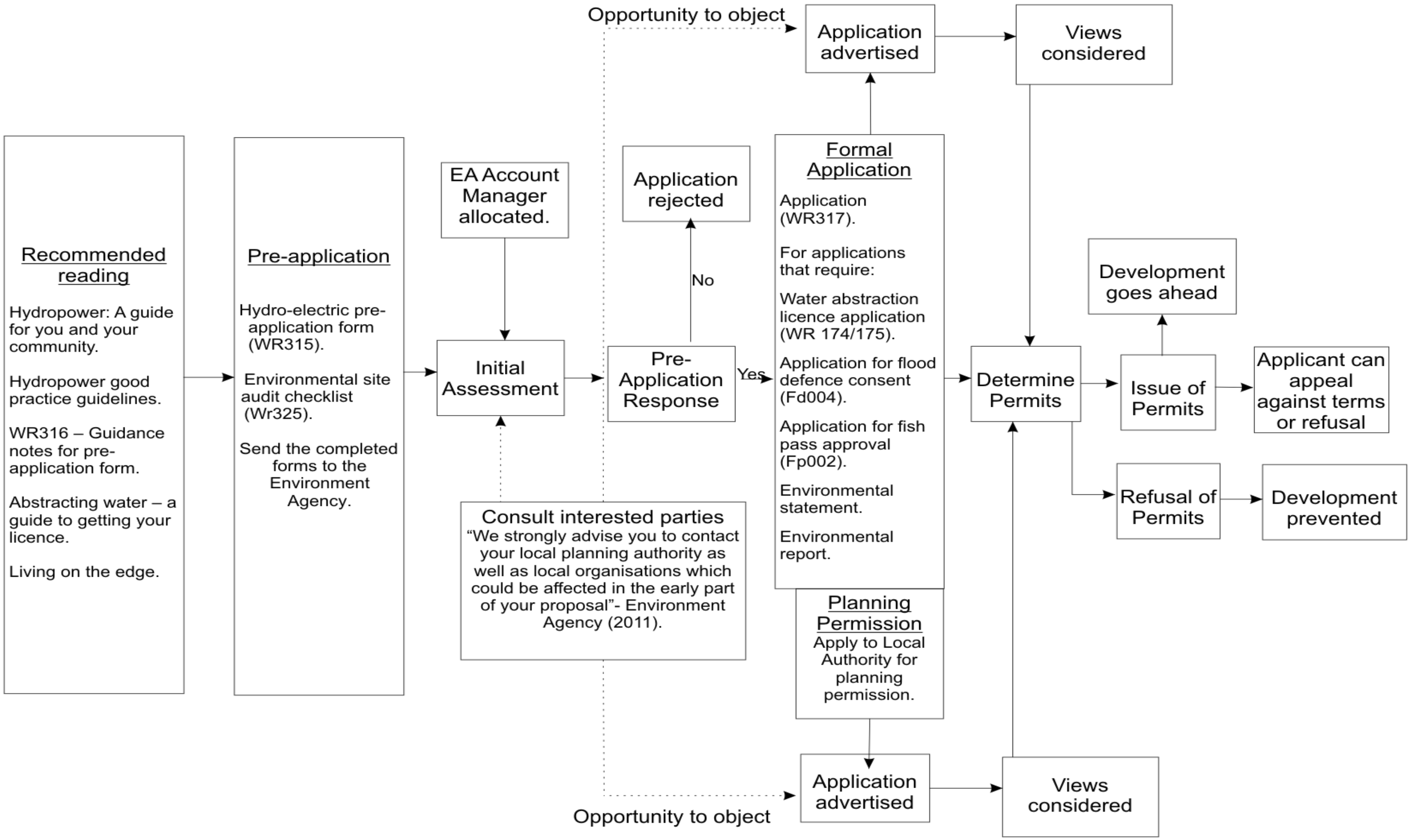
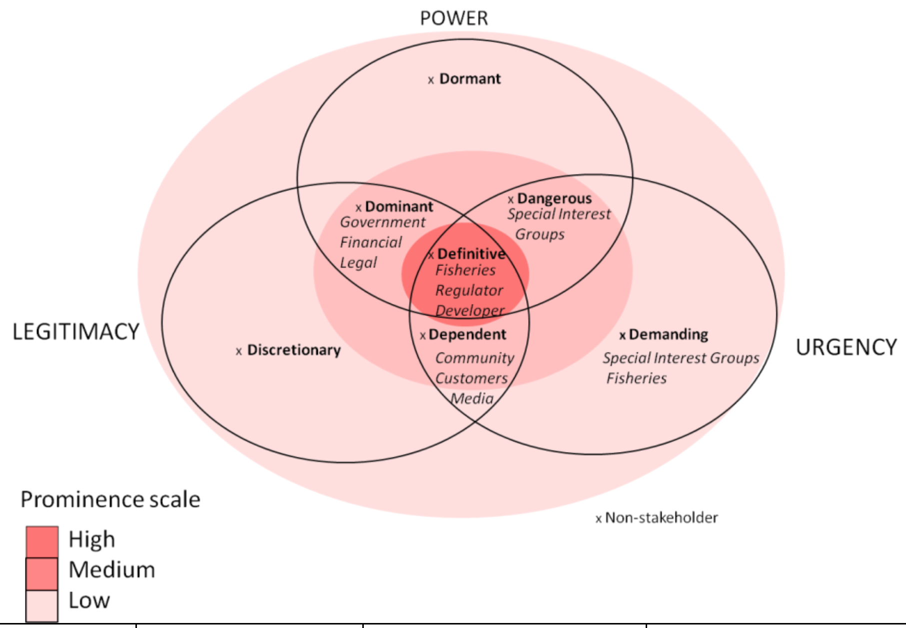


Figure 4.6- A schematic of the new hydropower permitting process.

Power among Stakeholders

Both legislative and permitting structures create differential power distributions among stakeholders. Structures examined above give considerable power to the developer and regulator, and limit access for other stakeholders. But possession of power does not directly translate to influence. Within stakeholder analysis, it is acknowledged that individuals play significantly different roles. Work by Mitchell *et al.,* (1997) classified stakeholders based on their possession of a certain combination of characteristics: power, legitimacy and urgency. Dependent on which of these characteristics they possess, stakeholders can be classified into groups, and each associated with differential involvement and power in the debate. Applied to hydropower stakeholders (it provides insight into the different stakeholders types involved in the debate see Figure 4.7).

While this manner of analysis provides a tool for understanding stakeholder dynamics, Friedman (2002) noted that people will play a different role with respect to different institutions and sets of ideas, and therefore will have different sets of vested interests and opportunities. These relationships are much more useful when analysed on a small scale surrounding a specific proposal. Analysis of stakeholder dynamics highlights a majority of identified stakeholders have very low prominence, and a limited ability to negotiate acceptable trade-offs. In addition, a single stakeholder can have multiple stakes; these can be organisations such as the Environment Agency (which could be seen as Government, Regulator, Legal, and Fisheries) or individuals who could fall simultaneously into customer, community and fisheries categories, and face internal conflicts.



Attributes	Classification	Prominence	Characteristic	Stakeholder type	Description
One	Latent (*are hidden or dormant*)	Low	Power	Dormant	Could become more salient over time if gain other characteristics
			Urgency	Demanding	Have urgent claims, but with no power to act they can be ignored
			Legitimacy	Discretionary	Represent optional or 'charitable' stakeholders
Two	Expectant (*require some form of action*)	Medium	Power Urgency	Dangerous	These stakeholders may be coercive and potentially violent
			Power Legitimacy	Dominant	Their influence is assured, should they chose to act.
			Urgency Legitimacy	Dependent	With no power they are dependent on others to carry out their will
Three	Definitive (*key stakeholders*)	High	Power Urgency Legitimacy	Definitive	Immediately have high priority and require recognition

Figure 4.7-Hydropower groups by stakeholder classifications and associated prominence by characteristic (after Mitchell *et al.*, 1997).

Information and Communication Flows

In hydropower the role of information is complex, with differential availability and acceptability among stakeholders. Issues of commercial confidentiality are a significant barrier to data distribution (Williams, 2010). Data is not fully disclosed to all, requiring stakeholders to seek information individually (Environment Agency, 2010b). Regardless of impact on perceptions; obtaining data independently increases the risk of one or more stakeholders having incomplete information, a central cause of conflict. The amount of information required is case specific, and stakeholders have significantly different views on its quantity and quality. During the permitting process review, fisheries interests felt no reduction in the amount or quality of information should be introduced (Salmon and Trout Association, 2010). Conversely, the BHA suggests the amount of information required in the decision-making process can be unnecessary, relevant information should be requested and justified on a case-by-case basis (British Hydropower Association, 2010). Interestingly, later in their response the BHA call for more data on the impact on fish to place hydropower in context. The importance of information therefore shifts dependent on its role in the stakeholders' argument. In the case of hydropower, it is accepted that many mitigation practices are limited by scarcity of scientific data on actual effectiveness and efficiencies of practices (Trussart *et al.*, 2002). This lack of information allows for uncertainty and conflict.

Within the review of permitting processes numerous stakeholders identify "*better communication mechanisms and wider consultation would be beneficial*"; along with "*better detailing of the justifications behind decisions*" are needed (Environment Agency, 2010b). Imperfect communication and incomplete information leave stakeholders to develop strategies based on their perception, influencing strategy and conflict potential. Issues with information flows largely centre on access, availability and suitability of data, dependent on how (if at all) it is communicated and understood. The nature of hydropower development and the associated science mean that a fully informed scheme is unlikely, as some issues remain unquantifiable. As a result, perceptions of risk and ambiguity will influence both arguments presented and subsequent actions.

The Role of Emotions and Values

Stakeholders' differential values are prevalent, influencing perceptions, often resulting in entrenched positions and 'labelling' of other parties (Opotow and Weiss, 2000). Values influence thoughts, associated action and importance; all of which shape a response to a potential conflict situation (North, 1990; North, 2005). In the case of hydropower, differential values often related to vested interests, will yield diverse criteria for a successful facility. One of the most easily identifiable values influencing hydropower conflicts is the differential worth of fish, in particular salmon, among stakeholders. Reid *et al.*, (2005) note that salmon have been a dominant concern in many project proposals. While there are undoubtedly socio-economic justifications for this, there is an element of intangible cultural importance which is widely recognised but seldom documented. The intangible importance of such elements can be the foundation of resilient arguments in favour of mitigation measures designed specifically for Atlantic salmon (*Salmo salar*). The values associated with fish, have made them a prominent feature of hydropower development, surpassing other environmental concerns such as impacts on invertebrate communities and water quality. Separation of these issues is interesting as they are not mutually exclusive. Hydropower debates are often colloquially referred to as 'fish versus flow' conflicts; in reality the factors involved are much more diverse. Values and associated emotions will influence the differential behaviours exhibited by stakeholders as they react to ongoing disputes. The strength of these values maybe such that a stakeholder maintains their position unwilling to negotiate, despite the potential futility of such action. This in turn influences their perception of the problem, the acceptability of solutions presented and the actions they take to achieve their individual goals.

The Importance of History and Timing

Hydropower developments have a tendency to involve the same core stakeholder types (Developers, Regulators, and Fisheries Interests) who may be involved in multiple cases in certain regions. Interactions from previous cases (both negative and positive) may influence the attitudes of those involved to their colleagues prior to engaging in talks over this case. Similarly, the success or failure of previous actions and solutions may influence current proposals. The outcomes of past conflicts alter what is considered to be important.

Fisheries concerns, in particular those related to salmonids, remain prevalent (Reid *et al.*, 2005) despite evidence of the negative impacts of hydropower on multiple species. These differential values arguably have historical elements. It is also possible that future considerations influence current actions. Future potential requirements of hydropower with regards to energy, water resources and biodiversity may influence the nature of schemes currently under development. Conversely, the future impact of continuing current development may feature; an emergent theme in the hydropower debate is the issue of cumulative impacts of multiple developments inclusive of those proposed in the future.

The impact of timing on hydropower conflicts has already been noted with long decision timescales associated with decision-making inducing negative attitudes. Timing of events is important, with the moment an action takes place influencing its success. The case of the proposed changes to the legislation surrounding fish passage illustrates this. While industrial opposition was likely to be significant regardless of the economic climate, the timing of their proposal added weight to their argument despite freshwater fisheries representing an economically important resource.

4.4.3 Summary

Using the conflict assessment helix it is possible to diagnose the generic causes of hydropower development conflict. Consideration of the structures involved highlights that the process of stakeholder consultation remains ambiguous with no clear guidelines as to how it should be undertaken and who it should include. As a consequence some stakeholders may be omitted, causing them to seek alternative methods (e.g. engaging in conflict) to ensure their views are heard; or are not appropriately engaged, preventing all problem elements from being identified. Given the highly structured nature of the rest of the process the motivations for a lack of detail in this area is interesting. The notion of stakeholder consultation is either considered to be separate and thus is not required to be outlined or its absence represents a lack of knowledge as to how to appropriately engage and manage such interactions. Within these structures the potential for stakeholders to disagree or have opposing interests is not highlighted despite numerous tensions over developments, nor are any mechanisms outlined as to how such conflicts would be addressed. This suggests that when they do arise they are handled in an informal, case-by-case basis with the notable absence of trained facilitators and conflict management mechanisms, or they are not addressed at all and thus represent a significant barrier to action.

In turn these structures create an environment, which influences the nature of one or more of the other forces of conflict. Existing legal structures create an environment where the nature of hydropower development is unclear and can be questioned, the provision of broadly applicable detailed guidelines is limited by the case specific nature of hydropower, thus in every case there are potentially multiple interpretations of development design and significant conflict potential. Structures may influence other conflict dimensions encouraging negative emotions, poor communication and obstructive behaviors; they also reinforce differential power hierarchies among stakeholders. Combined with polarized values among stakeholders, strong emotions linked to the issue and a history of dispute, it is clear to see how hydropower development issues often result in prolonged conflict. While this section attempts to consider the social processes engaged in the issue, it is impossible to map them entirely due to the unpredictable responses of individual stakeholders.

4.5 The Hydropower Problem

The purpose of this chapter was to explore the full extent of the problem, to establish why sustainable hydropower development is prone to dispute. Exploration highlights that it is multifaceted and highly complex; largely pertaining to the fact that hydropower does not occur in isolation. The development of a given hydropower facility involves a complex relationship between economic, social and environmental factors, which determine the nature of the scheme chosen. Achieving balance, as required by the ideology of sustainable development, is difficult due to inverse relationships between themes. Developing sustainable practices is both complex and subjective, making definitive action difficult. Further complexity comes from the requirement to place hydropower in its wider context, addressing its impacts on themes such as renewable energy generation, environmental protection and water management. Each theme provides a number of ecosystem services to society, and adds to associated environmental, economic and social factors involved. Some themes (e.g. renewable energy generation and protection of freshwater environments) are directly incompatible, and therefore combined solutions are not possible. But action is required due to associated legislation, generating urgency to act but an uncertainty as to how. The requirement to place decisions pertaining to hydropower development in wider context is a function of the people involved.

Another key part of the hydropower problem is the differential role of information. As a mature technology, hydropower is associated with a wealth of knowledge surrounding technologies, broad environmental and social impacts, economic concerns and mitigation measures. However while hydropower is broadly understood, there is a clear absence of the specific detail required to make decisions. For example, that impoundments reduce flow, which in turn can impact on fish movements, is recognized but how much water is required to facilitate passage unknown. The consequence of widely available knowledge is a high awareness of the deficiencies of hydropower, and the uncertainties which remain represent some of the most difficult to answer. Addressing these gaps in knowledge is the focus of significant research, but a key feature of the sustainable hydropower problem is uncertainty. The need for solutions which address these issues (new technologies, detailed guidance and better mitigation measures) is clear, and would greatly reduce conflict potential. However in this chapter, it is recognized that there are social dimensions which are fundamental to the nature of the problem which sustainable hydropower faces. Technological advancement must therefore coincide with social change.

Unable to determine a definitive course of action, requires stakeholders to choose from among options. The breath of possible solutions (combinations of technologies, operation methods and mitigation measures) to select from is considerable, and when faced with the choice individuals will inevitably select options which better address their needs, within the context of wider requirements. From stakeholder analysis, it is possible to note the considerable diversity of potential stakeholders engaged within hydropower issues and the diversity of interest they display. The spectrum of interests, means that as individuals, the range of actions selected may be considerably different and in some case incompatible. Multiple perspective on how resolution should be achieved occur creating ambiguity and potentially conflict. Within such an environment ensuring that environmentally sustainable solutions (ones that address environmental criteria while fulfilling design criteria) is difficult. While reducing uncertainty will undoubtedly play an important role, it will not resolve issues where stakeholders have fundamentally different perceptions. Similarly, new technologies may be assessed within existing attitudes and may therefore experience the same barriers as current practices. There is a need therefore to understand the impact of social dimensions of the problem, to facilitate change within the situation.

Having recognized that in its current state hydropower has a high risk of potential conflict; there is a need to identify the nature of its impact. While conflict may have multiple case specific impacts, a key concern is its influence on decision-making. Decision-making is a social process, actions taken are shaped by the nature of stakeholder interactions; the existence of these conflicts will therefore have some form of impact on the decision reached. The management of conflict may represent an area of necessary intervention for the achievement of environmentally sustainable hydropower, either to support or reduce it. There may be considerable argument for integrating conflict theory into conception of environmentally sustainable hydropower development practices, both in terms of enhanced understanding and the development of mechanisms to aid achievement.

The development of sustainable hydropower is complex and provides an interesting case of environmental conflict. Historically a significant renewable technology, hydropower currently faces many challenges such as economic viability, environmental and social acceptability in the face of changing values and concerns. Despite a wealth of information regarding its technology, impacts and mitigation measures, conflict ensues due to the nature of the challenges. There is therefore no single definitive answer, but a spectrum of potential actions which have differential acceptability among stakeholders. It therefore provides an excellent dilemma, in which the impact of conflict on decision-making and the associated implications for achieving sustainable development may be considerable.

Currently disputes over the proposed nature of future hydropower development are not recognised as conflicts. However, consideration of the stakeholders involved and their relative stakes which place contradictory requirements on hydropower schemes, highlights that conflicts within this field are inevitable and failure to acknowledge them as such significantly weakens understanding. These conflicts are not limited to the issue involved or the task to be accomplished, they involved a diversity of different conflict types (a characteristic of environmental conflict), inclusive of emotional and cognitive dimensions. Attempts to resolve the conflicts involved should therefore also address these dimensions. While technological innovation or scientific advancement is required to address some issues, it may not occur for sometime; in the interim hydropower development continues to intensify and the risk of unsustainable development is significant. It is suggested that instead the processes involved in hydropower development are examined, specifically how conflict is navigated; as this may yield insight into how environmentally sustainable hydropower may become a reality.

Having established that conflict is a significant feature of hydropower development there is a need to examine the extent of its impact, the role of stakeholders within conflict and subsequent impact on decision-making. Understanding the impact of conflict can then be utilised to develop strategic tools to allow the management of conflict and the implementation of environmentally sustainable hydropower. In the following chapters, individual cases of hydropower conflict are presented (Chapters 5-7). Each chapter investigates a different dimension of conflict impacts within the context of a given case study. A comparison and discussion of key findings is presented in Chapter 8.

Chapter 5 The Consequences of Environmental Conflict: A Contemporary Case Study of Hydropower in Scotland

Chapter Summary

The implementation of the EU's Water Framework Directive is simultaneously highlighting and driving the need to change operation of existing hydropower facilities. Determining the nature of this change is difficult; new environmental concerns must be considered in tandem with existing socio-economic benefits, and contradictory legislation supports different themes. The result is inevitable tensions as existing hydropower developments adapt to a new regulatory regime, exacerbated by high levels of social awareness and greater stakeholder expectations. This chapter aims to highlight the existence of environmental conflict using a contemporary case study, by identifying and critically discussing the nature of the dispute that arises when trying to address the requirements of the Water Framework Directive at existing hydropower developments.

Using the River Garry, Perthshire (Scotland) as a case study, soft systems methodology was used as a problem structuring method, to enable investigation. Using primary and secondary data, analysis was structured around the conflict assessment helix developed in Chapter 2. Analysis highlighted the presence of emotional and cognitive dimensions in addition to contextual variables. Conflict was identified as both functional, increasing information availability and knowledge, and dysfunctional, reducing trust and weakening communications; and its potential impact on decision-making was noted, but remains undetermined. To facilitate resolution, a number of changes, primarily legislative, would be required. A lack of participation was observed in this case, affecting implementation of the methodology. While largely attributed to baseline conditions of the case, poor acceptance of the method was noted. The case of the River Garry simultaneously highlights the existence and impact of conflict, and the lack of, and need for, conceptual tools to facilitate its management.

5.1 Introduction

The growth of environmental awareness over the course of the twentieth century has led to significant changes in public opinion and induced shifts in government policy and industrial activities to meet enhanced concerns (Reid *et al.*, 2005). A major driver of change within the hydropower industry is shifts in legislation. The EU's Water Framework Directive (WFD) is designed to improve water management and protect aquatic environments. Its implementation requires the classification of water bodies based on their 'ecological potential', the maintenance of high quality habitats and the restoration of those with poor status. Due to its potential for localised environmental damage, hydropower schemes may be significantly affected by implementation of this legislation, but exact requirements remain ambiguous due to exemptions which may be applicable. Balancing the unknown requirements of the WFD with renewable energy targets creates legislative incompatibility. While this represents a significant design challenge for new facilities, the impact on existing facilities represents a very difficult task. In the UK, particularly Scotland, there are a number of hydropower facilities which date back as early as the 1920s and therefore predate modern environmental impact assessment legislation. Such facilities already contribute to renewable energy figures, thus any action to reduce generation contradicts the goals of the Renewable Energy Directive (which seeks to increase the proportion of electricity that comes from renewable sources). However, under the WFD current practices are unlikely to be allowed to continue and require action. As the benefits and costs have both been encompassed into legislation and industrial practices, the conflicting advantages and disadvantages of hydropower have created a complex decision-making climate. The transition from old to new regulatory approaches is unlikely to be without tension.

Altering existing schemes to meet modern environmental legislation represents a considerable task conflicting themes must be reconciled, there is no option to cancel these schemes or for them to continue without change. The nature of conflict in cases of redevelopment is therefore potentially significantly different in scale and intensity to those experienced at new developments. Hydropower development in Scotland provides a good case study for several reasons. There is a long history of hydropower construction, containing some of the oldest schemes which are likely to have the most significant changes. Due to climate and topography, Scotland contains most of the UK's larger hydropower. These larger schemes tend to embody a greater proportion of the issues experienced. Hydropower in Scotland has a unique regulatory background due to its long history. Many of the dams were built in the last century and are governed by original agreements; legal control of water resources is also in the process of change. The disputes experienced may therefore be significantly different to those in England and Wales and should be considered in a review of hydropower conflict. Finally, there is potential for further (be it limited) expansion of hydroelectric power and new developments (e.g. the Glendoe scheme) continue to go ahead. It therefore represents an area where better understanding of the challenges facing Scottish hydropower development may be deployed in the future.

Soft Systems Methodology (SSM) was used to arrange the problem situation for subsequent analysis. Within this methodology there is scope for progression from analysis to actions which facilitate conflict management. It was intended that following analysis of the problem situation such actions would be undertaken to assess the success of SSM as a conceptual tool for conflict management. However, during the course of this work a number of barriers were experienced, which prevented application. While this limited intended actions, it provided insight into the challenge that conceptual tools which address hydropower conflict may face.

The aims of this chapter are therefore:

- To identify and critically discuss the nature of conflict that arises when trying to address the requirements of the Water Framework Directive as it applies to existing hydropower developments using the case of the River Garry.
- To highlight and critically examine the obstacles experienced in this case and assess the suitability of SSM as a conceptual tool for environmental conflict management.

5.2 The History of Hydropower in Scotland

Prior to analysing a conflict it is important to understand its historical context. Scotland has a long and complex history of hydropower development, inclusive of various past conflicts which inevitably influence the nature of modern development. The ability of antecedent conditions to influence current episodes is highlighted by Pondy (1967); therefore a discussion of historical context is required.

5.2.1 Regulation

Reid *et al.*, (2005) separate the history of Scottish hydropower regulation into three distinct phases (1900-1943, 1944-1970, and late 1980's to the present day) separated by different regulatory environments. During the first period (1900-1943), the schemes constructed, were authorised via Private Acts of Parliament. The Acts were substantial legislative documents and dealt primarily with the details of the build. Hydropower at this time was poorly regulated, despite awareness of the adverse impacts on both the freshwater ecology and surrounding landscape (Johnson, 1994). Under current legislation, permissions to take or discharge water are a standard feature of all approvals; but early schemes in Scotland were not so restricted. In 1901, large scale schemes had no provisions for water flow (Loch Levern Water Power Act, 1901); a later scheme in 1921 did contain measures to limit abstraction, but was due to landowner requirements and not wider environmental concerns (Reid *et al.*, 2005). In the Grampian scheme (1920) complex arrangements were a feature of associated legislation, including permissible flow levels, defining additional releases (freshets) and compensations flows, but would still be seen as unacceptable in modern environmental terms (Reid *et al.*, 2005). In 1942, the Cooper Committee was established to investigate hydropower developments. It concluded that remaining potential could be exploited via the creation of a new public service corporation. The Hydro-Electric Development (Scotland) Act 1943, established Hydro Electric Boards for both the North and South of Scotland causing a shift in the regulation of hydropower.

The Hydro-Electric Boards, combined with the nationalisation of the electricity industry in 1947, led to major accelerations in demand and production from 1944-1970 (Reid *et al.*, 2005). Approvals for schemes were no longer generated by individuals, but submitted to the Secretary of State, who notified parties and held an enquiry should objections, be received. Under the Hydro-Electric Development (Scotland) Act (1943), the Hydro Board was required to have regard to environmental considerations, in particular landscape amenity, cultural value and fisheries. Fisheries have played a dominant role in the regulation of Scotland's hydroelectricity industry (Reid *et al.*, 2005). Historically salmon fishing rights had been valuable commodities and Private Acts had extensive provisions to protect individual owners (Reid *et al.*, 2005). The Association of Salmon Fishery Boards (ASFB) were established, to protect, preserve and develop fisheries in Scotland, divided into 41 District Salmon Fishery Boards. The precise role of these boards and extent of their powers has varied over time; today they promote and protect the interests of Scottish salmon and sea trout fisheries and have powers to request mitigation measures for their protection. While formalised, these duties in this phase were secondary to the provision of electricity and interests of consumers (Reid *et al.*, 2005).

The final period (late 1980s-present day) is shaped by the need for renewable energy causing a resurgence in hydro-generation, but in a significantly different regulatory climate. Initial developments were not required to consider or mitigate environmental impacts, unless requested by an individual proprietor. Today, requirements to carry out environmental impact assessments require a much wider suite of issues to be considered, and involve a larger diversity of stakeholders. Modern environmental legislation, such as the Habitats Directive (92/43/EEC), generates additional provisions for ecology; for example the Garrogie approval includes monitoring protocol for bats and otters, while the application for a scheme at Shieldaig was refused due to potential impacts on pearl mussels (an Annex II species under the Habitats Directive). Reed, Pillai and Black (2005) note the existence of Scottish schemes (on the Garry in Perth and Kinross or the Bearreraig on Skye) developed under past regimes, which would be regarded as poor environmental practice today. They note that the Water Framework Directive and other European legislation are highly focused around aquatic ecology, will require action in such cases.

5.2.2 History of Social Concerns

Early proposals for hydroelectric schemes were met with resistance (Payne, 1988; Wood, 2002); opposition from local vested interest (land owners, mining unions, fisheries and amenities concerns) featured heavily in discussions (Langford, 2008). The construction of hydro-electric schemes was socially disruptive, creating noise, visual impacts and affecting the lives of many. The associated infrastructure, dams, roads, transmission lines and other industrial objects intruded on natural landscapes (Langford, 2008) while creation of some reservoirs drowned farms and hamlets, forcing some to relocate (Wood, 2002).

The disturbance was hardly tolerable for some people (Miller, 2002), but perhaps the largest social impacts came from the influx of migrant workers. While some local businesses may have benefited, many small communities felt threatened by the large numbers of men. High wages were available for those willing to dig the tunnels, attracted an influx of Germans, Poles, Czechs and Irish. In the late 1940s, a tunnel digger could expect to earn up to £35 a week, considerable in comparison to the £4 a week earned by a Highland estate worker, and may have been the root of animosity (Wood, 2002). Housed in large (up to 3,000 men) military style camps, conditions and food availability were variable, and the site of heavy drinking, fighting and gambling and disputes often involved local police. The migrant workforce was unpopular with residents (Wood, 2002) and, tensions among different societal groups became a feature of hydropower development.

The relationship between hydropower and its stakeholders today varies dependent on the location of the scheme and the range of interest involved. Fisheries remain a significant lobby, while new concerns have emerged, such as impacts of river regulation on canoeing and recreation. The issue of amenity has been accepted with time; large-scale hydro schemes, such as the dam at Pitlochry, now represent examples of industrial heritage (Bean and Thin, 2008) and are themselves tourist attractions. For some developments, local residents remain concerned, and there are a number of action groups which actively lobby against hydropower in Scotland. One such action group the “Save the Doon” campaign, gained considerable support with approximately 10 000 signatures on its petition. The campaign lobbies against proposed alterations to compensation flows released from Loch Doon dam (established in 1931) to enhance flows on the River Dee (Kirkcudbridgeshire). The change is required under the WFD but fundamentally different perceptions regarding the ethics of inter-river transfer, allowing decreases in electricity generation and the rights of large electricity companies, have resulted in interactions between stakeholders being disagreeable. As the need for existing schemes to change to meet modern legislative requirements, social conflicts such as the case of the River Doon will become more prevalent.

While this history of development and regulation is not comprehensive, it aims to highlight the significant change in framing of hydropower over time and the contrast between approach to development then and now. Initially regulation reflected various private interests, and was highly fragmented. In later years specific environmental concerns emerged and were recognised within regulation, but desirability of environmental protection was offset by the duty to provide services. As environmental awareness heightened throughout society, the requirement for environmental impact assessment expanded the range of issues to be considered significant. However, hydropower conflicts in Scotland are entering a new phase where the key issue is not between environmental protection and industrial development, but between different environmental goals. Tensions between renewable energy generation and environmental protection are growing, highlighted by the proposed Shieldaig facility, where the scheme was refused, despite official recognition of its contributions to renewable targets, on ecological grounds (Reid *et al.*, 2005). While the course of action for new developments is clearly outlined in legislation, there is a lack of protocol as to how operational facilities are to be regulated to meet modern legislative criteria. The following case study highlights arguably one of the principal hydropower conflicts currently ongoing in Scotland. It provides not only an example of the considerable complexity involved in decision-making within this field, but also highlights the intensity of the stakeholder debate.

5.3 Case Study: The River Garry, Perthshire

The River Garry provides an example of a situation where change is needed to meet modern environmental requirements. However, establishing the nature of this change has complex industrial, environmental, economic and social dimensions, and has resulted in tensions between stakeholders and felt conflict.

5.3.1 Study Area

The River Garry is a major tributary of the River Tummel (itself a tributary of the River Tay), located in Perthshire in the Scottish Highlands (indicated on Figure 5.1). It flows 20.2km from the north-eastern corner of Loch Garry, south-west until it joins the River Tummel south of Killiecrankie, prior to it entering Loch Faskally. The River Garry has three major tributaries, the Edendan water, Ait a Chireachain and the Bruar Water. The upper reaches of the River Garry sit within a glacier cut trench; as a result transport links (railway and A9) closely follow its course, providing a direct route from Edinburgh to Inverness.

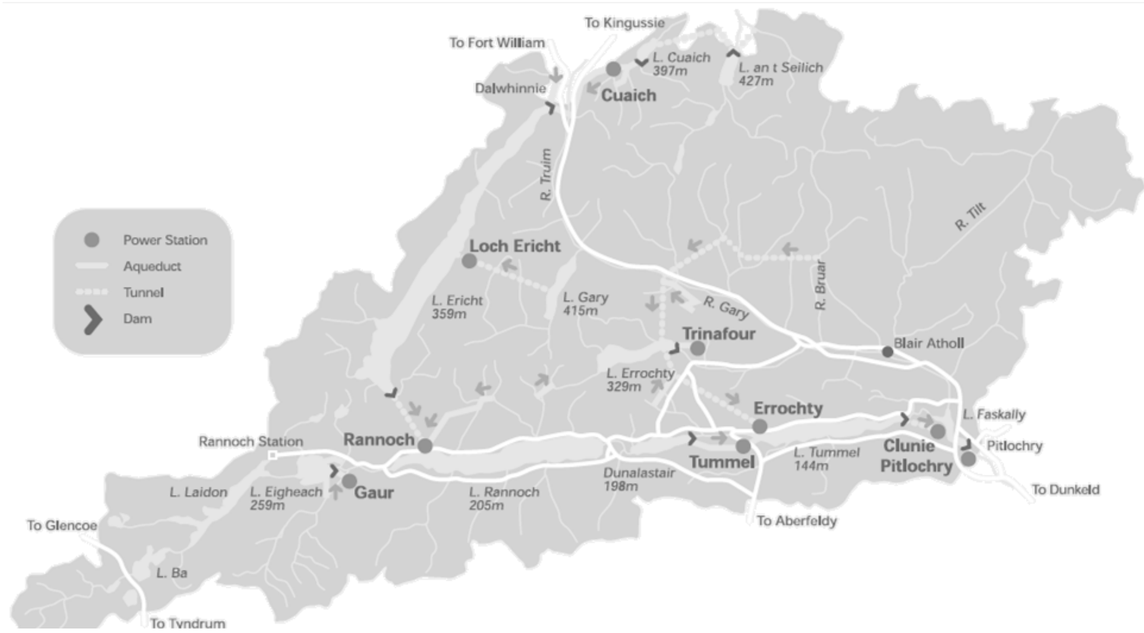
Figure 5.1- Map of the course of River Garry, Perthshire (*Source: Open Street Map*).

The River Garry is heavily modified and has poor ecological status due to its hydromorphology, morphology and fish barrier assessment (SEPA, 2008). Current pressures on the River Garry are abstraction, flow regulation, and morphological alteration caused by impoundment. River basin management plans for the River Garry highlight it as an area of poor ecological potential, requiring actions under the Water Framework Directive (WFD) to improve ecological status or demonstrate all practicable mitigations have been taken. Water is diverted from Loch Garry, reducing and at times removing flow at the head of the River Garry (Tay District Salmon Fisheries Board, 2007). While water enters from side streams, approximately 9km below Loch Garry, a second abstraction point and weir diverted flow to Loch Errochty. Further tunnels divert water from the lower tributaries, inclusive of the Bruar Water (15km downstream) and introduce them at this point. As a result, flow is slow to recover (Figure 5.2), and is considered unsuitable for salmon spawning. Flow conditions vary yearly dependent on climate, but impacts of abstraction are highly visible from both the A9 and the railway line (Figure 5.2). Modifications were made for hydropower generation; the River Garry represents one of many rivers incorporated within the Tummel Valley scheme.

Figure 5.2- Photographs of the River Garry showing the areas of dry river bed, taken from the A9 approximately 5km downstream of Loch Garry (*Source: Laura Watkin*).

5.3.2 Tummel Valley Hydropower Scheme: Systems Design

In 1927, construction started within Perthshire on what would become, in its time, the largest hydroelectric public supply scheme in Scotland (Wood, 2002). The Grampian Electric Supply Company built a complex cascade system, inclusive of tunnels and aqueducts. Today, the system involves 9 power stations (Figure 5.3) with a total installed capacity of 2,417MW. The system represents considerable engineering design, developed to feed water back through the system, maximising electricity generated per unit of water. A given unit of water may travel through up to 5 power stations before it leaves the system at Pitlochry. To do this the system gathers water from a large area, and redirects it around the catchment (Figure 6.2), leaving the River Garry without water.



Power station	Date	Head (m)	Capacity (MW)	Flow description
Cuaich	1959	27	2.5	Collects water from Loch An-t-Seilich, Loch Cuaich and discharges to Loch Ericht.
Loch Ericht	1962	55	2.2	Loch Ericht power station is on the eastern shore of the loch, fed by tunnel from Loch Garry to the west.
Rannoch	1930-33	156	44	Rannoch power station is fed by water brought by pipeline and tunnel from Loch Ericht.
Gaur	1952	30	7.5	Water is collected at Gaur dam, fed to the power station and discharged to Loch Rannoch.
Tummel	1930-33	53	34	Water from Loch Rannoch flows to Loch Tummel via a reservoir at Dunalastair, and then carried by aqueduct to the Tummel bridge.
Trinafour	1959	91	0.5	Compensation flow released in River Errochty is used to generate electricity at Trinafour.
Errochty	1955-56	186	75	Water diverted from the River Garry is carried to Loch Errochty, and discharged into Loch Tummel.
Clunie	1950	53	61	Water from Loch Tummel is diverted to Clunie power station, and discharges to Loch Faskally.
Pitlochry	1950	15	15	Located at the bottom of Loch Faskally, Pitlochry is the last power station in the scheme.

Figure 5.3- Map of the Tummel Valley Hydro scheme and associated power station (adapted from Scottish Hydro Electric, 2006).

Historic accounts suggest that the upper Garry was once actively fished in the 1920's but populations declined following abstraction in 1937 (Tay District Salmon Fisheries Board, 2007). The scheme was strongly opposed by a number of interest groups, in particular the Tay District Salmon Fisheries Board (TDSFB) and was subject to a public enquiry in 1945. The enquiry noted that the extent of the damage was the "*subject of acute divergence of expert evidence.......In a matter so uncertain... we think it wise to refrain from attempting to quantify the loss*" (Tay District Salmon Fisheries Board, 2007).

Diverging expert opinions involved the Fisheries Committee, against prominent salmon scientists (Mr. Calderwood, former Inspector of Fisheries for Scotland and Dr John Berry, fisheries scientist) hired by the Hydro Board. Much of the argument centred on opinions, and the need for electricity concluded to outweigh environmental concerns. The scheme remained in place and was enhanced over time; the current design continues to divert a significant proportion of flow in the River Garry. Required under legislation (WFD, the need to make changes within the Tummel Valley scheme has been recognised by both the regulator and developer, and is the subject of ongoing tension between the stakeholders involved.

5.3.4 Problem Definition

The Tummel Valley scheme is currently operated by Scottish Hydro Electric (SHE), part of the corporation Scottish and Southern Energy (SSE). In recognition of the need to change operations within the Tummel to meet the criteria of the WFD, SHE (prior to requirement) investigated potential actions which would allow a compensation flow to be released along the degraded reaches of the River Garry. These proposed measures allowed for a compensation flow, without causing a loss in generation, by increasing water transfer from the Spey catchment at the top of the system (above Cuaich power station). However, stakeholders differ significantly in their support of such an action, and there is considerable uncertainty related not only to how change will be achieved, but also as to how different legislative tools can be simultaneously applied. What began as an issue pertaining to one river in Scotland, has expanded rapidly, highlighting the underlying problems that faces hydropower regulation across Scotland. The Scottish Environmental Protection Agency (SEPA) is responsible for the regulation of hydropower in Scotland, and the implementation of the WFD. SEPA therefore has the difficult task of finding a solution which meets contradictory stakeholder requirements and fits with existing and new legislative requirements. Taking a decision in such an environment is a considerable challenge; this section highlights and discusses the various facets of the case over a six year period (2005-2011), the first three years (2005-2008) are analysed retrospectively.

5.4 Methodology

Systems thinking is employed to explore the situation associated with the River Garry and highlight key factors within this conflict. A suitable methodological framework is provided by soft systems methodology (SSM). SSM is an organised process of inquiry that allows problem structuring and thus enables evaluation of the River Garry situation. SSM has been combined with Lewin's (1951) three-stage change model to reflect the clear phases of movement and stagnation associated with the River Garry. Lewin (1951) theorised that change occurred in three stages: (1) unfreeze, (2) movement, (3) change; analysis of the River Garry conflict is examined within the context of the model.

The study involves a diverse range of stakeholders, of which six were identified based on initial problem definition: Scottish Hydro Electric (SHE), Scottish Environmental Protection Agency (SEPA), Tay District Salmon Fisheries Board (TDSFB), Scottish Natural Heritage, and the Royal Society for the Protection of Birds (RSPB), and the Save the Garry Campaign. Further investigation highlighted four additional stakeholders (Atholl Estates, Pitlochry Angling Club, Blair Atholl Tourist Association and the Spey Fisheries Board (SFB)). Having been identified, stakeholders were invited to participate in the study; levels of engagement differed significantly for various reasons, but largely centred on issues of sensitivity, confidentiality and parties no longer being or wanting to be involved. Where access to stakeholders was possible, information pertaining to the problem situation was gathered via individual semi-structured interviews using ordered questioning. These questions are adapted from a UNCHS (1991) action research manual for urban managers. The questions were:

1. What is the problem?
2. Why is it a problem?
3. Whose problem is it?
4. Where is it a problem?
5. How long has it been a problem?
6. Is it a priority to solve?
7. What is the solution?
8. What really is the problem? Is it part of a bigger problem?
9. What would happen if it didn't get fixed?

Interviews were conducted over 5 sessions, between August 2008 and July 2011 at seven to ten month intervals which corresponded with developments in the project. In between these phases, inquires were periodically made via email or phone, with stakeholders to keep abreast of potential developments in the situation and ensure they were captured. At each session, all stakeholders were contacted but were not always available or willing to be formally interviewed. As SSM is dependent on broad participation, application to this case was limited. As a result, analysis is restricted to stages 1 and 2, and based on the perceptions of a small proportion of the identified stakeholders. Where possible, views of those who declined to participate are represented by using documented statements or positions, but it is important to recognise subsequent analysis is influenced by selection of individuals willing to participate.

5.5 Analysis

5.5.1 Problem Expression

Initial stages of SSM are intended to explore and express a problematic situation (Checkland, 1985). This involves identification and definition of actors, components, interactions and relationships within the situation. This is achieved through the development of a rich picture, a key technique associated with SSM. This technique allows the communication of a complex issue and simultaneously highlights key areas for further discussion. Over time, conception of the problem situation has changed significantly, with a number of clearly identifiable episodes over varying timescales. These episodes represent distinct shifts in the problem situation, and are largely caused by internal events. This episodic change demonstrates a significant overlap with Lewins' (1951) planned change model, representing periods of unfreeze, movement and temporary refreeze. The refreeze is temporary as change has not yet been fully achieved, and thus temporary equilibrium positions are unstable and liable to further shifts. To combine the two methodologies, iterations of the rich picture development are presented as stages of the unfreeze-movement-refreeze cycle (Table 5.1).

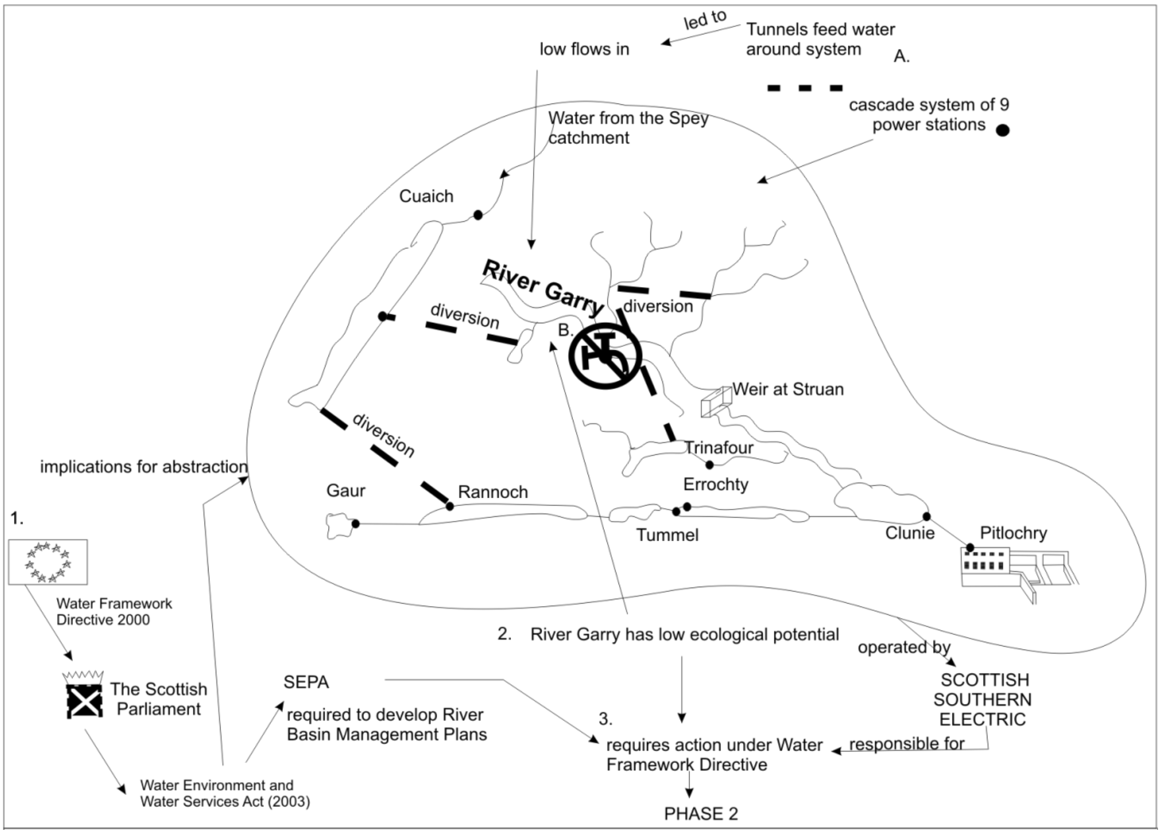
Table 5.1- Episodes within the problem situation and associated rich pictures.

Episode	Dates	State	Length of Episode	Associated Figure
1	1962-2005	Unfreeze	43 years	Figure 5.4
2	2006-2007	Movement	1 year	Figure 5.5
3	2007- May 2010	Refreeze	2.4 years	Figure 5.6
4	May-June 2010	Unfreeze	1 month	Figure 5.7
5	July 2010-April 2011	Movement	10 months	Figure 5.8
6	May-August 2011	Refreeze	4 months	Figure 5.9

Rich pictures were developed independently by the analyst using both primary data from stakeholder interviews and secondary data from position statements, public consultations and media articles. As a result of inability to access all stakeholders there may be unreported elements which are not represented in the rich pictures. All rich pictures were constructed using the river systems as a framework, human actors were then added and the relationships and actions between them described.

Episode 1

This episode (Figure 5.4) spans the 43 year period between the construction of the final power station and the recognition of the need to change operations to meet future legislative requirements. Knowledge of this episode may be incomplete due to temporal factors; other related events may have occurred that the analyst is unaware of. The cascade system of power stations is designed to maximise electricity generation and this is achieved by diverting water from the catchment via a series of aqueducts and tunnels. These transfers result in a significant reduction in flow in the River Garry from Loch Garry. The EU Water Framework Directive introduces a legislative driver which will require changes in the system to address current issues in the River Garry. Implementation of the WFD has itself occurred in stages, initial phases investigate baseline conditions. Recognition of the eventual need to change therefore predates requirement to act. Perceived legislative pressure pushes existing conditions out of equilibrium as the need for change is recognised, unfreezing the situation. During this phase, conflict is latent, there are underlying sources but it is not yet recognised.

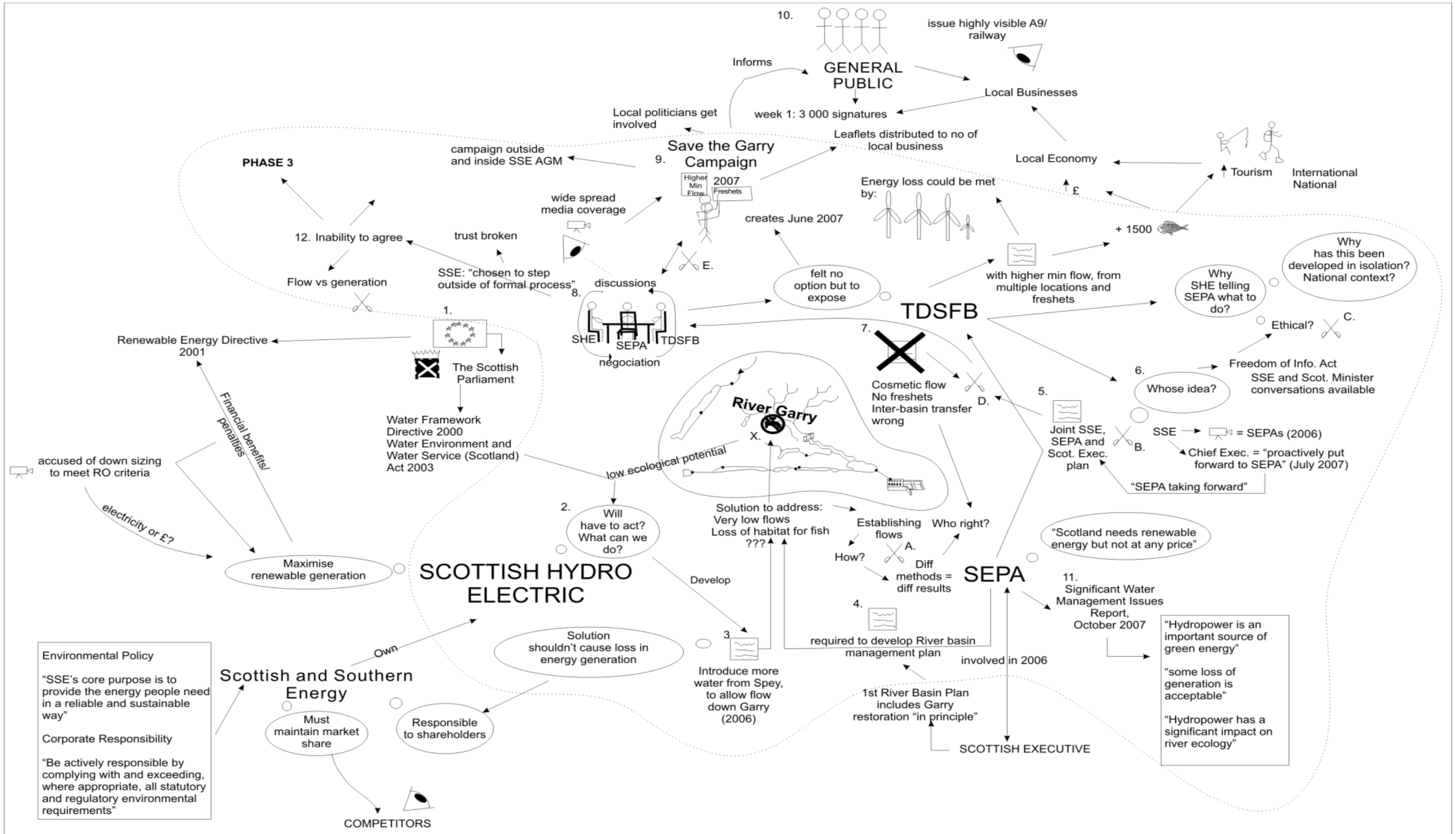


The rich picture starts at A detailing the layout of the cascade system and the consequent environmental impacts at B. Introduction of new legislation at 1, has resulted in the scheme not meeting environmental criteria (2), generating a need for change at 3.

Figure 5.4- A Rich picture of the River Garry problem situation, drawn by the analyst to represent the first episode of change, as the problem unfreezes.

Episode 2

The rich picture (Figure 5.5) depicted the emergent concerns and requirements of stakeholders in response to the required change. All participants recognised the need for change but disagreed over how to achieve it. This episode is associated with gathering of relevant information to support change, in doing so a number of conflicts emerge between different stakeholders; these represent key issues to be considered. This episode is associated with a number of actions, the generation of a potential proposal, and its subsequent rejection by the Tay District Salmon Fisheries Board (TDSFB), the creation of the “Save the Garry campaign”, and its publication in the media. The extent of the issue is much greater than initially conceived, with wide ramifications of any potential decision noted (e.g. impacts on the local economy). A number of areas of conflict can be noted (see crossed swords in Figure 5.5). Within this episode, conflict moves rapidly through stages, and is perceived, felt and eventually manifest following the launch of the public lobby.

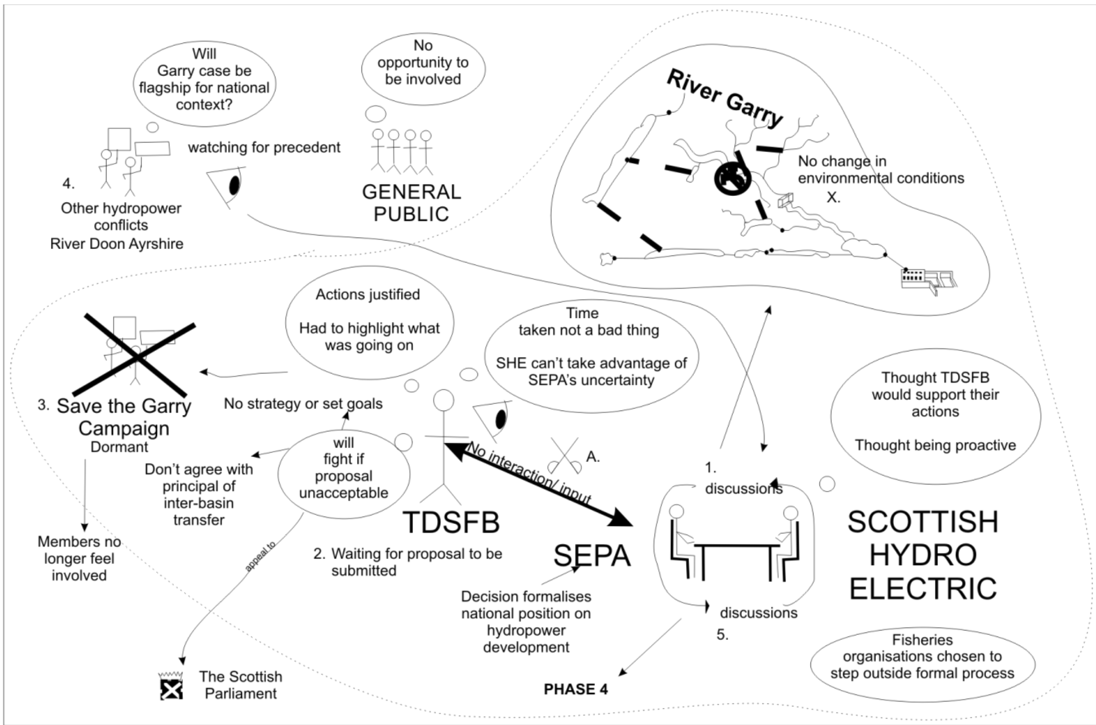


The rich picture starts with the situation at X from the previous episodes, where activities at 1 require change. Numbers 1-12 represent chronological events and associated concerns. a systems boundary denotes internal and external elements. Areas of conflict are highlighted by crossed swords and identified as : A- selecting appropriate methods and data, B- The origin of initial proposals, C- Fundamental ethical issues related to the nature of their development, D- Differential acceptance of initial proposals, E- Different approaches to finding solutions, and F- Fundamental issue of flow versus generation capacity.

Figure 5.5- A Rich picture of the River Garry problem situation, drawn by the analyst to represent the second episode of change, as the problem moves.

Episode 3

The refreeze (Figure 5.6) recognised and established change, generating stability within the problem situation. Evidence that the situation is refreezing occurs when implemented change becomes the accepted state and individuals behave accordingly (Schein, 1995). In the River Garry, the change that solidified is not the intended one, but there is a distinct shift in the manner of problem discussion and stakeholder interactions. During this episode, external stakeholders, in particular the TDSFB, are accepted as not being part of discussions, and they continued between SSE and SEPA in isolation. The change is accepted by the TDSFB, who do not seek to reengage at this stage, highlighted by the "Save the Garry" campaign becoming dormant. Stakeholders appeared to be waiting for further opportunity to act; a loss of momentum in stakeholder objections was noted.

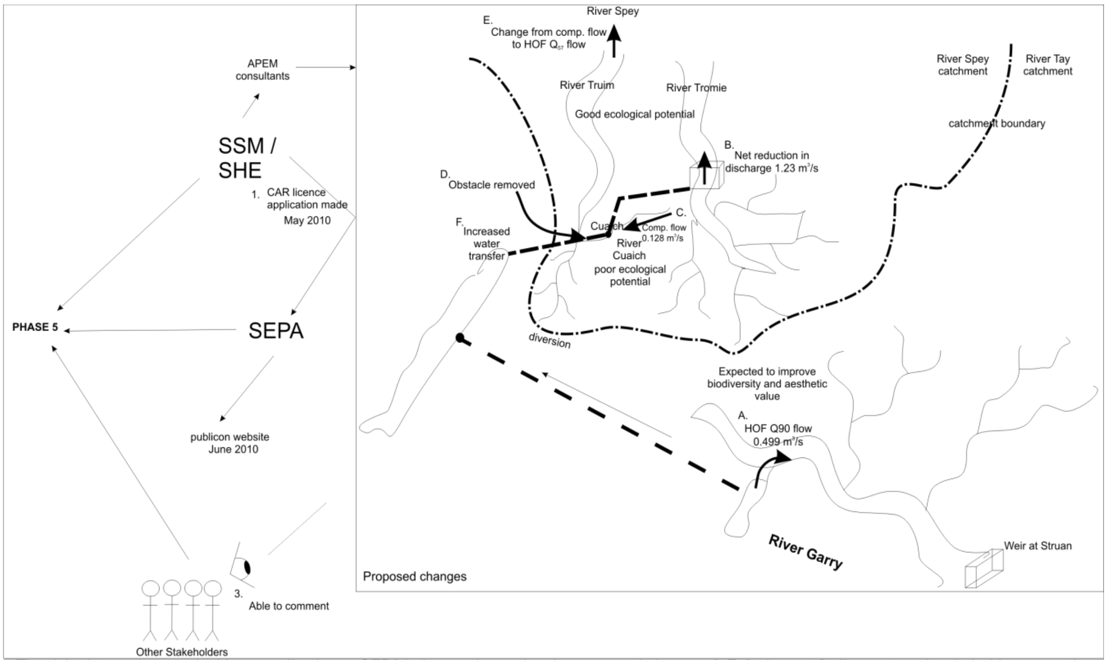


The rich picture starts at 1 where discussion continues but with fewer participants. Other interested parties (2,3,4) must wait until a proposal is submitted and formal participation channels become available. The situation pauses at 6 until a decision is made.

Figure 5.6- A Rich picture of the River Garry problem situation, drawn by the analyst to represent the third episode of change, as the problem refreezes.

Episode 4

The problem situation (Figure 5.7) unfreezes again following a formal application to change the terms of the CAR licence. The application and submission of detailed proposed changes developed by APEM (an environmental consultancy) became available for external comment. The proposal involved complex changes to existing abstraction patterns, most of which occur within the River Spey catchment to the north of the Tummel Valley scheme. A formal engagement process is now active; as a result, the time period associated with this episode is shorter than its predecessor, it unfreezes rapidly. Conflict is at this stage latent, but is affected by the aftermath of previous events.

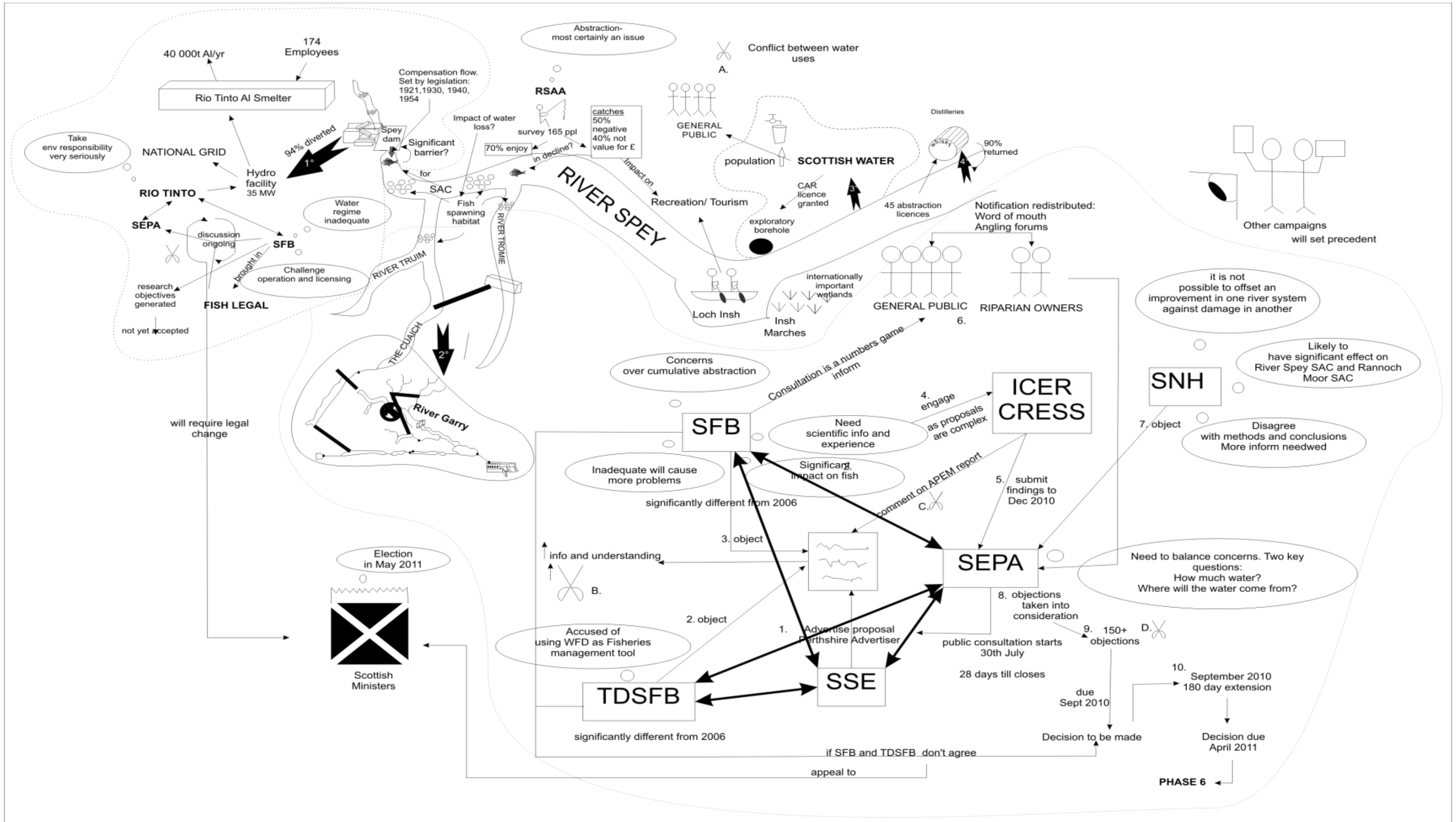


The rich picture starts at 1 with an application to SEPA being made, stating the proposed changes A-F. Actions at 2 allow external stakeholder to see the proposal.

Figure 5.7- A Rich picture of the River Garry problem situation, drawn by the analyst to represent the fourth episode of change, as the problem unfreezes again.

Episode 5

During secondary movement, the problem situation (Figure 5.8) expanded to include new actors and activities affected by proposed change in the Spey catchment. This episode is shaped by regulatory processes; following advertisement there was a 28 day consultation period where formal objections may be submitted to SEPA, creating a period of rapid movement. Key factors within this episode related to the need for information to validate proposals and to place decisions in context. Conception of the problem changed, focus shifted from resolution to the need to address the wider issues facing hydropower in Scotland. Conflict is ‘perceived’ by stakeholders as proposals are questioned, then ‘felt’ by some as formal objections are received. Following closure of the public consultation, SEPA have two months to decide a course of action, in this case, this period was further extended by 180 days due to the complexity of the issue.

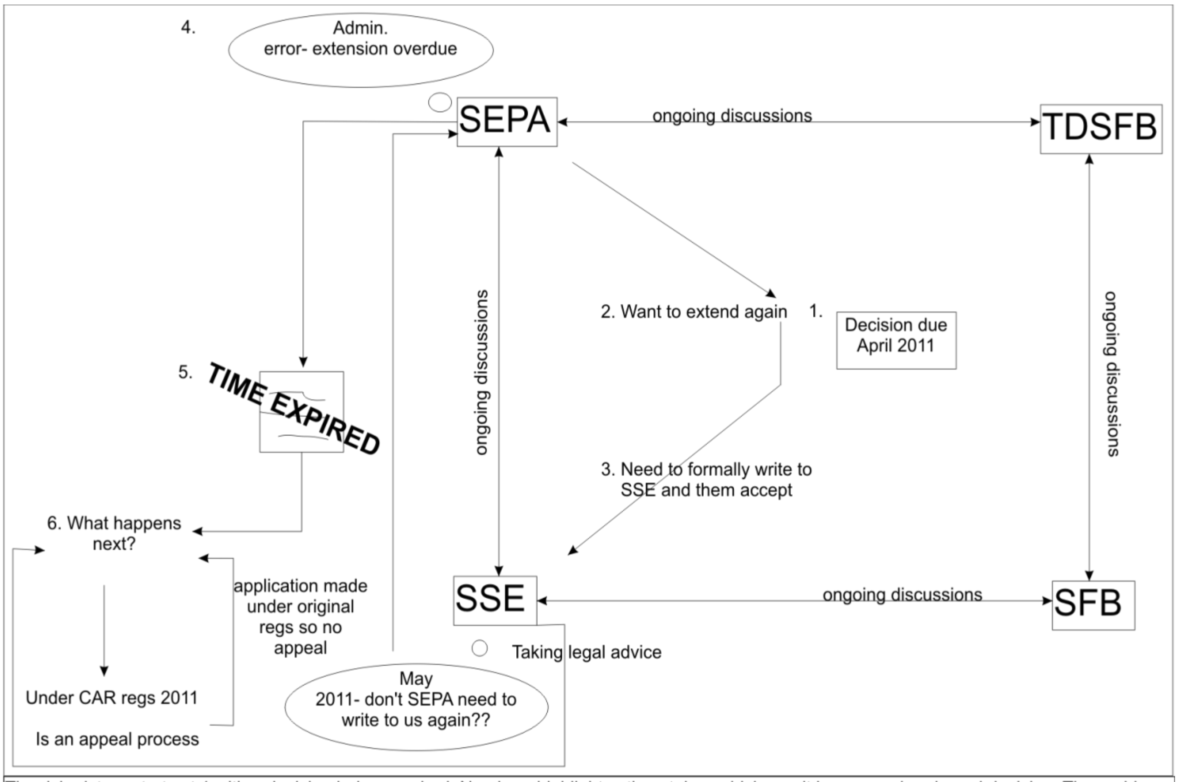


The new submitted proposal widens the scope of the problem situation, the rich picture starts by depicting the new areas which have arisen, largely focusing on highlighting new issues on the Spey catchment which occur alongside previous issues (identified in Phase 2). Actions within the rich picture start at 1 with the propsal being advertised. Numbers 2-7 represent objections to the proposal submitted to SEPA. Different problems are highlighted by problem boundaries, secondary problems are not depicted in such detail but are important components of the problem situation. Conflict is denoted by crossed swords and identified as: A- Differential use and water abstraction across the catchment, B- Conflicting positions and issueshighlighted by making proposals public, C- Conflicting conclusions of independant consultants, D- formal objections to the proposal.

Figure 5.8- A Rich picture of the River Garry problem situation, drawn by the analyst to represent the fifth episode of change, as the problem moves.

Episode 6

In the secondary refreeze (Figure 5.9), changes from the previous movement phase solidify, the desire for a secondary extension highlights that SEPA is considering and incorporating new themes that have arisen. Again, the change that solidifies is not the intended one, as proceedings take an unexpected turn due to an unforeseen administrative error by SEPA. Full resolution of the issue and subsequent action does not occur, suggesting that further change cycles are possible. This refreeze is process driven; failure to renew extensions led to the expiration of the application and subsequent rejection. Due to the original application being made prior to changes in the legislation, there is no legal mechanism for appeal and thus no mechanisms at present for further change cycles to occur. While the intended change has not been achieved and the matter not resolved, change has temporarily solidified. The impact of the formal regulatory structure is apparent, forcing a decision and change within the problem situation, although its ability to do so without resolving this issue is a limitation.



The rich picture starts at 1 with a decision being required. Numbers highlight actions taken which result in a procedure based decision. The problem refreezes at 6.

Figure 5.9- A Rich picture of the River Garry problem situation, drawn by the analyst to represent the sixth episode of change, as the problem refreezes again.

The rich pictures identified a variety of case specific elements which shape the nature of conflict regarding the River Garry issue (Table 5.2). As some stakeholder views are unavailable there is potential for further dimensions to exist. These problem themes are selected by the analyst based on rich picture analysis, and could not be validated by all stakeholders. These conflict elements form the basis of critical analysis of the nature of conflict regarding the River Garry.

Table 5.2- Key conflict elements highlighted by rich picture analysis of the River Garry problem situation.

Conflict elements
Flow versus Generation
Limitations of the proposal
Agreed methodology and information
Problem expansion
Informational control
Stakeholders and their changing roles
Approaches to problem solving
Perceptions of action: Pre-emptive versus pro-active
Role of legislation
Impact of application procedures

5.6 The Nature of Conflict associated with the River Garry Proposals

An analysis of the episodes highlights a range of factors which were crucial to the development of this case study. Although presented independently, these factors are not mutually exclusive; they interact to create the conflict episodes presented. The conflict elements highlighted in this case study (Table 5.2) are analysed in the context of the conflict assessment helix (developed Chapter 2). As the case is examined over a large time frame consideration of history and timing are embedded in other categories. Detailed analysis of conflict elements highlights the complexity of the challenge, which requires the resolution of both case specific issues and fundamental questions pertaining to water regulation in Scotland.

6.6.1 Needs and Interests

Differential stakeholder needs and/or interests are a central driver of conflict within this case study; "*We all have different aims, we (the SFB) have a responsibility to our stakeholders, as Rio Tinto and SSE have to theirs*" (Anonymous (a), personal communication$_a$). Given the conflicting nature of many of the stakeholders requirements, "*no one will get exactly what they want*" (Anonymous (a), personal communication$_a$). Resolution of the matter is therefore dependent on balance and compromise; however determination of tradeoffs is complex, highlighted by controversy over the issue of flow versus generation output.

A central theme within the problem situation is whether releasing a compensation flow should incur a loss in electricity generation. Proposals developed do not yield any loss of generation based on water reallocation within the system, this has differential acceptability among stakeholders. SSE argues that "*any reduction in renewable generation would be contrary to the Scottish Government's Renewable Energy Policy and to common sense*" (Donaldson, 2007). Such a stance limits potential actions to restore flow in the River Garry to amounts that can be recovered elsewhere. Proposed actions have been described as "*modest and aesthetic*" by fisheries interests (Tay District Salmon Fisheries Board, 2007). The TDSFB suggests the loss of electricity generation required to improve the River Garry is "*inconsequential in terms of national outputs and renewable targets, roughly equivalent to the output of 3.5 wind turbines*" (Anonymous (b), personal communication$_a$). Similarly, others highlight, "*there are plans to build 500 (wind) turbines at Murrayfield, and the whole thing just needs a bit of common sense*"(Anonymous (a), personal communication$_b$). The River Garry is the first scheme to address these issues, accepting a loss in generation may set a precedent which leads to a significant cumulative loss in energy production, adding further pressure to the decision. 'Common sense' arguments are frequently utilised over this issue, as they are subjective and not shared by others, they are indicative of differential worldviews.

While SSEs argument centres on the importance of renewable energy generation, their underlying motivations have been questioned by fisheries interests. In a separate issue, SSE accepted a voluntary loss of energy generation. The Renewables Obligation excludes existing large hydropower stations from the subsidy regimes. Prior to its launch, SSE refurbished a number of turbines, which resulted in downsizing (by 452 MW) at seven of their existing power stations; the action allowed these facilities to qualify for subsidies (Scottish Wind Assessment Project, 2005). Such action suggests that it is not the loss of energy which is a concern, but the loss of its value, although this cannot be verified. Discrepancy between past actions and current claims creates uncertainty as to what SSE's true requirements are, stakeholders make their own assumptions, "*SSE only care about money*" (Anonymous (b), personal communication$_b$). While this cannot be verified, this is a widely recognised and accepted goal of business, but this need is rarely discussed, suggesting a hesitancy to highlight this aspect of the problem. Interests may be being filtered by social acceptability, there may be underlying needs which have not been made explicit.

6.6.2 Information and Communication

The role of information and its communication among stakeholders is an important feature of the dispute. The differential role that information plays can be noted, simultaneously increasing availability and highlighting further gaps in knowledge and uncertainties. This is further complicated by the nature of stakeholder relationships and the communication between them.

Limitations of the proposal

The development of the final application in isolation with limited communication and stakeholder consultation results in poor acceptability when the proposal is advertised. Broadly stakeholders highlight areas where information is absent or people differ in their interpretation of its accuracy. That these issues have not been addressed or disproven highlights the impact of negative interactions on stakeholder communications, a consequence of development in isolation. The SFB, who praised SHE for keeping them informed early on in proceedings highlight that the application was "*significantly different to those that had been suggested in 2006, and the Board (SFB) objected for a number of reasons*" (Anonymous (a), personal communication$_a$). This suggests that the nature of communication had altered, and was perhaps not as open as originally thought.

The amount of information involved in determination of this issue is considerable, but there are still elements of the debate which remain ambiguous; the SFB note that "*there are a lot of question marks to be removed*" (Anonymous (a), personal communication$_a$). One method to do this is to engage experts "*to provide experience*" (Anonymous (a), personal communication$_a$) and "*a position on the matter*" (Anonymous (c), personal communication), but in this case the opinions of experts diverge. SSE contracted APEM (an independent environmental consultant) to undertake an ecological impact assessment of proposed changes on the Tummel scheme. The SFB contracted their own consultants; the subsequent report submitted by the International Centre for Ecohydraulic Research (ICER) and the Centre River Eco-System Science (CRESS) (independent environmental consultants) did not support the proposals of APEM, and highlighted further dimensions of the problem for SEPA to consider. The use of experts in this case is interesting as both 'sides' of the debate have utilised them to reinforce the validity of their arguments. The use of prominent scientists has been previously noted (during construction of the Tummel scheme in 1945), and appears to be characteristic of this conflict.

Divergent expert opinions create further uncertainty, and a lack of definitive conclusions makes subsequent action difficult. Analysis of the APEM (2010) report highlights frequent use of terminology such as "is unlikely to", "may be", "expected to" and "could potentially"; this point does not seek to diminish the quality of the report, but to highlight that providing certainty is difficult, and a degree of judgement will inevitably be involved. As judgement is subjective, the findings arguably represent informed expert opinions, and is why they diverge. Where one sees an acceptable uncertainty, the others do not. The same is true of other elements of the debate; the proposed compensation flow on the River Garry is acceptable to SHE, based on significant data and interpretation. However, the TDSFB highlight the amount of flow available, "*will be too low for salmon to ascend the river (Garry), or spawn successfully*" (Tay District Salmon Fisheries Board, 2007). APEM (2010) suggest proposed changes will not have a significant effect on salmon populations, compensated by additional smolt production from the Cuiach (a tributary which feeds the Tromie). The SFB "*cannot see 200 smolts returning to Cuiach, it is highly damaged, perhaps more so than the Garry itself*" (Anonymous (a), personal communication$_a$).

Better communication with stakeholders would have highlighted such informational gaps and stakeholder concerns prior to advertisement. The development of the proposal in isolation, with limited communication and no access to wider knowledge and information, generates a poor solution, evident by the number of objections. The conflict process highlights these deficiencies, and while this adds to the complexity of the decision, actions taken will be significantly more informed.

Methods and Data

A lack of agreed methodologies compounds the problem further. The debate seeks to resolve two key questions, how much flow should be released, and where should that water come from? Providing the answers to these questions is highly dependent on data and modelling of both hydrological processes and different solutions. The initial proposal of a maximum of 414 l/s from Loch Garry and up to 449 l/s from the lower Garry intake, is based on one such model, and would allow a low compensation flow along the dry section of the River Garry. This represents the Q90 flow (flow that would be exceeded 90% of the year) predicted within the model, a commonly used flow index within hydrology (Smakhtin *et al.*, 1995). There is significant debate among stakeholders as to whether this amount is adequate, during the course of which the accuracy of the predictive software has been questioned. The TDSFB (2007) note that "*it has been suggested that the model used may be underestimating what actually happens*". A lack of robust methodologies is a further feature which influences subsequent conflict. So too is a "*lack of experience*" (Anonymous (b), personal communication$_b$), SEPA have never had to previously manage water abstraction in Scotland, the River Garry represents one of their first major issues. The River Garry issue came out ahead of its contemporaries and prior to understanding of how the WFD would be implemented across Scotland. Uncertainty as to how to methodologically address the River Garry, at a time when guidelines were being development and refined (UKTAG guidelines were based on very simple methods at this point and have subsequently been amended), created an environment prone to conflict.

Expansion of the Problem

The proposed changes (see Figure 5.8) would increase abstraction from the River Spey basin as this will have downstream implications; the geographical boundary of the problem situation expands to include the Spey catchment and its related activities and issues, introducing further information to be considered, data to be obtained and actors to communicate with.

The primary impact is enhanced complexity, requiring further information and existing knowledge to be interpreted in a different problem context. The River Spey catchment currently has 45 licensed abstractions under the Controlled Activities Regulations (CAR) system (Spey Fisheries Board, 2010). While a majority are minor, major abstractions include the Spey Dam operated by Rio Tinto Alcan, abstractions on the Rivers Tromie and Truim by Scottish and Southern Electric and at the Dipple Wellfield near Fochabers by Scottish Water (Spey Fisheries Board, 2010). Abstraction in the catchment is a concern, particularly in the upper Spey due to its importance for fish spawning (Anonymous (a), personal communication$_a$). At the Spey dam, the amount of water transferred is estimated to be as high as 94% (Spey Fisheries Board, 2010), and is transferred out of the catchment. The SFB are currently engaged with lawyers Fish Legal, to act on their behalf in discussions with SEPA and Rio Tinto Alcan, to address "*an inadequate regime*" (Anonymous (a), personal communication$_a$).

While the Spey Dam and the River Garry represent separate issues, the SFB state they are "*inextricably linked*" as "*inadequate flow from the dam may be already impacting fish populations in the (River) Truim and the (River) Tromie. Any attempt to further reduce flows down these significant tributaries would compound the problem*" (Spey Fisheries Board, 2010). The result is a shift in problem, requiring proposals for the Garry to be placed in context of ongoing activities on the River Spey. With the impacts of various abstractions interrelated, there is significant potential for alterations in one activity to influence another, and conflict between abstractions emerge. Interrelated issues require decision makers in the River Garry case to have access to data on the Spey dam issue, representing a significant increase in information required and further highlighting the need for better communication.

Informational control

As communication is not entirely open, stakeholders have differential control and therefore power to influence the decision made. Much of the information generated is provided by SHE to support their proposal; the Fisheries Boards have considerable tacit understanding of these rivers, their catchments and ongoing activities, but SEPA as the decision maker "*lack information.... and local knowledge*" (Anonymous (b), personal communication$_b$), particularly in the early stages of project development. Communication of information is limited, "*SSE never tells you anything unless they have to. If you are ignorant then it is your fault, you have to inform yourself*" (Anonymous (b), personal communication$_b$). Information in this case can be linked to power.

5.6.3 People and Resources

Over time the number of stakeholders directly and indirectly involved in this case study expanded significantly, from 3 to 26 in total. The number of stakeholders involved in each phase varied considerably, with high numbers of stakeholders in movement phases and few during unfreezing and refreezing. This highlights that while few have the ability to facilitate change, there are numerous stakeholders who influence its nature. The diversity of people involved is considerable (Figure 5.10), reflecting the complexity of the issue and the expansion of the problem situation in later episodes.

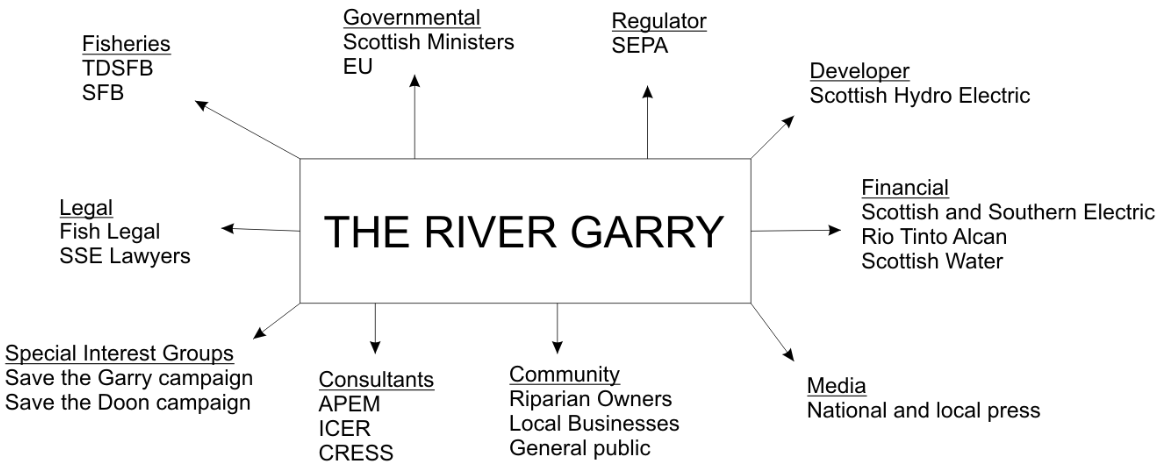


Figure 5.10- Stakeholder map for the River Garry Problem Situation.

Degree of involvement within the River Garry issue varies significantly, with a distinct core of highly involved individuals and a number of stakeholders able to indirectly influence proceedings. Over time participation has fluctuated. For some, long periods of stagnation created apathy, highlighted by the Save the Garry campaign, which is relatively inactive during the second change cycle. For others, advertisement of the proposal, created a formal mechanism to respond and form a position. Until this point speculation as to what the proposal may contain meant that many stakeholders could not formulate a definitive position. Scottish Natural Heritage (SNH), for example, was not involved with the River Garry as it "*is not within any site designated for natural heritage interests*" (Welsh, personal communication). However since the application was made, SNH now "*formally object to the proposal*" (Anonymous (c), personal communication), due to its impact on the Spey catchment. Statement of the problem allowed rigid positions to form and stakeholders to come forward.

As the proposal involves inter-basin transfer, the River Garry problem encompasses individuals who would not perceive themselves to be involved. The SFB are currently engaged in two separate conflicts, they advocate that SEPA take a holistic approach when determining each case (Anonymous (a), personal communication$_a$). The SFB's view, which advocates a catchment-based management approach, seeks a strategy which attempts to resolve both issues. Their choice of approach provides a link between the two cases; acceptability of the changes to the Tummel scheme is therefore influenced by intentions at the Spey dam and vice versa. The presence of inter-dependent conflicts also results in multiple individuals from the same organisation (SEPA) involved, due to the different locations and jurisdictions of these interrelated issues. Whether there is interaction between these individuals is unknown, but if absent there is potential for inconsistencies in approach.

A further dimension highlighted in interviews was the changing roles of stakeholders, implications for available resources and impact on approach to resolving this issue. The nature of "*fisheries management has changed markedly over the last 10 years*" (Anonymous (a), personal communication$_a$). In the past, issues associated with hatcheries and poaching were key concerns and thus tasks involved biologists and water bailiffs. Now issues related to water resource politics have caused a shift from "*that of a police force to one of a manager*" (Anonymous (a), personal communication$_a$) and the remit of work expanded. The change in role requires different skills, which are not freely available in-house. This is evident by the use of independent advisors and consultants contracted in to provide expertise. Similar changes have been noted in SEPA, now required to manage abstractions. In addition, shifts in resources have also been noted "*SEPA's role has expanded, but its capacity to do so is limited*" (Anonymous (a), personal communication$_a$). While challenged with a greater role, SEPA has faced budget (~10%) and staff cuts; similar cuts at SNH according to some "*undermined its ability to achieve its functions*" (Thompson, 2012). This has had implications for the Garry case, "*public perception is that* *there is a team of people working on this issue, in reality there is only one, and she does a great job, but it highlights the limited resources available*" (Anonymous (a), personal communication[a]). It was also noted that while SNH formally object, they wouldn't pursue the matter unless it breached the EC Habitats Directive as "*SNH are pulling back from non-mandatory sites due to a lack of manpower*" (Anonymous (c), personal communication). The impact of such factors is a reduction in ability to handle and respond to the debate. Wider social-economic factors, in this case economic recession and associated job cuts influences the course of conflict.

5.6.4 Emotions and Values

Many of the issues raised relate to fundamental perceptions, clearly associated with values and underlying worldviews. These perceptions are reinforced by strong emotions associated not only with the issue, but with the environment in question. Following advertisement, the public consultation received over 150 objections to the application. A majority of the objections represented individuals whose interests included recreation (rafting, canoeing, water sports), fisheries (Ghillies, anglers), local business interests (hotels and local estates) and other riparian owners. While the SFB did inform and encourage numerous individuals to object, extracts from letters of opposition received by SEPA, highlight the level of opposition to proposals and associated sentiments:

"*You have ruined the (River) Garry by ruthless and totally irresponsible over-abstraction: please please leave the Spey alone*" (Carr, personal communictaion).

"*It would seem on the face of it complete madness.... I applaud the concept of re-watering the (River) Garry system, one may ask where the water went, but to do this at the cost of the (River) Spey, which has an existing water based habitat seems absurd.*" (Litchfield, personal communication).

"*The hydro scheme ruined the River Garry, it is quite honestly short sighted and nothing more than out and out vandalism, the very thought of abstracting water for a few more MW is utterly criminal*"(Leigh, personal communication).

Public emotions are high associated with clear perceptions of the unsuitability of the proposal. Differential perceptions of key stakeholder have had a significant impact on the problem situation and the development of conflict; this is particularly evident in the issues raised around the origin of the initial proposal.

Pro-active versus Pre-emptive proposals

Originally described as a collaboration between SSE, Scottish Ministers and SEPA, it later became apparent that the proposal developed had been "*proactively put forward*" by SSE (Marchant, 2007). The TDSFB felt this amounted to a "*pre-emptive strike*", an "*attempt to control the process*" and move SEPA towards a solutions which meets their objectives (Smith, 2007). While SEPA describe the approach as "*proactive and collaborative*" (Bell, 2007), the difference between the two frames is considerable. The TDSFB's interpretation of the action highlights ethical questions as to whether these interactions should be collaborative, and an organisation be able to influence how it will be regulated. Without access to all stakeholders this represents one interpretation of the situation. However within business literature, proactive strategies are frequently utilised to allow for planning and the implementation of action, they represent a strategic choice based on an understanding of associated risks and opportunities (Banerjee, 2002). It therefore stands to reason that the actions taken were intentional, but whether pro-active or pre-emptive a matter of perspective.

The perception that actions taken by SSE were underhand was largely restricted to the TDSFB. Under the Freedom of Information Act, TDSFB gained access to a series of correspondence between SSE and the Scottish Executive, which they (TDSFB) publicise as evidence to validate their perceptions on their website. In these communications, the TDSFB state SSE attempt to secure a firm no loss of renewable generation position via the statement; "*We believe the time is right for Ministers to state that they intend to direct SEPA to the effect that River Basin Management Plans should be designed so that they do not lead to any reduction in the output of Scotland's hydro-electric schemes*." (Tay District Salmon Fisheries Board, 2007). While "*a blanket approach to hydropower as proposed in your letter would not be permitted under the Directive*" the Deputy Minister goes onto state that a reduction in hydropower output is "*something we would wish to avoid*". The TDSFB, state that the documents contain "*alarming discoveries*" that should be a "*grave* *concern*" to the reader. Whether this truly was an attempt to apply pressure and sway decisions, or just to gain a firm position on how the WFD will be implemented is unknown, but impact of perceived motivations is clear in subsequent behaviour and associated actions. This case provides evidence of the importance of cognitive dimensions of hydropower conflicts, clearly highlighting how perceptions influence behaviour and associated actions.

Approaches to problem solving

A distinct feature of the problem situation was the decision to take the issue public and the creation of the "Save the Garry campaign". The TDSFB recognise that their actions were unexpected, "*they (SSE) had no idea that we were talking to journalists*" and tactical "*it was like what the Japanese did to the Americans when they were planning Pearl Harbour*" (Anonymous (b), personal communication$_b$). SSE's views on this action are undocumented but they do note that "*Fisheries organisations have chosen to step outside a formal process set up by the Scottish Executive and SEPA*" (Marchant, 2007). In legislative terms, no formal processes applied at that stage of proceedings, but actions of the TDSFB fell outside of the expected process. The decision to gather power via public lobby and support is driven by both perceptions and fundamental understandings of right and wrong. The TDSFB undertook public measures in response to "*actions behind the scenes, and to give the Water Framework Directive a chance*", the aim of the campaign was "*to heighten awareness*" (Anonymous (b), personal communication$_a$). The decision to take such a course of action may be viewed by some as unhelpful and obstructive, but did highlight a number of themes which would not necessarily have emerged in different circumstances. The strategy that the TDSFB took may have significantly influenced the course of decision-making "*SSE tried to be ahead of the curve, and I believe that SEPA would have agreed to their suggestions from the outset had I not been there*" (Anonymous (b), personal communication$_b$). The consequences of this action are a breakdown of trust and communication; knock-on effects shaped the manner in which the issue was dealt with. In this action, the impact of the individual on the course of conflict is clear.

It is of interest that within this conflict there are two fisheries boards, which play the same role and have similar goals, yet adopted significantly different strategies. The SFB note that "*a solution is possible but it requires agreement and balance*" (Anonymous (a), personal communication$_a$), their strategy involves ongoing dialogues within existing channels and a collaborative approach. These differential strategies adopted are therefore a function of the individual, not of the role itself.

6.6.5 Structures

Much of the tensions which have arisen in this case are the product of existing structures. Two that feature most prominently are the impact of existing legislation and the formal process.

The Role of Legislation

Much of the initial conflict centres on "a *lack of preparedness for the WFD coming in. SEPA had no history of water management in water abstraction and hydropower and thus little expertise*" (Anonymous (b), personal communication$_b$), creating a situation whereby the primary decision maker is arguably disadvantaged. Differential perceptions of how the WFD should be used, was the root driver of the Save the Garry campaign, its aim to give the WFD a chance to achieve its intended purpose (Tay District Salmon Fisheries Board, 2007); suggesting that conflict stems from legislative ambiguity. As the proposal involves inter basin transfers, the WFD can also be used differentially to support and oppose the proposal. While it drives change on the Garry, the Tromie and Truim have been designated as moderate environments and cannot be allowed to decline under the WFD. Furthermore, the Cuaich has not yet been included in catchment management plans, but "*is likely to be poor and will need addressing*" (Anonymous (a), personal communication$_a$). Legislation is in this case a double edged sword; it has "*enhanced protection for freshwater environments but also bureaucracy*" (Anonymous (a), personal communication$_a$).

Incompatibilities between the WFD and other EU Directives differentially support the arguments presented, and a lack of definition as to how these legislative tools fit together causes further uncertainty. Alongside disparities between the Renewable Directive and the WFD, the situation is further complicated in this case by the legal protection attributed to some sites under the Habitats Directive. The River Truim, as a tributary of the River Spey, is a Special Area of Conservation (SAC) under the EC Habitats Directive (92/43/EC) for Atlantic salmon (*Salmo salar*), Otter (*Lutra lutra*), Sea lamprey

(*Petromyzon marinus)* and Freshwater Pearl Mussel *(Margaritifera margaritifera*), and therefore has high legislative protection. There is a "*big question mark of if not the legality, then the ethics of the proposal due to SAC*" (Anonymous (a), personal communication$_a$). Existing legislation fails to recognise that these themes overlap within the catchment; this is a gap that needs to be addressed. The role of legislation in the continuation of conflict is apparent and the need for change to allow resolution is recognised by stakeholders, "*agreements need to come with legislative change*" (Anonymous (a), personal communication$_a$).

The Impact of Formal processes

The role of formal procedures within the problem situation is clear; highlighted to significantly increase speed of movement, and where absent cause stagnation. Despite this, the time expiration of the application and lack of reapplication procedure result in further stagnation, "*no one knows what the process is now, SSE are taking legal advice but SEPA don't know either...No one knows what happens now*" (Anonymous (b), personal communication$_c$), and despite considerable shift in problem conception, realisation of change is not achieved. This case therefore highlights the importance of procedures, and while arguably the administrative error by SEPA creates an uncharacteristic dilemma, the importance of definitive processes to guide conflict is noted.

Formal engagement processes also provide an opportunity for wider stakeholder involvement; during the consultation period numerous stakeholders came forward that were unknown to the analyst. The strong views presented suggest that these individuals have always been interested in the problem situation, but previously unable to engage in the process. Similarly, it was recognised by SNH that they "*have had an interest in the issues, but there is no mechanism for us to be involved and no requirement for us to be asked*" (Anonymous (c), personal communication). These examples highlight a lack of formal mechanisms to guide stakeholder interactions, and for non-statutory stakeholders to express their views. This provides some individuals with a greater capacity to influence proceedings than others. The decision to develop these plans in isolation separate from the fisheries boards, not only affords greater power to SHE to influence the decision, but induces greater conflict in later stages.

5.7 Barriers to Participation

Following analysis of the conflict situation, it was intended that SSM would be used to facilitate conflict management and stakeholder interactions. To achieve an appropriate solution, broad stakeholder participation is required for subsequent activities. As stakeholder participation in this case study was limited, there was little value to pursuing these objectives, as solutions generated would be biased. The issues experienced during attempts to engage stakeholders highlight some of the barriers that SSM faces. Getting the important actors involved is a challenge highlighted by other users; Mingers and Taylor (1992) note this is particularly the case when SSM is used independently, and the analyst has not been invited to participate. They attribute this to the innovative and unfamiliar nature of the methodology; however, in this case gaining access to stakeholders was the primary barrier, with few opportunities to explain the nature of the methodology.

Stakeholder identification was difficult; while widely publicised, few of the people involved were known. A meta-analysis of media articles and press releases was used to identify organisations which had commented on the case, alongside potential stakeholders identified using the table of generic hydropower stakeholders (see Appendix 3). Accessing some stakeholders directly (e.g. customers, property owners, local residence) was not possible. This method of identification, along with the lag time between the manifestation of conflict and commencement of this study, resulted in a ‘cold calling’ approach, where prospective stakeholders were contacted and invited to participate, but were not expecting such interactions. Response rate to electronic invitations was 37.5%, and while followed up with further inquiries, did not elicit further participants. Where given, lack of willingness to participate was attributed to time lapse between manifestation of conflict and commencement of study (Wooton, personal communication).

A major limitation of the cold calling approach was that it did not provide direct communication links, or highlight relevant contacts, forcing the analyst to approach the issue of participation through centralised communication routes. In many cases, it was difficult to find the appropriate person, and inquiries were often relayed through several individuals before they reached the relevant contact. In some cases, this was avoided using details provided by the analyst’s own contacts. In these communications, the mutual acquaintance was highlighted to the potential stakeholder, to strengthen the authenticity of the request. Of those that responded, 83.3% were accessed in this manner, significantly increasing response rate, and this highlights the important role of mutual contacts. This suggests that the extent of the analyst's personal social network is important, providing an alternative route of access to potential stakeholders. The role of personal social networks in the workplace have been recognised; Nardi *et al.*, (2000) note that they provide key sources of information and resources. It could be argued that the same is true in research, and while stakeholder identification was conducted methodically, resources provided by the analyst's personal network influenced success. This implies that theoretically a different analyst, with more connections better correlated to this specific case study, would have had greater success with stakeholder engagement. While this represents a degree of unavoidable bias, it suggests that were such methodologies applied internally by those involved in the problem situation, who should have greater connections, such issues may be overcome. The greater success of internal application of the methodology has also been noted in other applications of SSM (Checkland and Scholes, 1990).

Solidifying participation was also difficult, while many of those who responded to invitations expressed interest in the project and the methodology; they were unwilling to formally participate. Antecedent conditions prior to commencement of the study created a lack of trust and negative perceptions between key stakeholders. Due to its contentious nature, SEPA were "*not keen to be involved in the Garry case study due to its sensitivity*" (Bromley, personal communication). SSE also declined to participate, stating that it was inappropriate for them to be involved, "*At this stage we do not want to have any discussions unless it is through SEPA*" (Stephen, personal communication). Whether this is a true representation of their views is uncertain, correspondence with SEPA implied it is SSE who objected; "*I'm afraid they (SSE) categorically do not want anyone else involved in the process at the moment*" (Silverman, personal communication). Unwillingness of key stakeholders to participate can therefore be linked to both poor timing of intervention and the perceived unsuitability of open communication.

While unwilling to participate, SEPA did suggest an alternate course of action, advising on "*other less sensitive case studies*" (Bromley, personal communication), highlighting the case of the River Doon, Galloway. While another interesting case, switching to a less contentious case to evade participation issues was contrary to the aims and objectives of this study, and this course of action discounted. Their suggestion did not resolve the participation issue as there was no scope for involvement from SEPA in this case either, "*I have been told that at the moment we couldn't help you*." (Silverman, personal communication$_b$). This simultaneously highlights another factor that influenced participation; power hierarchies within the organisations themselves. Those involved were constrained in what they felt they could do by those with greater authority within the organisational hierarchy. While many of the individuals involved were interested in the methodology and its potential benefits, approval for participation was often required from higher in the organisation and in this case not granted. This is a further dimension to consider during stakeholder engagement, approaching individuals further up the hierarchy may yield better results but is dependent on organisational structure.

Given the baseline conditions to the case, the perceived risk of participating in SSM is high. In tandem with elevated emotional components due to the aftermath of past conflict episode, conditions were not conducive to the implementation of SSM and the open expression of views and perceptions. This risk may be reduced in the future when examples of successful implementation for hydropower can be presented reducing the uncertainty of potential outcomes. However, there appears to be an unwillingness to be the first case to adopt such an approach, this is acknowledged as a further barrier to be overcome.

While unwilling to participate, many recognised the value of the project and wanted to remain informed, “I do think this is an important area of work and would like to be kept abreast of its findings” (Bromley, personal communication). Such a statement suggests that there is a recognised need for the development of such projects and methodologies, but they are not supported by those who would implement them. Inability to validate such methods, based on real world situations further weakens chances of implementation, and this case highlights a significant gap to be addressed. Argyris (1995) highlights this as one of the paradoxes of human behaviour, that there is a significant difference between what people say and believe, and the subsequent behaviours they implement. In this case, stakeholders recognise and believe in the importance of this study, but then behave in a manner which does not support it. Behaviours and perceptions external to the conflict itself may influence the success of its resolution, by predetermining participation. Argyris (1995) highlights the potential impact of such behaviours within a corporate environment, noting the presence of defensive positions which influence openness. In his work, Argyris (1995) highlights cases whereby managers have taken a defensive stance, and attributes this to fear of criticism and recognition of transgression. Whether such behaviours apply to those who chose not to participate in the River Garry case study is speculative, but is an interesting dimension to consider.

The final barriers noted were logistical issues, in particular relating to obtaining meetings and the difficulties experienced. During correspondence with existing contacts, there were nine cases of emails which received no response, when followed with phone inquiries individuals were frequently unavailable or out of the office. Inability to follow up inquiries in person, a function of distance between the analyst and the study location, made the study highly susceptible to such actions. On a number of occasions meetings were cancelled by stakeholders for personal reasons, delayed due to shifting workloads or called off in favour of email correspondence. While such factors are an inevitable barrier to participatory research, they may in part be attributed to external application of SSM, and may be less frequent were participation is formally required.

5.8 Discussion

The aim of this chapter was to identify and critically discuss the nature of conflict that arises when trying to address the requirements of the Water Framework Directive, as it applies to existing hydropower development, using the case of the River Garry; and, to highlight and critically examine the obstacles experienced in this case and assess the suitability of SSM as a conceptual tool for environmental conflict management. Discussion highlights a complex baseline problem, further compounded by stakeholder conflict. A lack of certainty as to what action to take to achieve good ecological status in the Tummel catchment is the driver of conflict. According to expert opinion, attaining good status would require the removal of all hydroelectric structures (Hanley and Black, 2005), but would cause the cessation of power production. While other renewable technologies exist, they do not represent a better environmental option to generate peak-load electricity, removal is therefore discounted as an option. Under Article 4(3) of the WFD, this conclusion requires the consideration of alternative scenarios which allow continued hydroelectric generation, while adopting measures (in this case compensation flows and fish passage mitigation measures) to raise ecological status. This requirement allows for a spectrum of responses, which have differential acceptability, creating an environment which increases conflict potential.

Using rich picture analysis, it was possible to note ten key facets of the case which had influenced the nature of conflict (see Table 5.2). In this case, existing structures reduce ability for stakeholders to interact, in turn limiting communication among parties.

Communication is further diminished by stakeholder behaviour and reduced trust, caused by actions determined by underlying values, emotions and perceptions. Information sharing is therefore limited, a product of poor relationships. Information is crucial in this case; differential knowledge creates power hierarchies, with the regulator (SEPA) arguably the primary decision-maker disadvantaged. Uncertainty allows ambiguity to emerge, increasing complexity of the decision to be made.

The impact of conflict has been differential with clear functional and dysfunctional elements. For the collective, conflict increases information and understanding of the problem situation. In a case where communication is limited, conflict provides an alternative method of exchange. Conflict has influenced problem conception potentially increasing the quality of future decisions, having already altered the course of decision-making by preventing the initial proposal from being implemented. At the individual level, conflict has provided an opportunity to highlight concerns, and pursue objectives. This is particularly evident looking at the role of the TDSFB in this case, and highlights a further individual function of conflict, to communicate suspicions of others and make underlying activities explicit. Dysfunctional elements are also clear; conflict highlights the incompatibility of stakeholder goals, increasing the difficulty of the task. This case is associated with negative emotions and reduced trust, which have fed back and further influenced the nature of conflict. This dysfunction has clear impacts at the individual and collective levels, reducing interactions and generating periods of stagnation. The role of the individual is also clearly highlighted; a key feature to the River Garry conflict is the decision to launch a campaign and engage the media, escalating conflict intensity and collapsing stakeholder relationships. The decision to undertake this course of action falls to one individual, and highlights that had this stakeholder not been involved the course of conflict and resultant decision could have been very different.

The cyclical nature of this case was clearly emphasised by Lewins (1951) three phase model. The conflict process is highlighted as being dynamic, inducing significant shifts in problem conception and stakeholder involvement over time. The nature of conflict has altered over time; Pondy (1967) noted five stages of escalation through an episode, events within the Garry problem situation match these cycles. Baseline context creates a latent conflict which becomes perceived as change is investigated. Development of the initial proposal causes conflict to be felt, and then leads to later manifestation in the creation of the campaign. The aftermath of this action then influences the second episode, with advertisement of a second proposal shifting conflict from perceived to felt. Conflict in this case forms two interlocking episodes, and a lack of resolution suggests significant potential for a third. If not resolved the option to appeal to the EU represents a potential further iteration. The prospect of continued conflict has further implications for the resolution of the River Garry conflict. Bercovitch and Langley (1993) found that dispute duration has a strong inverse relationship with successful mediation, suggesting that allowing conflict to continue will have a detrimental impact on resolution. Both the duration of conflict and potential for future episodes simultaneously highlights the need for and lack of intervention. Attempts to resolve this issue by SEPA are limited to closed discussions and negotiations; despite high awareness and at times significant intensity, there was no attempt to specifically manage conflict. This may be a function of a lack of tools to address conflict, that such responsibilities do not fall into SEPA’s remit, or an unwillingness and/or reluctance to treat the situation as such.

Analysis of conflict elements highlights the need for change to enable resolution on the River Garry. There is a need to establish the relationship between the contradictory themes within hydropower, and for them to be reflected in related legislation. The case of the River Garry highlights the management challenge of implementing legislation determined by theme, which are not mutually exclusive. A lack of integration between legislative requirements generates uncertainty which allows conflict to establish. This case also highlights the need for a change in approach to the management of such situations. Many authors (Pfeffer, 1993; Gilley, 2001; Gilley, 2005) note that a critical factor in enabling and driving change efforts is leadership. Lewin (1951) also notes the need for leaders to drive change. In the River Garry conflict, this role falls to SEPA who are recognised as having the power to resolve the issue, but much of the resultant conflict is shaped by their lack of leadership. Multiple factors, recent expansion of role, a lack of experience, a lack of manpower combined with uncertainty associated with the problem have limited the ability of SEPA to take an authoritative stance. Dependency on other stakeholders for information and experience, increased reliance of them and weakens SEPA’s role. While SEPA retains the power to act, their indecision provides stakeholders with a greater opportunity to influence proceedings and validate engaging in prolonged conflict.

During this case no formal attempts were made to structure, analyse or address conflict; suggesting that there is a lack of available tools. The contextual variables in this case create complexity which helps perpetuate conflict and blocks a solution. While there is evidence of incremental shifts within iterations of this case, ability to realise intended change is poor, suggesting that current approaches (or lack of) do not facilitate resolution. In this case, it was intended that following analysis of the nature of conflict, further stages of SSM would be implemented to further aid exploration and facilitation of conflict management. However, a number of barriers to participation were experienced, preventing testing of the methodology. While some barriers noted are an inevitable consequence of participatory research, others highlight not limitations in the methodology *per se*, but a potential aversion or apathy towards it. While interest and recognition of the importance of such tools was high among stakeholders, this did not translate to support of it. Perception of new tools, which seek to address issues in a manner which is alien to practitioners may therefore, be a significant barrier to their success. This is not a limitation of the methodology, but inability of actors to identify with such methods. Funtowicz and Ravetz (1993) highlight that science always evolves to meet new challenges; the potential success of conceptual tools like SSM to address the difficulties experienced by practitioners is considerable, but require stakeholders to evolve with them. While further work is needed to understand the impact of stakeholder conflicts within sustainable hydropower development and develop conceptual conflict tools to support decision-making, there is also a need for practitioners embrace such methods. This will require both a change in attitudes and perceptions of 'soft' methods by practitioners, and provision of evidence of their potential by academics.

5.9 Conclusions

The purpose of this chapter was to highlight the existence and nature of sustainable hydropower development conflict, and the parameters involved. The River Garry, Scotland, provides such an example, highlighting the impact of contextual drivers in inducing conflict, and stakeholder responses in influence its nature. This case highlights that the complexity of the problem is considerable, and determining a decision is not an enviable task. The role of emotions and cognitive dimension not only generate conflict but in this case sustain it, influencing events and acceptance of potential resolution mechanisms. Conflict is highlighted as being dynamic, with clear cyclical patterns. The case highlights that sustainable hydropower development conflicts can escalate as seen in other disciplines and without intervention and regulation, is likely to be a prominent feature of environmental management.

Analysis of this case highlights the need for change and the potential impact of a lack of tools specifically designed to address conflict. The consequences of conflict have clear functional and dysfunctional elements, simultaneously increasing information availability and understanding, while highlighting incompatibilities and damaging stakeholder relations. The impact of conflict on the course of decision-making is also clear, with conflict preventing the implementation of two proposed actions. Barriers to participation and successful use of potential conceptual tools are also noted, along with the need for change within the problem situation to allow conflict management. Both of these factors should be considered in the development of potential conceptual tools to address sustainable hydropower development conflicts.

Chapter 6 The Challenge of Sustainable Small–Scale Hydropower: The Impact of Stakeholders

Chapter Summary

The growing importance of the environment and its management on the political agenda has simultaneously emphasized the benefits of hydroelectric power and its environmental costs. In a changing policy climate, giving importance to renewable energy development and environmental protection, conflict potential between stakeholders is considerable. Navigation of conflict determines the scheme constructed, making sustainable hydropower a function of human choice. To meet the needs of practitioners, greater understanding of stakeholder conflict is needed. This chapter presents an approach to illustrate the challenges that face small-scale hydropower development as perceived by the stakeholders involved, and how they influence decision-making.

Using Gordleton Mill, Hampshire (UK) as a case study, soft systems methodology, a systems modelling approach, was adopted. Through individual interviews, a range of problems were identified and conceptually modelled. Stakeholder bias towards favouring economic appraisal over intangible social and environmental aspects was identified; costs appeared more influential than profit. Conceptual evaluation of the requirements to meet a stakeholder-approved solution suggested a complex linear systems approach; considerably different from the real-life situation. The stakeholders introduced bias to problem definition by transferring self-perceived issues onto the project owner. Application of soft systems methodology caused a shift in project goals away from further investigation towards consideration of project suitability. The challenge of sustainable hydropower is global, with a need to balance environmental, economic, and social concerns. It is clear that in this type of conflict, an individual can significantly influence outcomes; highlighting the need for more structured approaches to deal with stakeholder conflicts in sustainable hydropower development.

6.1 Introduction

Energy is one of the fundamental needs of modern society. Global problems with supply and use are related to numerous environmental concerns: climate change, air pollution, acid precipitation, ozone depletion and forest destruction (Dincer, 2000). The environmental impacts associated with energy consumption have gained attention from both industry and society, simultaneously increasing demand for environmentally sensitive energy and the cost of its provision. Global demand for energy is expected to increase significantly by 2050, with primary-energy demand predicted to increase by 1.5–3 times (WEC, 1998). Addressing this demand has implications for achieving sustainable development. Many factors contribute to the attainment of sustainable development, the most important perhaps being the requirement that the energy systems embrace the concept (Norton, 1991; MacRae, 1996; Dincer and Rosen, 1998). Sustainable energy systems should "meet the needs of the present without compromising future generations' ability to meet their own needs" (Bruntland, 1987). Energy should be readily and sustainably available at reasonable cost, meet current demands without negative societal impact, and be an effective and efficient utilization of energy resources. Consequently, the development of renewable energy sources has received considerable interest.

Exploitation of renewable energy is a key component of sustainable development (Dincer, 2000), and is the focus of considerable research. However, renewable technologies face many challenges if they are to replace traditional fossil fuels. Globally hydroelectricity is an important source of renewable energy (see Bartle, 2002) - non-polluting, non-exhaustible and economically attractive - but locally it can be environmentally damaging (Langford, 1983). The most significant biophysical effects include hydrological alterations, disruptions to sediment transfer, and impacts on aquatic ecology (Sadler *et al.*, 2000). While these studies refer to larger scale hydropower operations, they are also applicable to small facilities. The extent of these impacts varies depending on the type and scale of facility. While the breakage point between large and small hydropower varies from country to country, in the EU, small-scale hydropower is considered to be 10MW or less in size (Paish, 2002). Tensions regarding hydropower developments are experienced globally and cited as one of the top four causes of international water-related dispute (Yoffee *et al.*, 2003). Several hydroelectric projects have been cancelled or indefinitely postponed partly or entirely for environmental reasons, often the subject of disputes and sharp resistance (Kaygusuz, 2002; Klimpt *et al.*, 2002).

Hydropower development is complex; playing a dual role as a source of green energy and a locally destructive force, in policy terms, it sits at the interface of climate change, energy and conservation. Across the EU, conflicting themes are driven by contradictory legislation (Renewable Energy Directive (2009/28/EC); Water Framework Directive (2000/77/EC)). In North America, the need to address climate change and promote a sustainable energy future is recognized (United States Department of State, 2010). Simultaneously dams and water diversions represent a significant challenge to freshwater environments (Allan and Flecker, 1993). Resultant conflicts are noted on a number of US rivers (the Colorado River, the Columbia River, and its tributary the Snake River, for example). Generating energy and using ecosystems sustainably is an accepted goal, but translating it into viable technical solutions is difficult. Such difficulties are not limited to hydropower.

While sustainable development is accepted as a guiding principle for policy, implementation is complicated (Hopwood *et al.*, 2005). For hydropower, the scheme developed will be dependent on whether sustainable development is to be implemented as a definitive idea (i.e. a literal transference of its fundamental principles) or a net balance of costs and benefits. Multiple interpretations of sustainable development exist; without clear definition the concept is open to interpretation and the potential for conflict is considerable. Navigation of conflicts and the solutions generated will determine the extent of the gap between the ideology of sustainable hydropower and its practical reality. Although the impacts of hydropower are widely studied, highly innovative solutions are often limited by socio-economic factors. With numerous potential actions, stakeholder conflicts between groups may play a significant role.

Navigating the socio-economic challenges related to the sustainable development of large projects has been investigated. The World Commission on Dams (WCD) (2000) noted intensifying conflicts over dam construction and attributed this to decision-making processes prior to construction. The report highlighted that cost-benefit approaches are inadequate for effective planning, and supported decision-making processes that deal with competing interests and conflict (WCD, 2000). They advocated a stakeholder-based approach, giving all an opportunity to participate in decision-making. This however, relies on negotiation and availability of independent third parties to facilitate the process. Although viable for larger schemes due to the scale of their impacts, would such an approach be applicable for smaller-scale schemes?

In 2002, approximately 105 000MW of hydropower capacity was under construction globally; the greatest amount in Asia (84 400MW), followed by South America (14 800MW), Africa (2 403MW), Europe (2 211MW) and North America (1 236MW) (Bartle, 2002). Worldwide, there remain opportunities for the development of small-scale hydropower, particularly at existing hydraulic works (Bartle, 2002). The notion of rural hydropower attracts interest in developing countries, simultaneously addressing sustainability and costs of connecting remote areas to existing energy systems. However, despite being smaller in scale, the potential impacts on local freshwater environments, if not appropriately designed, remains considerable. Complex designs yield higher costs while smaller hydropower schemes suffer from weaker economies of scale (Paish, 2002). The impact of environmental mitigation measures on the economic performance of schemes causes tensions, particularly due to the ambiguous nature of the concept of sustainable hydropower.

In the UK, small-scale hydro opportunities exist at 25 935 natural and anthropogenic barriers across England and Wales (Environment Agency, 2010). The Environment Agency study classified 12% of these barriers into good, moderate and bad hydropower schemes based on hydropower potential and environmental sensitivity at the site concerned however, the exact definition of these categories is absent from the report. The remaining 88% of barriers represent marginal or difficult choices (Environment Agency, 2010). Navigation of difficult choices by key stakeholders will determine whether the future of small-scale hydropower represents a sustainable energy source. In Northern Pakistan, failure to consult all stakeholders weakened the success of government-led small-scale hydropower development (Williams, 1995). Schemes built by government engineers without consulting or training local communities resulted in more than half of these schemes becoming inoperative, as there was no one locally to manage them (Williams, 1995). At this development scale, involvement of stakeholders appears significant and mechanisms which facilitate sustainable solutions must be collaborative. This chapter aims to identify and critically evaluate stakeholder-related challenges involved in developing small-scale sustainable hydropower.

The author use a systems approach on a UK-based case study at Gordleton Mill, where existing hydraulic works are being redeveloped by a non-industrial stakeholder. The study investigates the challenges experienced by stakeholders and their impact on the sustainable nature of such schemes. While some elements are case-specific, the approach and considerations raised are internationally transferable. Soft Systems Methodology (SSM), a learning development and problem solving tool, is applied to determine stakeholder-identified barriers to development and the impact of stakeholders in the negotiation of complex and often conflicting decisions.

6.2 Study Area

Gordleton Mill in Hampshire, England (Figure 6.1), first built in the seventeenth century, is a Grade II listed building (Grade II buildings are nationally important and of special interest for their architecture and historical interest (English Heritage, 2010)). Now converted into a hotel and restaurant, the Mill has attained numerous awards in sustainable tourism. Located within the boundaries of the New Forest National Park, the Mill is situated on the Avon Water, approximately 12 km from the source, and flows directly into the Solent. The Mill retains its original wheel pit, which houses a redundant turbine. The owner intends to reinstall a modern waterwheel, to combat rising energy costs and add to the sustainable theme of the business.

Since conception in 2006, the project has faced numerous challenges (e.g. power generation estimates, economic viability concerns, difficulty obtaining funding, and environmental uncertainty), causing the scheme to stagnate. External factors such as a change in legislation and economic climate have placed differential pressure on the project development. Introduction of Feed-in-Tariffs generates financial incentives to continue, while an economic downturn makes investment harder to obtain and increases associated risks. This has led to project stagnation over a four year period. While this chapter does not focus on conflict management (see Chapter 2), the author’s involvement in the project (commencing April 2009) has the long-term goal of aiding participants to facilitate decision making. The desire to install a functional hydropower facility stems from the owner, who is the project manager in this case. Like many private developers across the UK, the owner has no previous experience of hydropower development, and no a background in the associated issues. Other stakeholders engaged in this case study represent specialists from across a range of disciplines. The author selected this case study for academic purposes, they were not invited or contracted to resolve this issue. The primary goal of SSM in this study is the examination of the situation, not resolution of the problem.

Figure 6.1- Location of Gordleton Mill, Hampshire, England (*Source: Open Street Map*)

The Avon Water currently achieves good ecological status (Environment Agency, 2009a), and under the Water Framework Directive (2000/60/EC), deterioration must be prevented. At Gordleton Mill, should hydropower development finally go ahead, the main environmental impact is likely to be related to water level and discharge, resulting in geomorphologic changes (Xie, 2006). A varied fish population is present in the Avon Water (Xie, 2006), including both migratory and non-migratory fish; there is therefore significant potential for damage as they move through the proposed facility. The impact of habitat loss and displacement of invertebrates is uncertain, but may result in the loss of spawning grounds for some fish species such as resident brown trout (*Salmo trutta*).

6.3 Method

The use of SSM has been adapted to fit an environmental management problem. While this study employs a number of techniques which are recognizable elements of SSM, there is no defined method as to how SSM should be used. Checkland and Scholes (1990) refer to two modes of SSM (1 and 2), with a continuum of approaches in between them. In Mode 1 the use of SSM is sequential and prescribed by the methodology rather than by the specific situation (Checkland, 1999). Mode 2 inquiries are less formal, and use recognizable features of SSM based on the nature of the problem situation. At Gordleton Mill, application is closer to Mode 2, and is employed to gain insight into an existing task.

A common feature of SSM is for stakeholders to work through the methodology in collaboration, but in this case the analyst undertakes SSM based on separate meetings and interviews. This variation is utilized for a number of reasons; primarily, as the study is concerned with the impact of individuals, it is therefore appropriate to gather attitudes, feelings and beliefs independently. Secondly, due to the time lapse between initial proposal and undertaking SSM, this case was not a leading concern for many of those involved, who work within a diverse range of organizations. Coupled with its external application, whereby the analyst has not been invited, frequent meetings could not be stipulated, nor full participation guaranteed. While these could be requested, due to existing work constraints, full participation would be unlikely and individual interviews allowed a more consistent approach. A disadvantage of this approach is that it limits SSMs' success as a collective learning tool and the implementation of agreed action; however as the aim of this study is to gain insight and not to achieve resolution; such an approach is considered appropriate.

The study involved a core group of five stakeholders. Initially, stakeholders were identified as representatives from key stakeholder groups - the owner and the environmental regulator. Additional stakeholders were identified in later iterations via a snowball technique; where key stakeholders identified others who should be included. Not all stakeholders were available for participation due to the time lapse (three years) between the problem's origin and their participation in the study. While not directly involved in the study, the general public was recognized as being able to influence the decisions of others. The core group of stakeholders consulted consisted of representatives from the Environment Agency (government regulator), researchers from the University of Southampton (from civil engineering and environmental departments), the National Park

Authority (a case-specific stakeholder), and the site owner. Academic institutions are involved instead of engineering firms, as ongoing research is mutually beneficial for both parties. Stakeholders selected represent those whose involvement in the waterwheel project predates commencement of this study; not the full suite of theoretical stakeholders who could have been approached.

During individual interviews, stakeholders described the problem situation at Gordleton Mill and commented on conceptual models of relevant systems generated by the analyst. Interviews were semi-structured, designed to allow stakeholders to define the nature and scope of the problem, including the expression of values and perceptions. There is no set number of iterations required for SSM to be considered complete. In this case, all stakeholders were engaged at least once to ensure all dimensions of the problem were gathered, however due to the time that had elapsed between project conception and the commencement of this process, stakeholders exhibited differential levels of interest in involvement. The need for intervention to be appropriately timed is well documented in conflict literature (Pondy, 1967). Problems with involvement are often noted in cases such as this where SSM is applied to externally assess a project, rather than those where an analyst is invited or SSM is run in-house (Mingers and Rosenhead, 2004). While this represented a methodological limitation in this case, its use as an accepted conflict management mechanism engaged at the appropriate time would overcome them.

6.4 Problem Expression

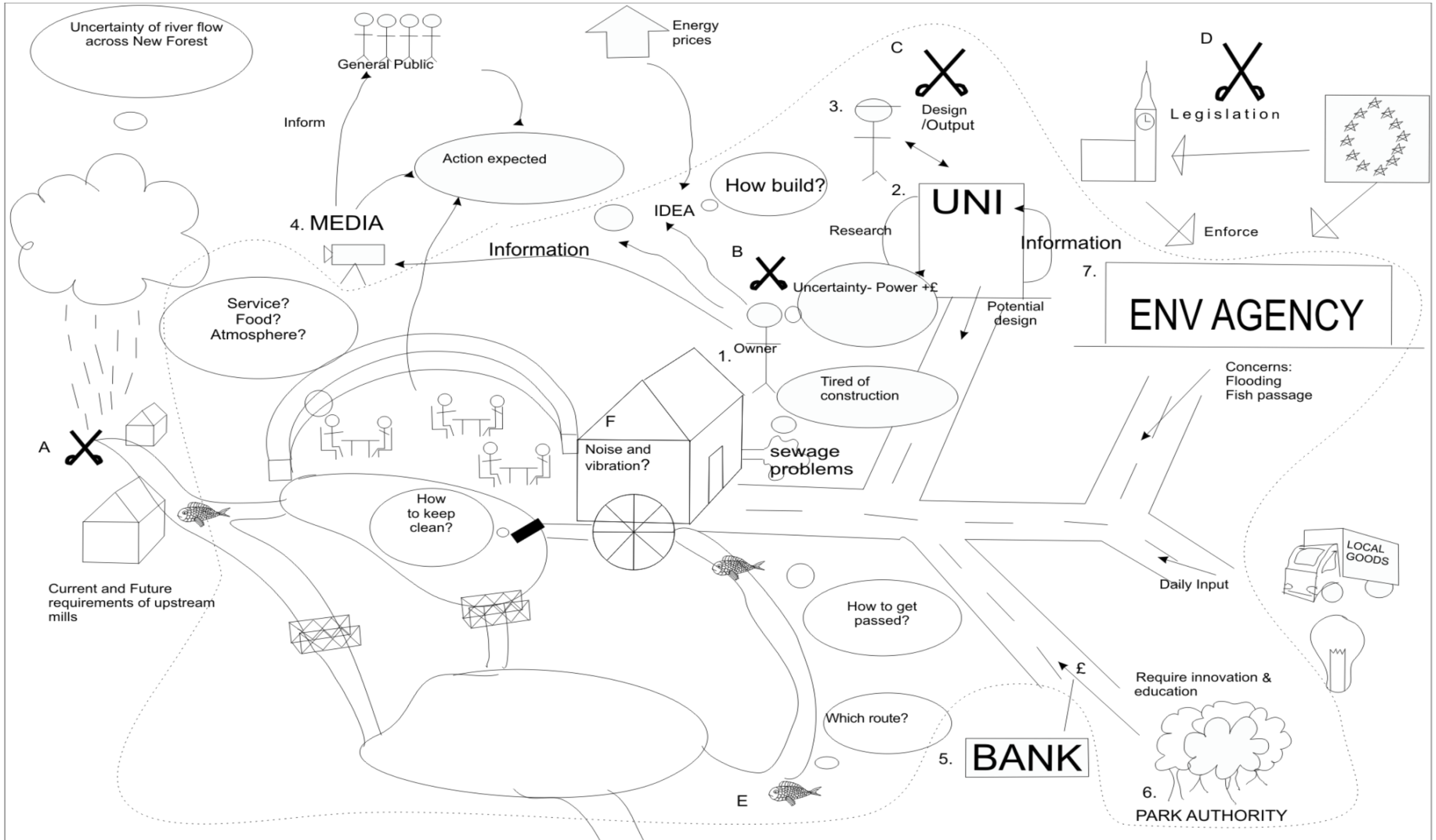
Checkland (1999) notes that the use of diagrams to express problem situations is a better medium for holistic thinking, as the ability to visualize interacting relationships pictorially is more effectively communicated than in prose. Checkland (1981) refers to these diagrams as ‘rich pictures’, portraying structures, actors and their relationships in the context of both the problem situation and the day to day functioning of the system. In this case, the rich picture (Figure 6.2) was developed independently by the analyst using primary data gathered from stakeholder interviews, and presented to stakeholders for modification and validation. The rich picture was constructed by beginning with the structures which make up the Mill, including the river system. Human actors were then added, separated by a systems boundary into internal and external stakeholders and the relationships between them. From this state, various elements were added by stakeholders both prior to and after subsequent stages as they became apparent.

At its final iteration, the rich picture (Figure 6.2) represents a diagrammatic overview of the situation allowing participants to begin to consider the situation in a holistic manner. During development, consideration of the problem shifted to include wider themes external to the hydropower systems (such as social issues). The owner/developer found the rich picture to be a visual representation of the complexity experienced, providing justification of the emotions felt. While the picture was a useful tool for allowing holistic consideration in a non-technical manner, the lack of quantitative analysis prompted some scepticism from technical stakeholders who operate within more traditional research paradigms. This does not represent a weakness in SSM, but an obstacle to how it is perceived. In one case, however, similarities were noted between the role of a rich picture structuring a problem situation, and a food web structuring an ecosystem (Langford, personal communication). Stakeholder interviews identified a range of problem facets associated with the issue of hydropower development, demonstrating the complexity of the task. After consolidating identification of the problem from multiple stakeholders, 47 problem elements were identified, separated into nine categories (Table 6.1). While there are indisputable links between categories, separation highlights the numerous challenges facing the project at Gordleton Mill, and their relative importance to stakeholders.

Table 6.1- Problem categories associated with the Gordleton Mill waterwheel identified by stakeholders

Category	Number of items
Economic viability*	10
Fish passage criteria*	7
Legislative compliance*	6
Social importance*	6
Power generation*	5
Wheel design criteria	4
Unrelated Mill activities	4
Environmental impact*	3
Planning issues	2

*represents categories later taken forward to conceptual modelling stages.



The rich picture begins with the primary stakeholder (1) and the initial idea. As other stakeholders (2-7) are engaged, they introduce new areas of input via roads to the Mill in the centre. The rich picture includes daily activities which are ongoing, but are indirectly linked to the issue. Thought bubbles represent expectations or questions which need to be answered. Areas of conflict are denoted by crossed swords. Conflicting issues are identified as: A-potentially damaging upstream activities, B-Uncertain power generation, C- Uncertain costs and profits, D- Conflicting legislation, E- Multiple issues regarding fish passage, F- Potential noise and vibration impacts.

Figure 6.2- Rich picture of the problem situation at Gordleton Mill

6.5 The Challenges of Micro-generation at Gordleton Mill

The development of the rich picture allowed for problem categories to be identified and discussed, revealing a range of themes (see Table 6.1) to be addressed to achieve a sustainable solution. Many problem categories may overlap with those recognized by other practitioners in other sustainable development fields; identification alone did not yield unexpected results. Detailed analysis of problem elements, highlighted in subsequent paragraphs, noted complex relationships both between and within categories and the challenges of sustainable development.

At Gordleton Mill, economic uncertainty is a significant barrier, hindered by unknown power generation potential/output, total project cost and environmental factors. Economic viability is the most readily identified challenge and is the owner's primary criterion for success; "*at the very minimum it needs to be cost effective*" (Cottingham, personal communication). Total costs are estimated at £82,000. Although exact requirements for fish mitigation are uncertain, these may add £20,000 to the scheme. Economic evaluation of the proposed scheme operating an undershot wheel generated a 2007 energy value of £1,700 per year (13% of 2007 energy requirements) and a 35 year payback (O'Brian *et al.*, 2007), but actual output is uncertain.

Since conception, there have been significant changes in energy prices, the economic climate and legislative mechanisms. In April 2010, Feed-in-Tariffs (FITs) became available under the Energy Act (2008) providing economic support for small-scale technologies. At Gordleton Mill, FITs generate a subsidy of 19.9 p/kwh, thus altering the payback period (Table 6.2). Nonetheless, investment attractiveness remains low with a net present value of -51,356.08 at a 10% discount rate (Project B), or loss of generation capacity for fish passage maintenance. Non-cash benefits are not included. Net present value is used for capital budgeting to determine whether an investment is worth pursuing. The net present value decision rule is to accept positive values; in this case all project options yield a negative result, but as options are mutually exclusive, project A represents the best financial decision. In seeking funding for the project, the issue of support from financial institutions needs to be readdressed and requires more detailed economic data to be approved. Obtaining external grants has aided project costing by reducing operator investment (New Forest National Park, 2008), but simultaneously placed additional conflicting requirements on the project design and required promotion of the scheme for education.

Table 6.2 - Economic appraisal of hydro-scheme options

	Project A	Project B	Project C	Project D	
Projected output (kWh)	1.55	1.55	1.55	1.55	Based on initial design
Electricity price (p/kWh)	13.50	13.50	13.50	13.50	June 2010 price.
Income (£)	1,835.73	1,835.73	1,835.73	1,835.73	
Annual ROC (£)	611.91	611.91	611.91	611.91	Using 4.59 p/kWh
Annual FiT (£)	2,706.00	2,706.00	0.00	0.00	Using 19.9 p/kWh
Total income	5,168.69	5,168.69	2,462.69	2,462.69	
Capital expenditure (£)	-82,000.00	-82,000.00	-82,000.00	-82,000.00	Based on initial design
Fish mitigation costs (£)	-0.00	-20,000.00	-0.00	-20,000.00	Based on initial design
Total cost	-82, 000.00	-102,000.00	-82,000.00	-102,000.00	
Payback (yrs)	15.86	19.73	33.30	41.42	
Net Present Value	-27,949.68	-51,356.08	-50,993.97	-74,400.37	Discount rate= 10%

(A= FiTs, no mitigation, B= FiTs and mitigation, C= no FiTs or mitigation, D= no FiTs, mitigation)

Table 6.3- Net Present Value calculations for Project A

Year	Inflow (£)	Outflow (£)	Net flow (£)	Discount factor (10%)	Discounted
0	24,000.00	-102,000.00	-78,000	1	-78,000
1	5,168.69	-2,040.00	3,128.69	0.909	2,843.98
2	5,168.69	-2,040.00	3,128.69	0.826	2,584.30
3	5,168.69	-2,040.00	3,128.69	0.751	2,349.65
4	5,168.69	-2,040.00	3,128.69	0.683	2,136.90
5	5,168.69	-2,040.00	3,128.69	0.621	1,942.92
6	5,168.69	-2,040.00	3,128.69	0.565	1,767.71
7	5,168.69	-2,040.00	3,128.69	0.513	1,605.02
8	5,168.69	-2,040.00	3,128.69	0.467	1,461.10
9	5,168.69	-2,040.00	3,128.69	0.424	1,326.56
10	5,168.69	-2,040.00	3,128.69	0.386	1,207.67
11	5,168.69	-2,040.00	3,128.69	0.351	1,098.17
12	5,168.69	-2,040.00	3,128.69	0.319	998.05
13	5,168.69	-2,040.00	3,128.69	0.290	907.32
14	5,168.69	-2,040.00	3,128.69	0.263	822.85
15	5,168.69	-2,040.00	3,128.69	0.239	747.76
16	5,168.69	-2,040.00	3,128.69	0.218	682.05
17	5,168.69	-2,040.00	3,128.69	0.198	619.48
18	5,168.69	-2,040.00	3,128.69	0.180	563.16
19	5,168.69	-2,040.00	3,128.69	0.164	513.11
20	5,168.69	-2,040.00	3,128.69	0.149	466.17
NPV					£-51,356.08

Assumes a 20 year investment lifespan (exact lifespan is not known), no fluctuations renewable energy prices or changes in FITs (given that FITs for solar panels have rapidly decreased in the UK, this may be a considerable assumption). Assumes no loss of generation capacity, due to fish pass operation.

Actual achievable electrical output is uncertain, as it is dependent on available flow, the generation scheme used and potential water loss for fish passage. The catchment's geology is relatively impermeable, with rapid runoff and a low base flow generating large fluctuations in flows throughout the year (Environment Agency, 2009a). Fluctuations in water available for power generation may be compromised by current and future upstream requirements. Proposals by O'Brian *et al.*, (2007) suggest a configuration generating 13.5MWh/year; other stakeholders suggested the scheme would "*only contribute to a sixth of the Mill's energy use*" (Cottingham, personal communication). Neither scheme takes into account the generation losses that may occur to ensure fish passage.

Power generation was expected to be a primary concern to stakeholders involved. The issue of power generation has been separated from profit, despite profit being a function of output capacity. The findings suggest that stakeholders perceive economic value of output to be more important than the production of power itself. Water-wheels are designed for a given application, head difference and flow volume to maximize efficiency and power output (Müller and Kauppert, 2002). Initial design at Gordleton based on flow and power generation criteria proposed an undershot wheel, 3.5m in diameter with 1m wide cells. However, secondary design constraints need to be considered (innovation, aesthetic, and noise/vibration). Obtaining a grant required an innovative design and educational value. Initially, the wheel was to be constructed from carbon-fibre, but this material was rejected because of inadequate structural integrity. To fulfil its educational value, the wheel will be visible to customers, requiring an aesthetically pleasing solution as opposed to a traditional engineering solution. Placement of the wheel adjacent to the conference room and patio, directly below the master bedroom, raises the issue of noise and vibration (Figure 6.3.). Xie (2006) noted that waterwheels emit a low frequency rhythmic noise and thus a design that reduces or eliminates noise will be favoured.

Development of appropriate mitigation measures for fish was a concern for all stakeholders consulted. Recognition of impacts on fish populations (Mathers *et al.*, 2002) has been a fundamental feature in the development of the hydropower industry (Reid *et al.*, 2005) largely due to its socio-economic importance, and associated legislative protection (Salmon and Freshwater Fisheries Act, 1975). Stakeholders differ significantly in their opinions of what fish passage measures are required. The Environment Agency noted that any proposal will require fish easement. In the academic community, Xie (2006) highlighted the need for fish passage mitigation, although others believe it may not be necessary: "*There is anecdotal evidence to suggest that fish have moved up the bypass channel*" (Langford, personal communication), away from the Mill.

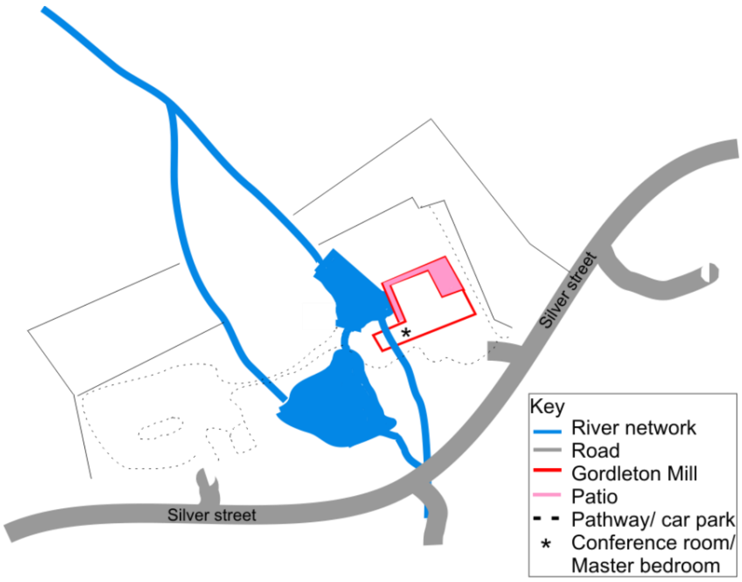


Figure 6.3- Schematic Diagram of Gordleton Mill.

Exact fish passage requirements are unknown, but provisions for upstream and downstream passage, appropriate screening, species specific requirements and fish response behaviors must be considered (Environment Agency, 2009a). A further challenge is the issue of fish versus flow at this site. If required, the fish pass/bypass channel will require "*much of the base flow of the river to operate, thus rendering any hydropower installation unused except in times of spate*" (Sidebottom, personal communication). Decreasing operation potential compromises economic viability, reducing the feasibility of the scheme.

In terms of legislative requirements, the penalties for non-compliance are not considered and compliance is assumed; the challenge lies in balancing multiple contradictory requirements (such as Renewables Obligation (2001/77/EC), Water Framework Directive (200/60/EC), Habitats Directive (92/43/EEC), The Eel Regulation (1100/2007/EC), and Health and Safety at Work Act, 1974). As compliance is not contested, the manner in which legislation was used was recorded and analysed. Legislation is used to support various arguments and strengthen their validity. For example, "*Bullhead (Cottus gobio) and brook lamprey (Lampetra planeri) (present in the Avon water) are particular conservation concerns, listed in Annex II of the EU Habitats Directive (92/43/EEC)*" (Xie, 2006). In this case information was accepted as important due to its legislative backing, despite the absence of detailed facts and relevance to the hydro-scheme. While finding a balance between legislative requirements is the responsibility of government, the manner in which ambiguity is used by stakeholders is of interest. It suggests that until a unified legal framework exists, the development of hydropower will remain challenging.

Environmental and sustainability themes are incorporated into the Mill's corporate identity, reflecting growing changes in environmental awareness (Thornton, 2009). Despite operating within the service industry, the social value of reinstalling a waterwheel was not observed. Subsequent interviews revealed it to be an important criterion for the developer, after cost and power generation capacity. The intangible (and to date unquantified) level of interest from customers may explain its absence from the decision-making process; "*I'm trying to approach the project from a business perspective but I recognize the wider benefits*" (Cottingham, personal communication). The waterwheel proposal has been publicised widely in the media, generating considerable interest. The New Forest National Park Authority had at its conception labelled Gordleton Mill as a flagship case for hydroelectric power, acting as a role model for the other 240 watermills across Hampshire (New Forest National Park, 2008), adding further pressure to the project. The need for a socially acceptable solution is apparent as, "*with all the media coverage and customer interest it now has public relations elements*" (Cottingham, personal communication).

Development of a hydro scheme is not the primary function of the business; numerous external issues have impacted both project development and importance. Since project conception there have been numerous sustainability-themed projects completed (e.g. a functional heat exchanger) and proposed (e.g. construction of eco-lodges). In addition, maintenance required for ongoing business activities, have "*forced the hydro project to take a back seat*", due to limited available construction time and disruption (Cottingham personal communication). In resolving hydropower development conflicts, solutions must be feasible within ongoing non-hydropower-related operations. Resolution techniques which do not consider the wider context of the issue weaken the solutions generated.

While many of these problem themes are highlighted in existing literature, consideration of them at a case study level highlights the considerable task which is faced by potentially non-technical developers at this scale of hydro scheme implementation. Although examined individually, in reality these problem categories interact and are inter-dependent. Stakeholder conflict in this case is latent (Pondy, 1967), where the parties are not fully aware of the presence of conflict but are aware of difficulties. How conflict between differential activities is negotiated will determine the nature of the scheme and whether it is feasible. The scheme implemented will therefore be a function of stakeholder choice from among the various themes modelled as sub-systems by SSM. Decision-making within this complex situation is difficult with so few definitive guidelines. Utilizing SSM problem structuring provides a tool to highlight how potentially significant the impact of stakeholders can be in influencing both conception of the scheme and the decisions that are taken.

6.6 Conceptualising Relevant Systems

Six conflicting themes (see Table 6.1), identified by multiple stakeholders as barriers to the development of hydroelectric power, form the foundation of the problem situation in this case study. Having identified these relevant themes, systems thinking can be used to further understand how they function both independently as sub-systems, and as a larger system. Within the framework of SSM, prior to development of conceptual models, it is necessary to characterize the function of the system. The development of root definitions allows problem themes to be modelled as a system of fundamental activities. Each individual root definition captures a particular worldview and thus may limit or exclude certain activities. Checkland (1979) provides guidelines for the development of root definitions through the acronym CATWOE (Table 6.3), suggesting that each definition includes the Customer, Actor, Transformation, Weltanschauung, Owner and the Environment involved. The term ‘weltanschauung’, also known as a worldview, refers to the fundamental cognitive orientation of an individual; essentially how each of us perceives the world. From each root definition, a conceptual model was built, identifying the minimum activities necessary for the system to function and the relationships between them.

Construction of a waterwheel was established as the primary function of the situation and was defined and modelled conceptually as:

"A system developed by the Mill Owner, to transform a redundant turbine into an operational, aesthetically pleasing waterwheel with no maintenance requirements. Achieved by wheel design and construction stakeholders, the system delivers benefits to the Mill owner and customers while including measures to mitigate against any potentially negative impacts to the natural river system and fish populations. To maximise profit margins, establish long term energy security and meet public environmental expectations of the business. Activities occur in the face of an economic downturn, rising energy prices, local competitors, in addition to increased interest in green energy following concerns over climate change, and environmental concerns over the negative impacts of hydropower development."

This definition was utilized to construct the main nodes of the conceptual model, and model was built by identifying the minimum activities necessary for the system to function and the relationships between them. Root definitions of problem themes (Table 6.3) provide the basis of conceptual model; which having been developed separately, were mapped onto the main system as a series of subsystems of a larger waterwheel construction system. The concept of modelling the natural river system did not originate from the rich picture, or from stakeholder problem analysis. In another study employing SSM, Bunch (2003) highlights that rivers were perceived in terms of their social functions. Thus to allow truly sustainable solutions to develop, the biological and physical elements of the natural system must be considered. Biophysical elements are typically modelled in a generic manner due to incompatibility with the CATWOE techniques (Bunch, 2003). The use of sub-systems differs to that of traditional SSM where they relate to system hierarchy. In this case they denote the actions which must take place to systematically achieve a given root definition. As a result, at any given system node there may be multiple sub-system activities from numerous root definitions. Draft models were presented to stakeholders for annotation and validation.

The appreciation of the system gained through interviews led the author to conceptualise the situation as a waterwheel construction system, where a redundant wheel pit is transformed into an operational, aesthetically pleasing waterwheel with no maintanence requirements, to reduce costs and energy usage. This formed the definition of the primary system (Figure 6.4 Nodes A-H). This construction is concerned with a number of other themes championed by stakeholders and these form the various root definitions of the sub-systems. Not all possibilities were defined and modelled; six of the nine conflicting themes (Table 6.1), identified by multiple stakeholders as barriers to the development of hydroelectric power, form the foundation of the problem situation in this case study. The various CATWOE components of these root definitions and associated stakeholders (Table 6.3) highlight not only the conflicting stakeholder requirements of the waterwheel design, but the range of different actors and owners perceived to be involved. These components highlight the different conceptions of the system associated with different worldviews, and produced significantly different sub-systems to achieve the primary activity.

Table 6.3- CATWOE Components of Root Definitions and Associated Stakeholders

Theme of the system	**Power generation**	**Cost reduction**	**Customer attraction**	**Legislation**	**Fish passage**	**Natural river**
Customer	Mill owner	Mill owner	General public	Natural world	Fish populations	River system
Actors	Wheel Engineers	Wheel Engineers	Media	Wheel Engineers	Wheel Engineers	Natural world
Transformation	Kinetic to electrical energy	Investment to long-term savings	Existing restaurant to one with unique feature	Legal requirements to compliance	Downstream to upstream movement and vice versa	Continual physical and biological change
Worldview	Renewable energy will ensure long term energy to the mill	Reduction in utilities costs will increase profit margins	Public awareness and expectations of businesses are high	Environmental protection / renewable energy needed	Fish represent an ecological and economic resource	Fluvial systems are vital to ecosystem health
Owners	Mill owner	Builders	Mill owner	Government	Regulator	Riparian Owners
Environment	Rising energy prices and interest in green energy	Economic downturn.	Competitors within the New Forest	Reduced CO_2 output and maintains of environment	Social and economic pressure to maintain fish populations.	Water flows to sea, along continuum of biological and physical change
Associated Stakeholder	Engineering Researchers	Mill Owner	Mill Owner National Park Authority	Regulator	Regulator Environment researchers	Regulator Environment researchers

Having identified these sub-systems, systems thinking can be used to further understand how they function both independently as sub-systems, and collectively as a larger system (Figure 6.4). The conceptual model illustrates the high degree of complexity involved. Node A requires the collection of data from a variety of sources; the conceptual model does not allow for inability to access data nor does it account for what actions should be taken in their absence. Conflict within the system is easily identifiable at Node C; deeper understanding is limited by what is technically and economically feasible. Inability to solve conflict and implement a sustainable solution or unwillingness to navigate conflict via tradeoffs between sub-systems would prevent further movement through the system at this point. The system is regularly influenced by external factors, thus there is potential for changes in the status quo of the system.

At other nodes, multiple interacting sub-system activities do not directly conflict with each other; however, their pattern of influence varies. Consideration of cost features heavily at Nodes A and B; at Node B, activities are assessed based on their economic merit, while at Node F, success is measured in economic terms. The natural environment system generated very few activities when considered in relation to other sub-systems (e.g. power generation potential). Whether this is representative of the system or it signifies poor transference of environmental concepts into systems thinking is uncertain. Activities within the conceptual model were attributed to stakeholder control or influence.

All internal and external stakeholders were able to exert a degree of influence at Node A, via the provision of data; collation, analysis and interpretation of these data are controlled by the owner, noted at Node C. In the latter stages of the model (Nodes E-H), the owner has sole control but the success of the project is influenced by potential external socioeconomic changes and potential future environmental change.

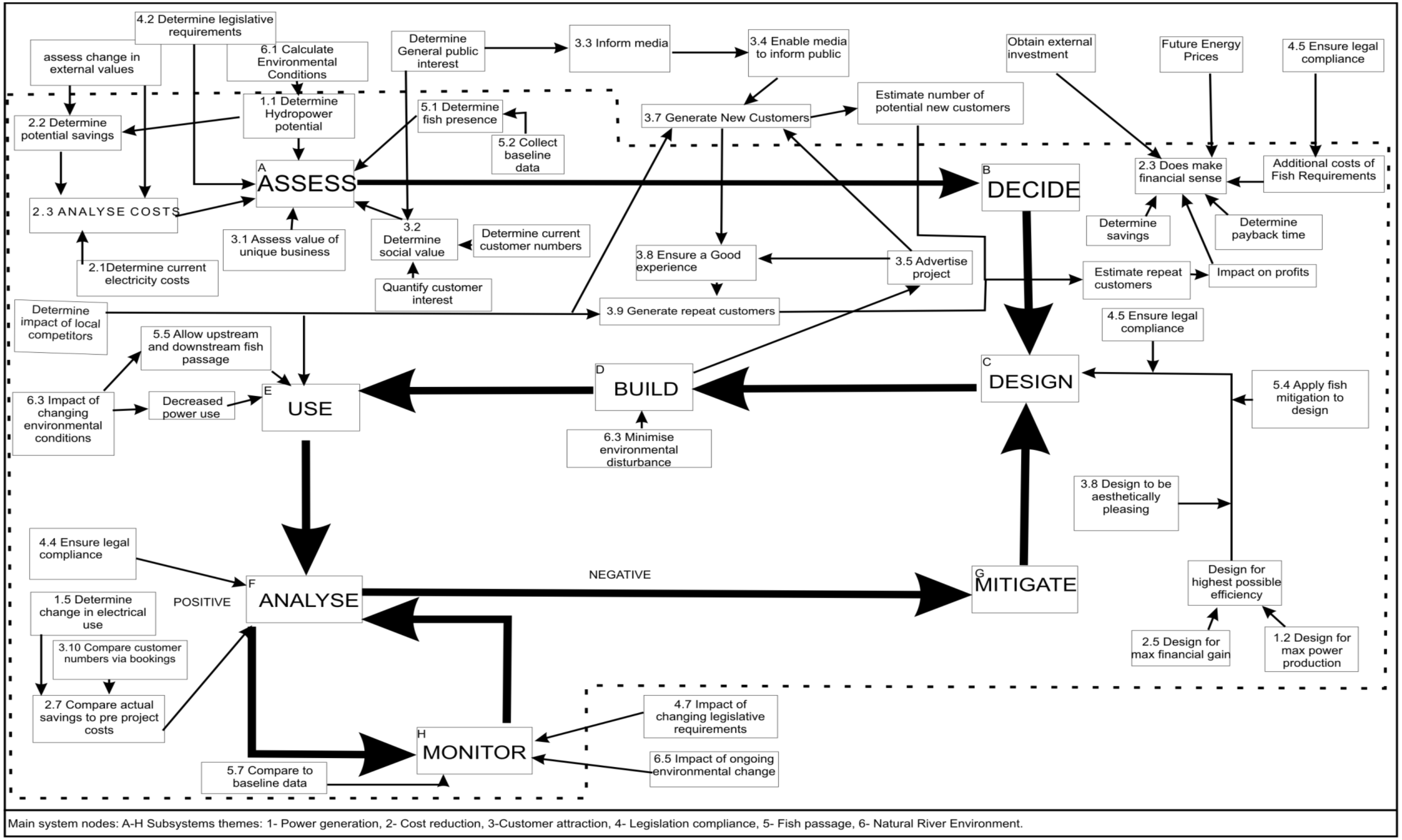


Figure 6.4- Conceptual Waterwheel Construction Model including Sub-systems

6.7 Comparison and the Way Forward

The final stages of SSM involve comparison of conceptual models and the problem as it exists in reality. Comparison can be undertaken using one of four techniques: (a) using models as a basis for ordered questioning, (b) informal discussion around models, (c) comparison with a historic case or a given scenario, or (d) by modelling reality and drawing direct comparison(s) (Checkland, 1981; Checkland and Scholes, 1990). In this case, the latter method was employed to highlight the impact of stakeholders and their worldviews on project development. The two models were presented simultaneously to stakeholders who were invited to consider why they were different.

A systems model of the problem situation in reality was developed (Figure 6.5), independent of different worldviews, by modelling actual activities already undertaken and those planned for the future. A direct comparison of the two models highlights the differential complexity of both systems. Initial comparison emphasizes two different problem-approach structures. The conceptual model has a largely linear process with a positive feedback loop in the latter stages. Assuming sub-system conflicts are resolved, this results in the construction of the waterwheel. The model of reality shows past activities (Nodes A-F) and those planned in the future (Nodes H-K). The structure in this model is linear but with a negative feedback loop in the centre, causing stagnation at Node F. Information (Node G) is the barrier to progression. Until resolved the system rests at Node F. Once sufficient data are gathered, the system resumes its linear progression. The model of reality is more complex and does not assume construction of the waterwheel as the end product. Both models recognize that information is crucial. The conceptual model identifies the diversity of information needed in the early stages. In reality, gathering of information has been an iterative process, gathering data as the need arose.

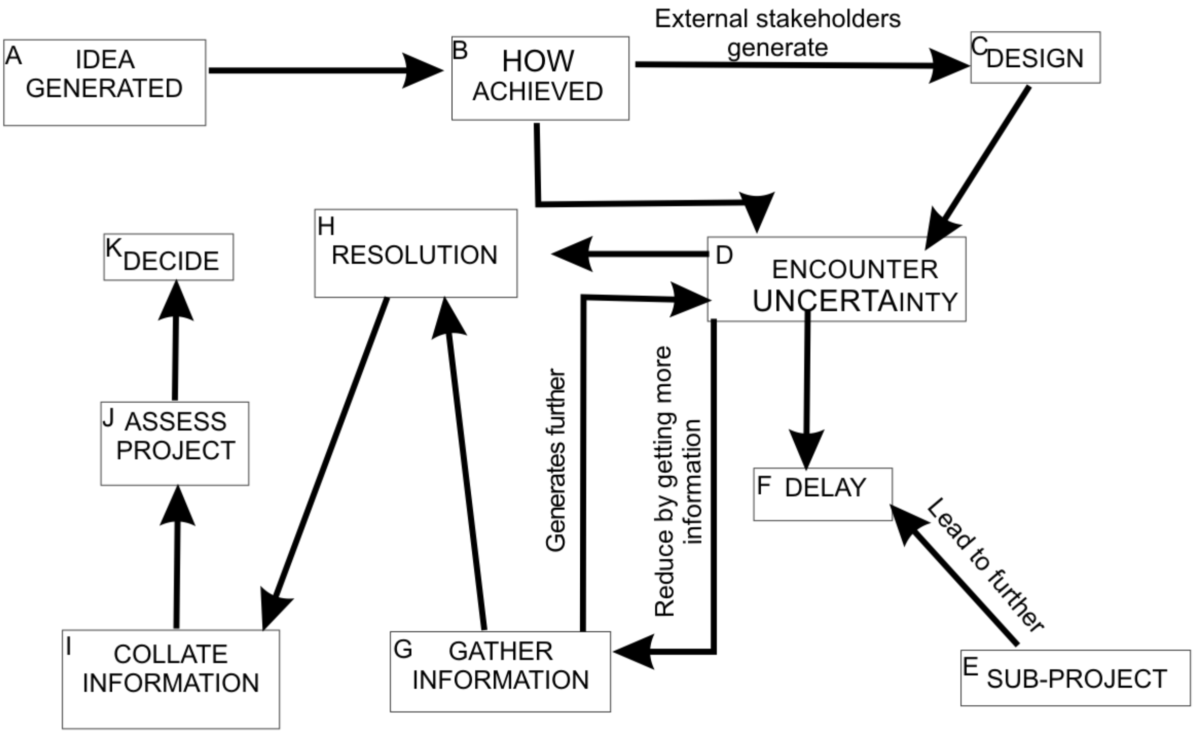


Figure 6.5- Systems Model of Actual Activities at Gordleton Mill

In discussions with stakeholders, the conceptual model (Figure 6.4) was recognized as being idealistic, and that in reality many of the activities generated could not take place simultaneously as sub-systems were not mutually exclusive. The model of reality (Figure 6.5) did not highlight specific activities to be undertaken or recognize this. That all the associated sub-systems cannot in reality be methodically incorporated into the waterwheel development and construction is significant. It highlights the need for choice, which is in turn influenced by perceptions and understanding of both the situation itself and the associated risks involved. Social characteristics of the decision-maker and relevant stakeholders are therefore important. It is inability of the primary stakeholder to take decisive action (whether the correct course or not) which generates uncertainty and subsequent delay.

6.8 The Role of the Stakeholder

Numerous problems were noted during project conception at the initial planning stages. Identified as the first and largest problem to overcome was "*how to put a hydro installation into the existing wheel pit*" (Cottingham, personal communication). Driven by an operator with no technical expertise, development has been difficult with no clear indication of "*where to go to get advice*" (Cottingham, pers.comm.). Since then documentation has been developed and published (Environment Agency, 2009b) but lack of information has been a crucial factor in shaping the role stakeholders have played. The stakeholder role was to provide information and expertise to aid development of a solution to a complex situation. Perception of the optimum solution was a function of individual beliefs, values and worldviews, highlighted by the differences between root definitions (Table 6.3) where each stakeholder has significantly different criteria. Thus there was considerable scope to introduce bias to the decision-making process. The provision of conflicting requirements significantly enhances the perceived complexity of the task significantly beyond the initial conceptions of the primary stakeholder. In this case where the primary stakeholder does not have access to the necessary skills and information to formulate an independent solution at no further cost, it significantly altered her perception of the task to be performed. As a result barriers of uncertainty that may be easily overcome by an experienced developer are significant in this case and prevent a sustainable technology from being deployed. Understanding how these behaviours and perceptions affect the decision-making process is crucial to identifying barriers to the implementation of sustainable hydropower.

6.8.1 Favouring financial decision-making

Analysis highlighted that stakeholders favoured financial decision-making, causing it to be modelled as an entire sub-system. Outputs from various stages of SSM highlight that economics was the primary concern. Cost was the most widely perceived barrier and a central factor in both the design and success of the wheel, despite recognition of numerous other socio-environmental issues. The need for economic viability was a function of both business concerns and human decision-making. Decision-making techniques at the project level are dominated by conventional cost-benefit analysis, where only the quantified direct costs and benefits are incorporated into the analysis (Tiwari *et al.*, 1999). Numerous techniques, such as the ecosystem approach, exist to quantify socio-environmental variables in an economic capacity, and could be a useful tool for future decision-making. In the context of Gordleton Mill, a fully comprehensive approach was difficult to apply due to lack of information and associated costs; but was notably absent given the sustainable themes of the business. If economic constraints were removed, a sustainable solution could be engineered given appropriate technical expertise; in reality socio-environmental sub-system activities will be traded off against each other on the basis of financial gain, legislative requirements and the presence or absence of stakeholders to support them.

6.8.2 Imbalance of stakeholder consultation

In terms of stakeholder involvement, there was an imbalance of consultation (Table 6.4). The mix of stakeholders involved with the Gordleton Mill project influenced conception of the problem, which is perhaps best highlighted by the issue of environmental mitigation. Over the project lifespan, as the number and range of stakeholders changed, the issue of environmental damage was more strongly represented and biased towards fisheries' concerns over engineering interests. Despite wider stakeholder consultation on the environmental issues and similar levels of legislative support, fish passage was more frequently perceived as a problem, and more frequently discussed locally (within this case study) and at the national scale.

This debate raises the question of whether it is the issue itself which is significant or the number of people who champion it, that make it such a significant issue in this case. The issue of fish passage has historically been a prominent feature of the hydropower debate (Reid *et al.*, 2004), and remains central to the discourse. The disparity between the precedence of fish over the river itself was somewhat paradoxical given that the two are not mutually exclusive. While there is no evidence to suggest that potential alterations will impact fish habitat availability, it is a dimension which has not featured significantly within discussions. Disassociation of passage issues from potential habitat changes is of interest, particularly as both will determine the long-term success of fish populations. An interesting point to consider is whether this is a reflection of trends within the wider hydropower industry or a reflection of this case study.

While widely discussed there was a lack of consensus among stakeholders as to exactly what measures were required. Within the conceptual model this debate was not recognized, and therefore does not provide a method through which options can be chosen. The recommendations selected for action will be a function of perceived power, and are likely to favor the regulator's criteria.

Table 6.4- Comparison of Environmental and Engineering Stakeholders Consulted

	Directly Involved (in SSM)	Indirectly Involved (via project work, etc)	Total
Environmental stakeholders	3(2)	2	5
Fisheries interests	3(2)	2	4
Engineering stakeholders	1(1)	3	4
Hydropower specialists	1(1)	1	2

6.8.3 Response to uncertainty

Using SSM acknowledged the various conflicting themes and gave them equal power in the conceptual model via their transference into sub-systems, reinforcing the difficulty of the situation. Solutions generated to resolve one theme created challenges in another, suggesting that achieving a truly sustainable approach to hydropower development will be unlikely and instead involve the establishment of tradeoffs. The nature of these tradeoffs will be dependent on the worldviews of the stakeholders involved, the information available and the manner of its communication amongst stakeholders prior to decision making. The potential for uncertainty was a major barrier to project progression, but was not recognized within the conceptual model; therefore no mechanisms to reduce it were developed. In reality, information is required to reduce uncertainty. That uncertainty represents the absence of information is widely accepted (Downey and Slocum, 1975; Tushman, 1979). In the case of Gordleton Mill, however, as further information was collected, more themes were exposed, thus generating further uncertainty and the need for more detailed information. The gathering of information is therefore an iterative process, as further understanding distills new challenges that need to be overcome.

6.8.4 Differential control

At Gordleton, the owner acted as a central hub of information, but was limited by the extent of their knowledge of hydropower and their worldview of the situation. To reduce uncertainty, the primary stakeholder engaged multiple stakeholders in series, each introducing both new themes and data obtained within the context of their own worldview. Alongside the introduction of new information each stakeholder generated equivocality, the existence of multiple and conflicting interpretations of the situation (Weick, 1979; Daft and Macintosh, 1981). As equivocality increases, so too does confusion over what information is necessary to reduce uncertainty. Work by Daft and Lengal (1986) notes that in situations with high uncertainty and high equivocality, rational data collection may obtain some answers but other elements require subjective judgments and discussions. The effect of ambiguity will be to impact on choices (Elsberg, 1961), but discussion of how this takes place varies. Bettman (1979) views ambiguity (in this context) as perception of risk. Thus response to ambiguity is dependent on an individual's values and perceptions of probability (Smith, 1969) and psychological tolerance of the risk involved (Kahn and Sarin, 1988). These factors will generate a behavioral bias.

6.10 Discussion and Conclusions

Soft systems methodology (SSM) was applied to the issue of development of micro-hydropower to explore the nature of the problem and to identify conflict potential and its impact on development at Gordleton Mill. Conflict centered on the issues of design, economic viability, lack of data for decision making and differential stakeholder values. Costs were highlighted as the key determinant of project approval and were the predominant criterion for success of the project. Despite a holistic approach, environmental and social issues were secondary to economic concerns. The ability to assess the project in economic terms was limited by availability of data. In this case, conflict resulted in stagnation; the primary stakeholders retained control over decision-making but lacked the data to force a decision. Alongside conflict identification, the implementation of soft systems methodology was intended to generate a new understanding of the problem. This was done via stakeholder re-engagement and re-establishment of information flows in an attempt to induce action where other approaches had failed. Consideration of Gordleton Mill as a socio-economic system of interacting sub-systems and actors, generated a new understanding of how the actors involved had shaped the situation. If fewer stakeholders had been engaged the problem may have been of low complexity and high feasibility, but here generated a poor solution. Multiple stakeholders were engaged to generate a high quality solution, but a lack of technical understanding led to dependence on data from stakeholders developed in the context of their own views and opinions of what constitutes a good hydropower development.

Inability to evaluate these views impartially – that is separating data from opinion - has led to uncertainty and project stagnation. Tensions between the need for broad stakeholder consultation and consensus are widely noted in decision making (Child, 1972;

Mitroff, 1982) as well as within sustainable development literature (Leeuwis, 2000). All note that engagement is needed to generate innovative solutions but, to be effective, outputs must be agreed. Conflict and its resolution are thought to be the appropriate mechanism to achieve both, suggesting that a conflict-based approach may successfully address sustainable development disputes. Daniels and Walker (2001) highlight a number of cases whereby the collaborative learning informed by conflict management has been successful in environmental fields. The role of social characteristics, in particular worldviews, was found to influence information and communication, by impacting on decision-making, and should be incorporated into conflict methodologies.

With regards to the development of a waterwheel at Gordleton Mill, whether a viable solution is achievable in the future remains unknown. Introduction of government support mechanisms have significantly altered the costing of the project, but impact on economic viability cannot be assessed. Under current and proposed future legislation, fish passage mitigation will be required. Further data are, however, needed on fish movement through the current system to fully understand what requirements will be necessary. Given that further investigation will incur more costs, willingness to undertake further study may be limited. At present, the situation remains stagnant, although the problem definition has changed. Prior to the application of SSM the aim was to solve and build a waterwheel at Gordleton Mill. The focus now is to decide whether to continue to find a solution or to cancel the project.

Soft systems methodology informed the development of a collaborative problem definition and the identification and conceptual modelling of relevant systems, via both underlying theory and a number of key techniques. Approaching the problem situation within the context of systems thinking has led to the conclusion that the role of the stakeholder is significant within hydropower development conflict. In this case, the stakeholders engaged and their perceptions of the problem shaped investigation of the issue and thus the resultant data generated for decision makers. Better understanding of the role of the stakeholder is a key learning outcome from this study. The use of SSM allowed formalisation of relationships between problem themes without the requirement to quantify them. This revealed intangible factors which were crucial to the development of the problem situation but which may have been overlooked if more traditional research paradigms had been used. The successful use of SSM within the problem of environmental management conflicts has been noted by others (Allen *et al.*, 1994); while using SSM in partnership with an ecosystem approach, SSM was recognized as a tool for making sustainability concepts operational. Although this work has not led to an operational solution at present, there is scope to use outcomes to shape development of a sustainable solution should there be sufficient change within the system. Work by Bunch and Dudycha (2004) exemplified this idea, using the development of conceptual models to develop a decision-support system. While such an approach is not possible in this case due to lack of information, it may become an option in the future. By generating a heightened understanding of the situation, the actors and the relationships between them, there is an opportunity to use this knowledge in the future as part of a formal or informal decision support system. The lack of successful facilitation of action may be linked to the timing of the application of SSM. Pondy (1967) notes the importance of timing within conflict scenarios; based on this it is possible that earlier engagement in the SSM process would have provided a structure to facilitate collaborative problem development and may have yielded different results.

The issues raised in this chapter have significant implications for management of sustainable development. The most prevalent is that while a definition of sustainability and its specific practical implications remains ambiguous, the nature of actions taken will be dependent on the people involved, their worldviews and the nature of their interactions with each other. There is therefore sufficient scope for the gap between the notion of sustainable development and its realisation to be significant. This raises fundamental issues that will determine the nature of sustainable development in the future:

1. The importance of stakeholder selection: who is invited or excluded could potentially alter conception of the problem and resultant solutions generated.
2. Scientific research will not provide all the answers alone. Information must not only be available but it must be communicated, and thus is exposed to social effect. The development of mechanisms which consider not only these social effects, but also consider issues holistically and their impact on decision-making is crucial in facilitating solutions.

Further work is needed on the application of SSM to this type of problem, to determine the extent of the role which it can play in sustainable environmental management.

Chapter 7 Moving Through Impasse to Implementation: Conflict in the Severn Estuary

Chapter Summary

As conflict over environmental management becomes more prevalent, uncertainty as to the appropriate course of action has in some cases caused decision-making to stagnate. Combined with a growing pressure to address anthropogenic concerns, increasingly impasse situations emerge where a decision cannot be taken but simultaneously nor can it be abandoned. Attempting to move from these stalemate situations is difficult due to significant physical, social and informational complexity. To facilitate movement through impasse, both a greater understanding and tools to guide change are required. This chapter presents an approach to identify and critically discuss the nature of environmental impasse, in relation to cases of enduring environmental conflict.

Using the case of tidal power development in the Severn Estuary (UK) as a case study, force field analysis was used to conceptualise the impasse. Through literature review and stakeholder surveys, barriers and opportunities for the development were identified and analysed. Uncertainty (across numerous fields) was identified as the largest resisting force, inability to remove it represents a significant barrier to change. Analysis highlighted the impasse was not held in an equilibrium, suggesting that barriers remain constant once established while opportunities diminish over time. Historical analysis of the case highlighted a cyclical pattern over time which corresponds with shifting forces. Conceptualising opportunities and barriers as a set of opposing forces significantly enhanced understanding of the impasse. Furthermore, it highlighted that conflict was both a cause and consequence of impasse. While further work is needed to study its mechanics, it is proposed that actively managing change represents a tool for facilitating movement from situations of impasse through to implementation.

7.1 Introduction

Conflict creates dilemma; participative environmental management is recognised to simultaneously improve decision quality (via enhanced innovation - (Murray, 1978) and greater cognitive diversity - (De Dreu and Van De Vliert, 1997), but reduces ability to work together - (Schweiger *et al.*, 1986; Schwenk, 1990). The result is a paradox (Slatte, 1968; Gaenslen, 1980); decision quality, and consensus are necessary for strategic decision-making, yet, in many ways are contradictory (Amason and Schweiger, 1994). In some cases, the multitude of perspectives and problem elements presented creates a complex scenario, where for the decision maker(s) navigating through conflict and reaching a collaborative decision seems unfeasible, creating an impasse. Many environmental conflicts experience this, and as a result long standing tensions which defy resolution occur (Lewicki *et al.*, (2003). Stuck in an impasse, over time functional benefits which yield better understanding become limited and awareness of dysfunctional elements which prevent consensus remain, acting as a barrier to implementation.

Cases where stakeholder consultation has enhanced understanding but highlighted further issues and uncertainties, which enhance problem complexity, have been noted (see Chapter 5 and 6). Uncertainty and its associated concepts, such as risk and ambiguity, are prominent features of decision-making (March and Olsen, 1976; Kahneman *et al.*, 1982). Recognised as ubiquitous in everyday life, uncertainty and ambiguity represent a major obstacle to effective decision-making (Corbin, 1980; McCaskey, 1982; Brunsson, 1985). Uncertainty is often associated with the absence of information; Wynne and Mayer (1993) suggest that ignorance is a better description of its role in environmental scenarios, as it emphasises that what is unknown is just as significant for policy and decision-making, as what is known. Ambiguity relates to project definition (Dewulf *et al.*, 2005), and is a function of the multiple conflicting interpretations presented by the stakeholders involved. Presented with contradictory information, opinions, and arguments, selecting a course of action from a number of options may be a significant challenge to decision makers. As a degree of conflict is required for effective decision-making, it cannot be avoided, but is not always resolved resulting in stagnation. Unresolved conflict can create intricate problem scenarios characterised by physical (associated with the nature of the problem to be resolved), social (associated with the relationships of the people involved) and informational (associated with the degree of uncertainty and ambiguity) complexity. Making strategic decisions within such an environment is a significant challenge.

Faced with environmental decisions which are inherently complex and urgently needed, there is a significant need to facilitate action. One example of such a case is the need to facilitate strategic decision-making to begin to address climate change. There is little doubt among both scientists and politicians, that due to global concerns over climate change, the twenty-first century will be one where issues of climate, energy and resources are paramount (Szerszynski and Urry, 2010). Facilitating an effective management response will therefore be crucial for the future of global populations, but represent issues which are beset by conflict. In attempting to address energy concerns, many renewable technologies face significant difficulties in becoming established, largely due to social or institutional conflicts (Elliott, 2000). In the UK, there have been numerous cases of conflict in response to the development of renewable technologies, including biomass energy plants (see Upreti and van der Horst, 2004), placement of waste management facilities (see Andrew, 2001) and the construction of wind farms (see Wolsink, 2007). With an expanding population, current trends in consumer demands, and with ambitious carbon emission targets (60% reduction by 2050 in the UK) there is a significant pressure to find renewable alternatives to traditional fossil fuels. This creates pressure for development, while uncertainty and ambiguity restrain it; decision-making becomes stuck in a situation of impasse whereby the best course of action is not known and may carry significant unknown risks. Situations therefore emerge, whereby the need for action is counterbalanced by risk of implementing the wrong solution. With the implications of taking no action potentially as significant as the risk of selecting the wrong option, there is a need to facilitate definitive decisions (including decisions not to develop) to allow strategic action towards addressing climate change and appropriate allocation of resources.

Facilitating action, despite a problem which is complex, uncertain and the subject of significant stakeholder conflict, represents a considerable challenge. Difficulties in facilitating implementation of research into tangible action are noted across numerous fields, including health interventions (Haines *et al.*, 2004), and policy transference (Watts and Selman, 2004). This ‘knowing-doing gap’ (Pfeffer and Sutton, 1999) is also widespread in many applied sciences, including organisational science (Dunbar and Starbuck, 2006), environmental psychology (McKenzie-Mohr, 2000), ecology (Ehrlich, 1997), and ecosystem management (McNie, 2007). In an attempt to bridge this implementation gap, focus is on planning for change and actively managing the transition towards it (see Pfeffer and Sutton, 1999). It is proposed that undertaking the same approach for cases of environmental impasse, whereby conflict *per se* is important, but how to move out of it is more so, will yield insight into their nature. Work by Lewin (1936; 1947; 1951; 1980) on field theory, group dynamics and action research, represents one of the earliest robust approaches to planned change. Lewin based his work on the notion that any situation could be understood by conceptualising "the present situation" –the status quo- as being maintained by certain conditions or forces (Lewin, 1947) and that once identified, they could be strengthened or diminished to bring about change. It is proposed that analysing situations of environmental impasse in the same manner will aid understanding of why decision-making stagnates and facilitate action.

Lewin's (1951) planned change model is offered as a theoretical framework to analyse cases of environmental impasse, provide strategic direction to decision-making and help to facilitate implementation. Lewin's (1951) planned change model involves three stages: unfreezing, change (moving), and refreezing. While to implement successful change all three must be addressed in succession, this chapter focuses on the movement stage and how to facilitate transition from unfreezing to refreezing. The chapter aims to identify and critically discuss the nature of environmental impasse in relation to cases of enduring environmental conflict. It is proposed that better understanding of the impact of conflict on the creation of persistent problems and decision-making processes, will aid the transition through impasse to implementation. Lewin's (1947:1951) theory of planned change is applied to the case of the Severn Estuary, where potential development for tidal power is the subject of long-standing tension. The chapter investigates the extent of the stakeholder perceived force-field surrounding this issue, and analyses it to yield both understanding and suggestions as to how movement may be achieved. While the subsequent analysis is case specific, the approach is intended to be transferable, and is used to advance conceptual understandings of the impact of conflict. Force-field analysis (FFA) is used as an analytical exercise, to assess stakeholder perceptions of the current situation and as a tool for selecting and assessing action strategies.

7.2 Case Study: The Severn Estuary Hydropower Proposal, UK

The potential for development of the Severn Estuary for tidal power provides an example of a situation where strategic decision-making is prevented by a lack of consensus and complexity, creating an environmental impasse.

Only approximately thirty sites in the world have been identified as suitable for tidal power stations (Charlier, 2003), of them the Severn Estuary is of particularly interest due to its high tidal range (Roberts, 1980; 1982; Kerr, 2007). While this makes it attractive for renewable energy, the estuary has a high nature conservation interest, due to its 22,000 ha of intertidal habitats and unique features such as salt marshes and mobile sandbanks (English Nature, 1997). Damage from the development of tidal power schemes is potentially significant but largely uncertain, presenting an acute environmental dilemma - the prospect of more renewable energy versus damage to arguably one of the UK's most important nature sites, and the subsequent biodiversity loss. Faced with a decision which is inherently complex, urgently needed (in terms of renewable electricity production, reduction in CO_2 emissions, increased regional economic investment), but simultaneously carries significant unknown risks (potential damage to estuarine habitats and biota, public discontent and economic losses), the impact on the decision-making process has been profound.

7.2.1 Study Area

The Severn Estuary constitutes a large, semi-enclosed water body in the south-west of the UK (see Figure 7.1); its exact boundaries vary in definition. With one of the most extensive catchments in the UK fed by numerous tributaries (Rivers Severn, Wye, Usk, Avon), the Severn Estuary is a high energy system with a hyper-tidal, semi-diurnal tidal range (Langston *et al.*, 2007). High turbidity creates an ecologically suppressed environment (Kirby and Shaw, 2005), and while harsh conditions yield little productivity (DECC, 2009), it generates unique habitats (DECC, 2010), supports a large and diverse bird population (English Nature, 1997) and is important for migratory fish movements (populations of Atlantic salmon (*Salmo salar*), shad (*Alosa alosa* and *Alosa fallax*), river and sea lamprey (*Petromyzon!marinus*/*Lampetra fluviatilis)* and eels (*Anguilla Anguilla*)). It also contains one of the largest aggregations of salt marsh habitat and is the largest coastal plain estuary in the UK (English Nature, 1997). The estuary's high nature conservation interest is reflected in numerous national and international designations, including Special Protection Areas, Special Sites of Scientific Interest, Ramsar sites and is part of the Natura 2000 network[5].

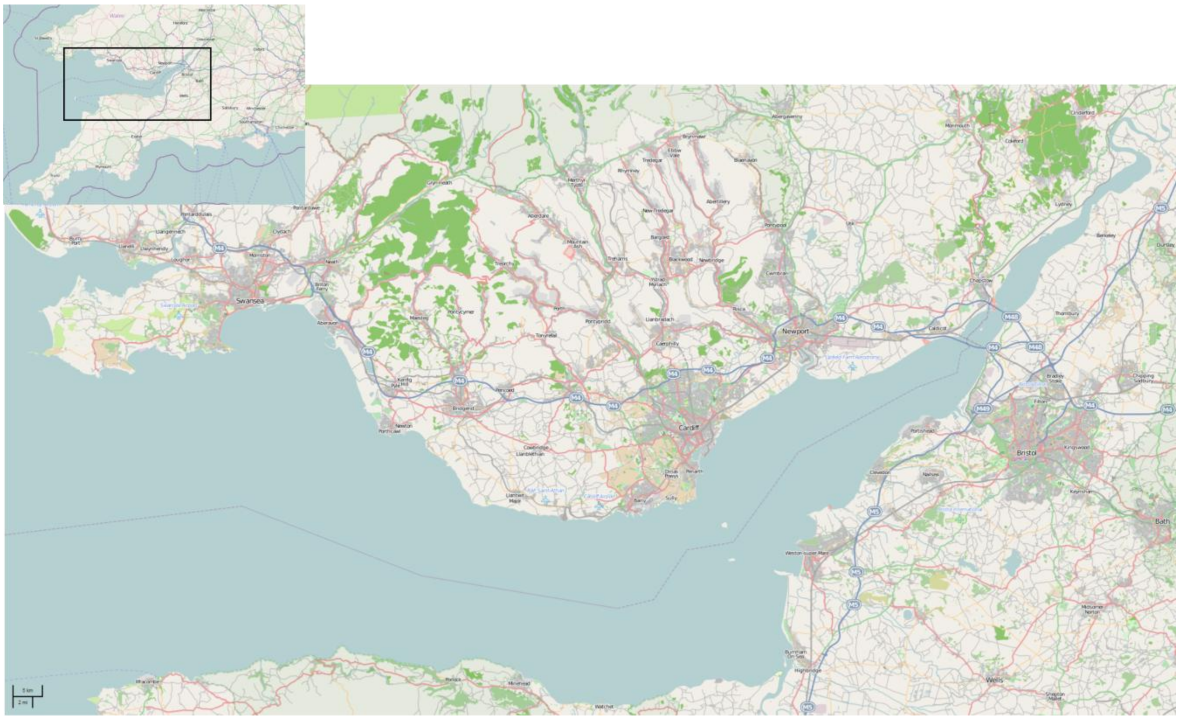


Figure 7.1- Location of the Severn Estuary, UK. (*Source: Open Street Map*)

Human usage of the estuary dates back to the Romano-British and medieval periods, developed for trade and reclaimed for agricultural purposes (Rippon, 2000). The Severn Estuary has a primarily urban coastline, reflecting the historical evolution of industry and seaports. The largest urban areas include the cities of Cardiff, Newport, Bristol and Gloucester, with principal ports at Newport, Bristol, Cardiff, Port Talbot and Swansea (Severn Estuary Partnership, 2001). A wide range of anthropogenic uses are represented in addition to shipping, including power stations, industrial interests, aggregate dredging, waste disposal, and flood defence. In addition, there is considerable coastal tourism, recreation and agriculture in the area (Ballinger and Stojanovic, 2010).

[5] Natura 2000 represents a network of protected areas for seriously threatened species and habitats across Europe.

Infrastructure projects related to the Severn Estuary date back to the nineteenth century, considered for improved transport, flood defence, harbour creation and power generation. The feasibility of harnessing the power of the Severn Estuary's tidal bore has been investigated *circa* 1918. Maxtone-Graham (1977), in reference to pre-1975 considerations highlighted that plans for the Severn seemed almost certain to go ahead on multiple occasions, but were then abandoned. Over time it has been periodically revisited, and subsequently dismissed. A historical review of these investigations in relation to study findings is presented in section 7.5.

The issue of Severn tidal power is multi-faceted, highly complex and largely uncertain; as a result it is difficult to communicate the dilemma in detail. The problem is therefore expressed using a simplified overview of the problem situation (Figure 7.2), similar to the rich pictures utilised in previous chapters. Unlike "traditional" rich pictures, the information presented does not include stakeholder perceptions of the situation, obscure or unreported dimensions may therefore be absent. While the physical problem to be addressed and its associated uncertainty represent a complex challenge for decision-making, it is arguably the associated social issues which create the environmental impasse. If not the focus of social concern and subsequent debate, issues of environmental impact may not represent the barriers to development they currently do. Choosing among options is highly complex as each is associated with differential advantages, possibilities, costs and limitations, which are perceived differently by the people involved. The diversity of opinions and perceptions involved in the case of tidal power in the Severn Estuary is a function of the stakeholders involved. Those involved vary significantly in terms of interests and roles, and include: central, regional and local government, industrial representatives, specialised consultants and academic institutions, non-governmental interest groups, local actions groups and registered environmental charities.

Due to the intricate mix of stakeholders, the complexity of the problem to be addressed and the significant uncertainty, there is considerable conflict as to what the appropriate course of action is. Much of the debate centres on barrage options, in particular the Cardiff-Weston scheme. While the full extent of the debate is complex, every position occupied involves a diversity of arguments; two examples of the disparate arguments involve are presented below.

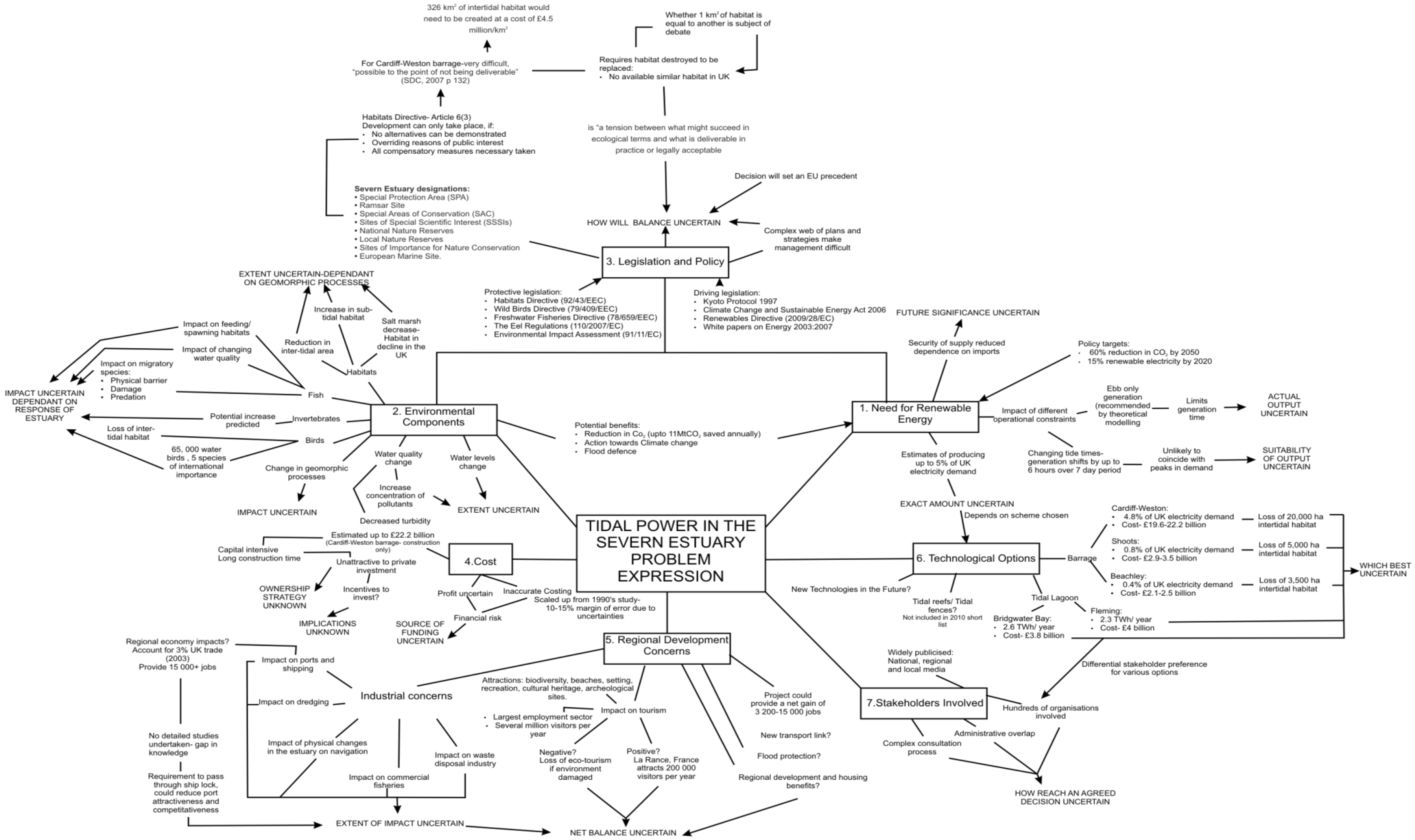


Figure 7.2- Overview of the key problem elements in the proposed development of the Severn Estuary.

For a Barrage Scheme

"*Climate science is telling us that we will have to reduce our carbon emissions to near zero by 2050, if the rest of the world is to have any chance to develop at all, so we must take all options for Severn tidal power very seriously indeed. The Cardiff-Weston barrage could be sustainable if it passed two tough tests. The first is EU law: breaching the Habitats and Birds Directives would set a dangerous precedent. The second is the public interest- we said that any scheme must be publically managed and owned. The barrage is a player for 2050, as are the newly emerging tidal fence and tidal reef technologies which might have less environmental impact. Ironically, a smaller scheme could also have significant environmental impact, while being too small to help much in the energy mix and hived off entirely to the private sector to boot*." Andrew Lee, Chief Executive, Sustainable Development Commission, published in the Daily Telegraph, 27/01/2009.

Against a Barrage Scheme

"*For the amount of energy produced, a Severn barrage would be too damaging to the ecological features and species of international importance in the estuary- even given that climate change and sea level rise would be gradually affecting habitats. At a cost of around £15 billion it would be uneconomic, and public funds for "climate mitigation" projects could be better spent generating more energy in a shorter period of time from alternative renewable and or low carbon schemes. The barrage would preclude the building of large tidal lagoon impoundments and other tidal schemes in the Severn Estuary from Bridgwater bay eastwards, which may amount to considerable electricity and storage potential, and it would generate large amounts of electricity in two pulses of around four hours each day, which would not necessarily match high demand, and create problems for the national grid*" Gordon James, Director, Friends of the Earth, published in the Daily Telegraph, 27/01/2009.

While these extracts represent a small sample of the debate that surrounds the issue of tidal power in the Severn Estuary, each contains claims which are valid, yet simultaneously incompatible. Both speakers represent key organisations, whose positions add authority to their arguments, and could support claims with evidence. Based on these extracts determining what action should be taken is difficult; when placed in the context of hundreds of differential arguments, deciding what is the appropriate decision is ambiguous.

7.2.2 Problem Definition

The physical and social complexity of the issue, combined with the high degree of uncertainty as to what is the ‘best’ course of action, creates a situation of environmental impasse. Using the Severn Estuary for tidal power cannot be dismissed due to its renewable energy potential, but threat of environmental damage and associated uncertain socio-economic impacts remain a barrier to development. While at present plans have been ‘shelved’ due to financial concerns (SDC, 2007), the project has not been abandoned, with the government suggesting they may be revisited in the future (see SDC, 2007). The amount of resources to date committed to a scheme which may not go ahead, is likely to be considerable. While some of the research generated is arguably transferable, these resources have been and may continue to be unavailable for alternative renewable energy schemes. Similarly, the impact of the possibility of Severn tidal power on national renewable energy strategy is unknown, potentially deflecting from smaller initiatives which could cumulatively represent significant action. A decision regarding the project needs to be taken; if it is to go ahead then stakeholders need to work together to address uncertainties and deliver an appropriate solution, if the development is abandoned then resources need to be directed to more feasible renewable energy projects. Maxtone-Graham (1977) noted that there has been a lot of thinking about tidal power in the Severn, but not much doing; thirty-five years later, and despite advances in technology and understanding the same is arguably true. Understanding why a lasting decision cannot be made with regards to tidal power in the Severn Estuary may have important implications when it next comes under review, and therefore represents an important area for consideration.

7.3 Method

Force field analysis (FFA) is a well established problem solving and action technique, associated with Lewin’s (1951) concept of field theory. While often used informally, the theory behind FFA’s development is complex (see Chapter 3). The conceptual strength of associated theory, and ease of use of the technique itself, suggests it may represent a further tool for a Mode 2 style approach to conflict management (see Chapter 1). Lewin (1951) conceptualised that unsolved problems were frozen within a field of forces, which push away and towards a desired solution (Weisbord, 1987). The concept of a frozen problem provides an accurate analogy for situations of environmental impasse, and may therefore yield considerable understanding as to its nature. Lewin (1951) notes that disequilibrium of forces is needed to facilitate change. Force field analysis can be used to identify driving forces for change, and restraining forces which prevent resolution and thus can be used to determine the nature of the impasse in the Severn Estuary, and subsequent analysis determine how strategic action may be facilitated.

The use of FFA has been adapted to fit with the problem context. Due to the complex nature of the case and the large number of stakeholders involved, it was not possible to implement FFA in the same manner as in other studies. Traditional applications of FFA refer to decision-making in organisations, where teams work through the methodology collaboratively to identify and measure forces. A fundamental difference in this case is that forces were identified via literature review and selected by the analyst, and presented to stakeholders individually via postal questionnaire. A limitation of this approach was that stakeholders did not benefit from the potential learning opportunities generated as a by-product of FFA facilitating stakeholder dialogue. While this use of FFA has been shown to be a useful technique in conflict management (Nambisan *et al.*, 1999; Rowden, 2001); it was not feasible in this case due to the number of stakeholders involved. It is recognised that this design constraint limits the scope of the force field analysed to key concerns, however this approach provides an effective methodology for the multiple stakeholders involved. The tension between participation and detail of investigation is an inevitable trade-off in this case. It is proposed that facilitating an initial multi-stakeholder understanding of the core issues of the impasse was a priority for facilitating action, and one that could be later supplemented by detailed analysis in smaller representative groups. A further adaption is that in this application there is no predefined goal or ‘desired state’ towards which change is directed. Frequently, FFA is utilised to facilitate the achievement of change towards predetermined management goals. Determining a ‘desired state’ for tidal power development in the Severn Estuary is beyond the scope of this study. This work focuses on assessing the status quo and the changes needed to create imbalance, and facilitation of movement towards a decision; it does not comment on what the decision should be. The following sections outline the various phases involved in developing a methodological approach.

7.3.1 Identifying the Forces

While FFA represents a well established technique, one key limitation highlighted by empirical research is its susceptibility to cognitive bias and heuristic errors (Haley and Stumpf, 1989; McNamara and Bromiley, 1997; Spell, 2001; Schwering, 2003). Schwering (2003) noted it is possible to overcome such errors by the use of structured techniques deployed in conjunction with FFA. One technique is the construction of a conceptual template, to ensure holistic consideration recognised to show improvements in planning and problem-solving (Fischoff, 1989; Browne *et al.*, 1997). Such a conceptual template was developed for the issue of tidal power in the Severn Estuary (Figure 7.3) based on the concept of issue clusters, highlighted in the “7S” organisational change model developed at McKinsey Consulting (see Waterman *et al.*, 1980). Categories from the “7S” model could not be taken forward as they apply to cases of organisational change. Determination of categories was based on work by Trudgill (1990), who argued that logical analysis of complex environmental policy issues can be aided by categorising barriers into six major groups—agreement, knowledge, technology, economic, social and political. In this case, categories were expanded along these dimensions to generate the Severn conceptual template (Figure 7.3). Barriers and opportunities within these dimensions were then identified via literature review.

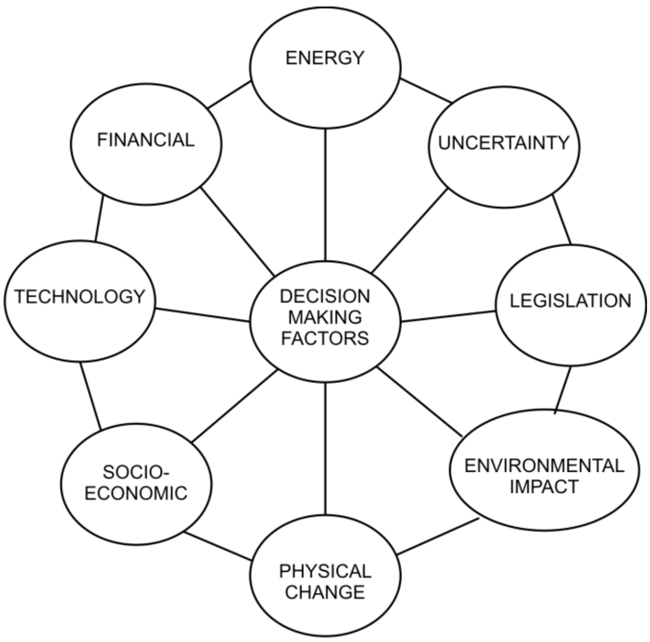


Figure 7.3- Conceptual template model of problem categories for force identification. The model is designed to guide force identification specific to the case of Severn tidal power development.

7.3.2 Stakeholder Identification

Stakeholder analysis techniques were used to identify key stakeholders to target for involvement in this study. Within this study, the stakeholder analysis seeks to identify groups with interest in and/or influence over development in the Severn Estuary. A non-participatory approach was used to identify stakeholders; the justification for this is based on the high prevalence of the issue, and therefore evidence of stakeholder influence and interest is well documented, and partly due to limited resources.

Potential stakeholders were initially identified using the first level of Freeman's (1984) tiered analysis, previously developed for issues of hydropower development (see Appendix 3). Due to resource constraints, individual stakeholders (e.g. customers, consumers, general public) were not included in this study. Using the theoretical suite of potential stakeholders as a basis, organisations were identified as participants within the Severn Estuary debate if evidence could be found of their involvement or interest. This method naturally adopted a snowball sampling technique; whereby validation of one potential stakeholder often identified further organisations. Using this approach, 146 stakeholders were identified from across 14 stakeholder groups. Determining what constitutes a legitimate 'stake' has been the focus of much debate (see Reed *et al.*, 2008); in this study all stakeholders are attributed with equal power and levels of interest and it is assumed that those who have voiced concerns in the past remain engaged. This approach was then validated using the list of respondents to the Severn tidal feasibility study consultation (DECC, 2009), which itself had 145 participants. Of those participants, 77% (112 respondents) had been identified using the tiered analysis and snowball technique. The remaining 33 participants were incorporated to highlight 179 organisations with an interest in or influence over the Severn Estuary debate (see Appendix 5 for full list). Due to government restructuring, administrative changes and time lapse, not all organisations identified were in existence at the time of study (2011); further issues of access to relevant data resulted in 148 stakeholders being invited to participate.

7.3.3 Data Collection

Data was collected via stakeholder survey. A questionnaire was developed to assess stakeholder perceptions of the development of the Severn Estuary for renewable energy generation (see Appendix 6). Questions were formulated to establish: stakeholders' general attitudes to the principle of development; acceptance of the recent government's decision to shelve plans; perceived causes of debate and potential actions to be taken; and weightings of pre-identified barriers and opportunities. The questionnaire was piloted among a group of 32 individuals, to ensure clarity. The final questionnaire was administered as a targeted postal survey to the stakeholder organisations identified. However, there was an option to respond electronically via a corresponding internet survey. To prevent over-representation of any given organisation, responses were limited to one per organisation, targeting senior team members who had worked on projects associated with tidal power in the Severn Estuary.

7.3.4 Analysis

Analysis was conducted in three parts: assessment of participants, investigation of stakeholder perceptions of the current situation, and construction of the force field. Participation analysis was conducted to determine whether data collected was representative of the identified sample population. Stakeholder categories were amalgamated into three groups (government, industrial/academic, interest group) of similar size to facilitate further analysis. Assessments of stakeholder perceptions of the government's last decision were used to determine the current state of impasse, by analysing extent to which stakeholders agreed with the decision. Examination of trends between stakeholder categories is considered as a proxy of conflict. Single ANOVA tests were conducted to highlight association between stakeholder categories and the following factors: stakeholder development positions and issue importance, extent of agreement with government's decision, and extent of agreement that decision was justified by evidence. Using a five point semantic differential, respondents were asked to state to what extent the pre-identified factors represented an opportunity or barrier for future development in the Severn Estuary. Scores were amalgamated to create a total 'value' for each force. Forces are presented as acting on the status quo diagrammatically. In this study, they were converted into an actual force, using the standard equation (force = pressure x area); where pressure is represented by the extent to which stakeholders perceive that factor to be a barrier/ opportunity (the sum total of semantic differential scores), and area represents the extent of 'argument space' dedicated to that factor. Argument space was identified by coding responses to open questions regarding the current cause of the debate and future potential actions. Each point raised was sorted into a category which corresponded with the barriers and opportunities identified. An area value for each was calculated by stating the frequency of issue reoccurrence in stakeholder narratives as a proportion of the total points raised in open questions. The area of argument space and pressure associated with the opportunity/barrier were multiplies to create force values (see Table 7.2).

7.4 Results

7.4.1 Study participants

A total of 28 questionnaires were completed with 18 stakeholders declining to participate (see Table 7.1), yielding a response rate of 31% and a participation rate of 19%. Interest groups represented the largest percentage of stakeholders invited and incorporate a diverse range of interests involved: archaeology (2%), birds (8%), business (10%), conservation (36%), farming (6%), fisheries (11%), rivers (6%), recreation (15%) and transport (2%).

Table 7.1- Severn Estuary questionnaire invitation and participation profiles by stakeholder type.

Stakeholder type	Invited (%)	Participated (%)	Declined (%)	No response (%)
Interest Groups	32	46	33	29
Local Authorities	19	25	0	20
Industrial	17	17	17	17
Specialist Agency	11	4	11	14
Governmental	7	4	22	4
Action Group	7	0	17	7
Academic	5	4	0	6
Specialist Consultant	1	0	0	2
Trade Association	1	0	0	1
	n = 148	n = 28	n = 18	n = 102

7.4.2 Stakeholder Acceptance of Current Decision

Despite a decision being taken, the issue continues to be important for a majority of stakeholders (59%). Variations in stakeholder-perceived importance of the issue are summarised in Figure 7.4, grouped by the position statement they most closely identified with. A single factor ANOVA test conducted to compare the effect of stakeholder position on perceived importance of the issue, found a significant difference, F(3,16)=3.63, p= 0.036. The position of “if an appropriate, agreed solution can be found, hydropower should be developed” was most frequently selected by participants though displayed a significantly larger degree of variance in importance (6.7), compared with other positions (full considered = 2.8, definitely developed= 0.7).

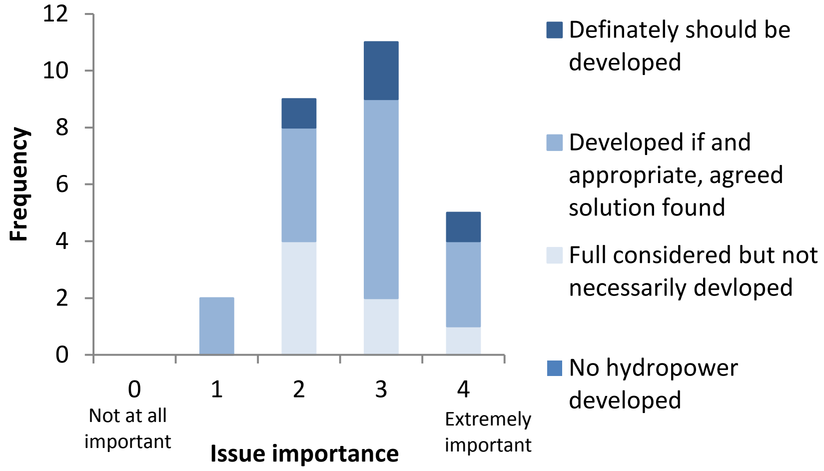


Figure 7.4- Stakeholder positions on Severn tidal power development and degree of scheme importance to participants.

Respondents were found to predominantly agree with the government’s decision to shelve plans for the Severn Estuary (55.56%), although did not display consensus with 18% tending to disagree. Within stakeholder categories, governmental representatives and interests groups most frequently agreed, although there was no clear trend (Figure 7.5), and no significant difference between stakeholder groups, was found (F (2,12)=0.29, p= 0.76).

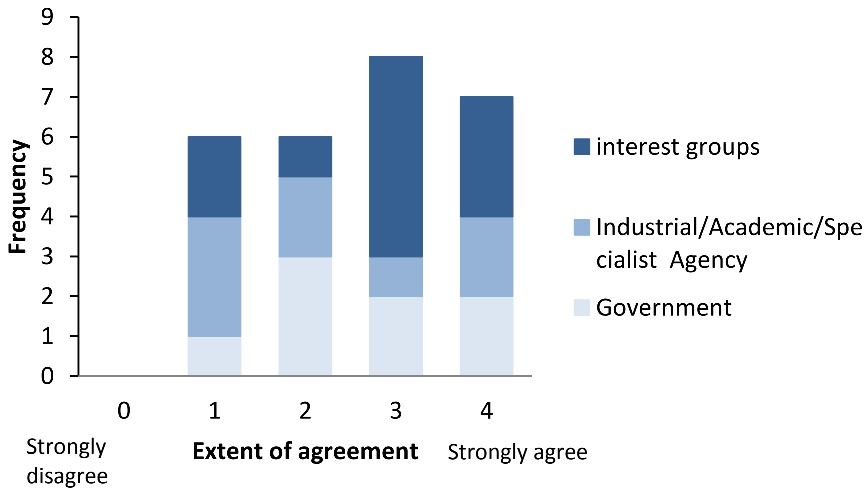


Figure 7.5- Degree of participant agreement on the recent government decision to shelve plans for Severn tidal power.

With regards to the extent to which participants agreed with the government's decision, interest groups were found to have a higher mean (2.2) and greater variance (3.7) compared with other stakeholder categories ($\bar{x}$ = 1.6, σ^2= 1.3). The extent to which participants felt the decision was supported by evidence closely followed levels of agreement; inter group analysis noted the same mean distributions, but slight differences in variance (interest groups, σ^2= 2.2; Industrial/Academic/ Specialist Agency, σ^2= 1.8). When asked to consider the type of evidence provided, the predominance of traditional forms was noted: scientific literature (21%), economic analysis (19%), expert opinion (18%) and theoretical modelling (13%). A number of potential actions to resolve the current impasse were suggested by participants via open questions (Figure 7.6); less than a third (31%) were suggested by more than two individuals.

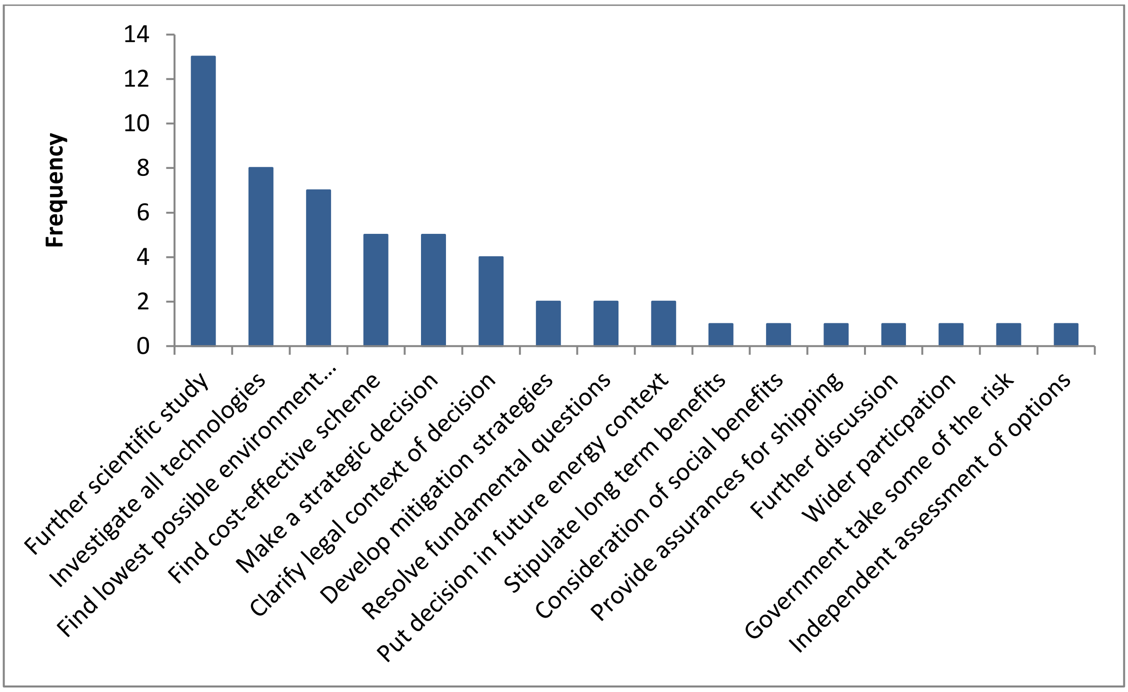


Figure 7.6- Potential actions suggested by participants to resolve any future debate, coded from open responses.

7.4.3 Force Field Analysis

From the literature review, 21 barriers to decision-making in the Severn Estuary were noted and 14 opportunities and their respective forces calculated using survey data (Table 7.2). A force field diagram was then be generated (Figure 7.7).

Table 7.2- Opportunities and barriers identfied by participants in the Severn Estuary questionnaire and their associated force values

Opportunities	**Driving force**	**Barriers**	**Resisting force**
Reduction in CO_2 emissions	19.25	Impact on migratory fish populations	16.60
Generates renewable electricity	6.58	Impact on bird populations	16.20
Provides a domestic source of supply	5.81	Potential damage to the physical estuary environment	16.00
Increased flood protection	5.30	Uncertain project costing	14.08
Current energy legislation	4.20	Funding available	3.56
Potential improvements in turbidity	3.40	Uncertain extent of impacts	2.64
Potential increase in biodiversity	3.00	Patterns of power delivery to the grid	1.10
Long operational lifetime	2.34	Variable energy generation amounts	1.02
Positive impact on the local economy	2.07	Current environmental legislation	0.79
Opportunity for local development	1.98	The decision-making process	0.79
Positive impact on the local job sector	1.86	Potential impacts on shipping	0.66
Increase in recreational opportunities	1.53	Involvement in the decision-making process	0.64
Potential increases in tourism	1.35	Loss/ weakening of the Severn bore	0.57
Improved transport links	1.05	Technology available	0.57
		Potential drop in water levels	0.50
		Number of people involved	0.49
		Existence of other renewable technologies	0.47
		Impact on local archaeology	0.42
		Potential impact tourism	0.41
		Reduction in recreational opportunities	0.39
		Potential impact on local jobs	0.36
TOTAL	**59.72**	**TOTAL**	**78.26**

Top driving forces for change involved potential to reduce carbon dioxide emissions, renewable energy production, better energy security, and enhanced flood protection. Top resisting forces included environmental concerns (impact on fish, birds), physical changes in the estuary and uncertain costing. Further high-scoring opportunities such as long operational lifetime and positive impact on the economy were recognised by stakeholders, but did not yield correspondingly high forces; the same was noted for some barriers (funding availability and uncertain impacts).

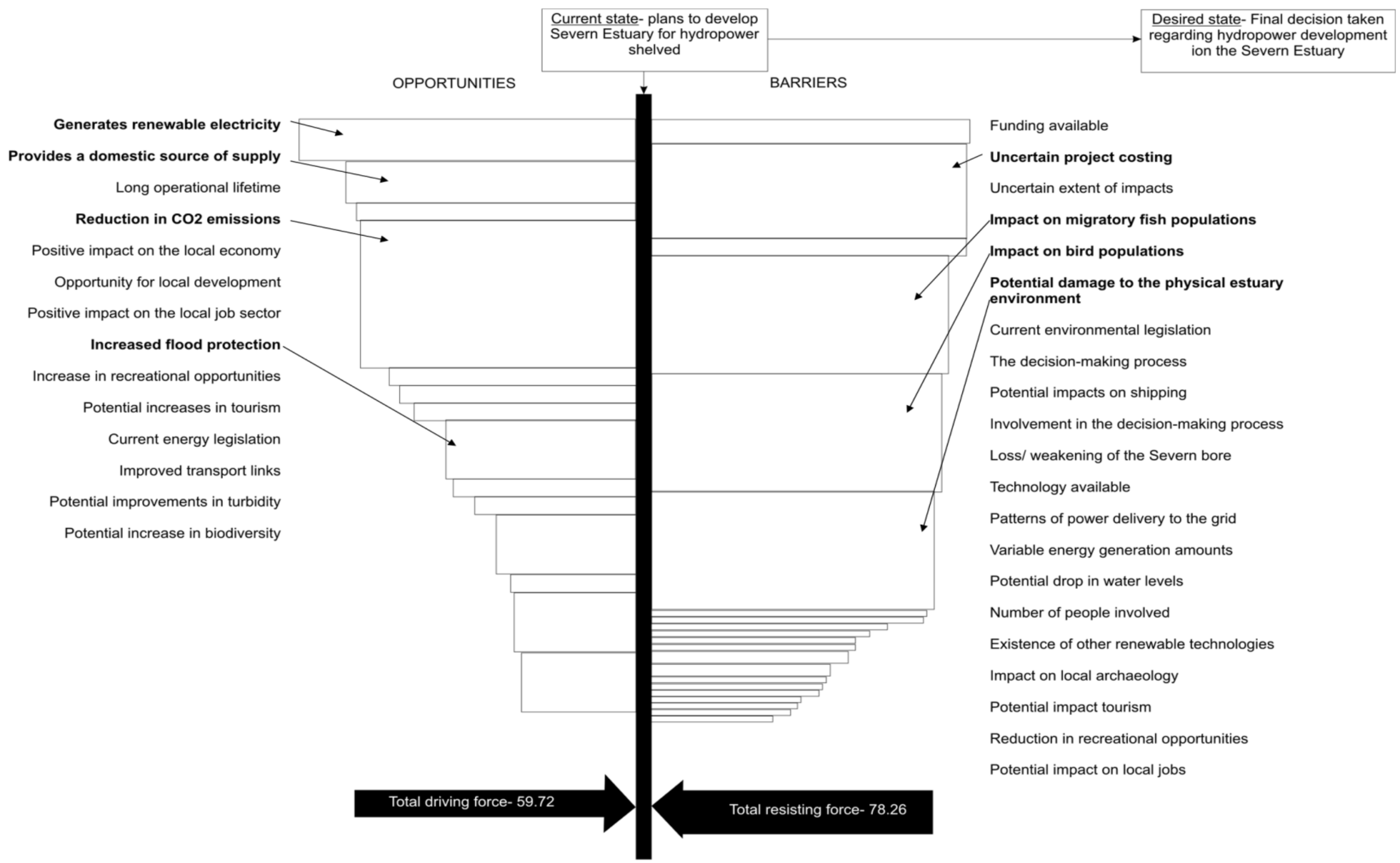


Figure 7.7- Force field diagram highlighting identified opportunities and barriers as driving and resisting forces for change (top four forces are highlighted in bold). Length of the bar represents the extent to which a factor represents an opportunity or barriers, width represents area.

7.5 Analysis

Prior to analysis it is important to note that while attempts were made to invite a representative sample, participant responses did not match the invitational profile (see Table 7.1). Most notably there was an over-representation of interest groups and local authorities, and an under-representation of specialist agencies and governmental stakeholders. Governmental stakeholders displayed a significant tendency to decline to participate, frequently citing that they felt it was inappropriate to comment on the decision. It was intended that the survey assess the state of the impasse prior to a decision being taken, however during design the government's decision was announced and the survey had to be amended. Due to the significant length of consideration period (4 years) and the backlash of stakeholder response in the media, it was expected that undertaking a survey at this time would enhance participation rates. While low government involvement is understandable, no participation from action groups (both for and against development) was unexpected. While poor response may be a function of external assessment of the problem (also noted in Chapters 5 and 6), a lack of participation could be attributed to a reduced need for conflict following a decision recently being taken. For stakeholders involved, while attitudes regarding development are unlikely to have changed, conflict may hold little value to them at this time. If this is the case, two inferences can be made, that when there is no purpose stakeholders do not engage in conflict, i.e. it has a functional purpose for them; and taking a decision (in this case) removes the need for dispute.

Importance of the issue remains high for a majority of participants, despite acceptance of the current government decision. It is interesting to note that higher levels of issue importance were not associated with definitive "yes" or "no" positions, but with a 'yes if' middle option. This may explain why a lasting decision has not been taken, such statements give the perception of support and drive further investigation, but the prerequisites of the 'if' clause remain a barrier to implementation, particularly as they may be significantly different among stakeholders. This disparity may also explain the lack of consensus among participants regarding the government decision. While sample size is small there is no overwhelming consensus, suggesting that the issue is not fully resolved. There is a slight skew in data towards stakeholder agreement, this may have been influenced by the over-representation of interest groups; of those that responded 54% represented environmental concerns and 31% recreational interests, both industries could be significantly impacted by development. Their support may therefore not be related to the decision *per se*, but to avoid potentially negative impacts. There is however considerable divergence in responses, reflecting the range of interests included the discourse between them, highlighted by the high level of variance, making it difficult to identify clear trends.

The degree of association between the extent of agreement and the perception of evidence suggests it may be an important factor in stakeholder acceptance. However, consideration of the types of evidence provided predominantly cited scientific literature, expert opinions and economic analysis, all of which are associated with uncertainty and ambiguity in the literature. This suggests that evidence was not definitive but interpreted to support the decision, but still accepted by participants, a further sign of a current lack of conflict. While uncertainty and ambiguity may have a significant impact on the process of decision-making, it does not appear to affect perception of it. The prevalence of expert opinions as an acceptable form of evidence is potentially a function of uncertainty, given the multitude of opinions involved in this issue; it represents a further factor which contributes to impasse and clouds decision-making. When asked to identify potential actions which should be taken to resolve any further debate, suggestions varied significantly. Further scientific study and investigation of wider technologies were most frequently suggested potential actions, alongside various decision-making criteria and the need to clarify legal and administrative issues (see Figure 7.6). While a range of other actions were suggested, they were not corroborated by other participants. Both the diversity of suggestions and poor consensus among participants highlights how difficult facilitating collaborative action may be. Furthermore of those suggested, most participants' highlighted actions which have arguably already been attempted (e.g. find a cost-effective solution) and are difficult to achieve. Although not directly asked, very few participants considered how action would be facilitated.

It is therefore possible to note that in its current state, decision-making in the Severn Estuary presents an interesting case. A temporary decision has stopped formal investigation and removed the need for conflict among stakeholders. While many agree with the situation at present, tendency to hold a 'yes if' positions with regards to development suggests present conditions may be subject to change in the future. A lack of definitive consensus suggests that the 'if' conditions vary considerably among stakeholders and with expert opinion forming a valid evidence base in this case, consolidating ‘if’ conditions may be difficult. The need to address uncertainty via further study was noted as a potential action to resolve debate, as was the need to facilitate effective decision-making. The Severn Estuary, following a temporary decision, therefore appears to sit in a state of dormancy, neither resolved nor abandoned, waiting for the situation to change. Further analysis of stakeholder perceived barriers and opportunities may yield further understanding of what is required to facilitate change.

7.5.1 Force Field Analysis

Consideration of the forces driving and opposing change Severn Estuary highlighted significantly more barriers (21) than opportunities (14). The largest barriers identified by participants included: issues of funding, uncertainty, environmental concerns, legislative issues and the current decision-making process. Issues of technology, power delivery and socio-economic concerns were perceived to be smaller barriers; this is relative to other concerns and should not be considered insignificant. Conversion into resisting forces caused a shift in order of significance, but top themes remained largely the same. The number of people involved represented a much more significant resisting force than perceived barrier. Generation of renewable electricity and the provision of energy security were the top opportunities identified, along with long operational lifetime of the scheme, reduced carbon dioxide emissions and positive impact on the local economy. The perceived socio-economic benefits were significantly greater than potential environmental ones. Low environmental opportunities in comparison to high barriers and vice versa for socio-economic benefits highlight the dilemma of the situation, and are a further characteristic of this impasse. When converted into driving forces a distinct shift in order of significance was noted, introducing further factors such as opportunities to address flood defence and meet energy legislation targets. The opportunity to reduce carbon dioxide emissions was identified as the largest of all forces acting on the problem situation.

Analysing the force field, a majority of the resisting force is produced by relatively few factors. Analysis of these key barriers notes they are linked with uncertain and ambiguous problem dimensions, highlighting its impact on impasse creation. With the exception of the force associated with carbon dioxide emissions, opportunities are more evenly distributed. However, it is important to note that opportunities across schemes proposed differ, tidal lagoons for example will not yield increased flood protection. While this work does not distinguish between development options, it recognises that force field analysis by scheme would not only yield a useful management tool when selecting among options, but further highlight the complexity of the current situation. When amalgamated a total resisting force of 78.26 was noted, and a driving force of 59.72; there is therefore a net force of -19.85 exerted on the problem situation.

7.5.2 Historical Analysis

Interest in development of the Severn Estuary can be divided into four distinct phases: 1918-1953, 1971-1975, 1981-1989 and 2006-2010. Each phase can be linked with external events which potentially increase driving factors for change, but inability to overcome barriers then results in its abandonment (see Figure 7.2). Little is known regarding consideration in phase one (1918-1953), but it is likely that early proposals did not go forward due to the significant costs involved (Maxtone-Graham, 1977). As this period engulfs both World Wars, interest in developing Severn tidal power may be linked to global affairs, and lack of investment to the diversion of funds to war relief, but this is speculative. At the end of this phase, plans for tidal power in the Severn estuary were shelved for a considerable length of time; this could be attributed to the invention of atomic power and considerable interest in nuclear energy, causing a reduction in driving forces associated with the project. In the 1970s (phase 2), the scheme was again considered and subsequently rejected on economic grounds. Consideration coincided with increasing awareness of global warming, and thus a greater need for renewable energy (an increase in driving forces).

Significantly more is known about the latter phases, where proposals were the focus of significant government and industrial study. Following the 1979 energy crisis, where civil unrest in Iran led to disruption in oil supplies, plans for the development of the Severn Estuary were revisited. During investigation, six potential barrage locations were proposed, the optimum, a ten mile barrage between Brean Down and Lavernock point (Bondi, 1981), but it was concluded that the extent of environmental impact would be crucial in assessing the viability of a Severn barrage scheme (HMSO, 1989), and no decision was taken during phase three, as barriers of environmental uncertainty could not be overcome. The establishment of formal energy policy via the 2003 White Paper on

Energy (amended by Energy White Paper 2007- see Appendix 4) was a potentially a major driver of the fourth phase of consideration, as a Severn tidal scheme may aid both renewable energy and carbon dioxide reduction targets. Following significant investigation, it was concluded that a tidal energy power scheme in the Severn Estuary could play a key role in meeting emission targets (SDC, 2007) and led to formal investigate of options (DECC, 2009). In 2010, the UK government concluded that it did not see a strategic case for public investment in a tidal energy scheme in the Severn Estuary, but wished to keep the option open for future consideration due to the significant renewable resources the estuary represents (DECC, 2010). In a Commons Debate of UK Parliament, Chris Huhne (then Energy Secretary) stated,

"*The costs and risks for the taxpayer and energy consumer would be excessive compared to other low-carbon energy options. Furthermore, uncertainties over compliance with regulation would add to the cost and risk of construction. The Government believe that other options, such as the expansion of wind energy, carbon capture and storage and nuclear power, represent a better deal for taxpayers and consumers at this time. However, the Government recognise that factors which will determine the feasibility of Severn tidal power could change over time..... The Government do not intend to review Severn tidal power before 2015*" (Huhne, 2010).

Again uncertainties this time related to legislation and financing, represented significant barriers which prevented action. Recognition that feasibility may alter over time as the need for renewable energy increases, adds further justification to the analogy of forces generating change in this case.

Each phase of consideration can be associated with an increase in driving forces which creates tension, investigation in an attempt to remove barriers, failure to remove resisting forces and a release of pressure by diverting interests into other schemes. Inability to remove barriers and allow movement is therefore the reason for the state of impasse within the Severn Estuary. As driving forces increase and create tensions, pressure is released by diverting focus into other projects, but background driving forces to development remain; this explains why the development is periodically revisited over time. Based on this analogy of forces, to facilitate movement through impasse to successful implementation requires the removal of barriers to allow low tension movement. While some forces such as uncertain environmental impacts can be lessened, their complete removal is unlikely in this case.

However other significant barriers such as funding and financial concerns may be addressed. In December 2011, talks regarding a tidal barrage in the Severn Estuary resumed following plans to privately finance the project by the consortium Corlan Hafren (Severn Estuary Partnership, 2012), suggesting that another iteration of consideration is imminent. If these concerns can be address, total resisting forces would theoretically decrease to 60.62, reducing the net force to +0.9. This may be sufficient to facilitate movement towards the desired state.

Force field analysis therefore yields some interesting implications. It suggests that those wishing to facilitate decision-making, should focus arguments on reducing perceived barriers as opposed to reinforcing and increasing the importance of opportunities. This may allow for low-conflict decision-making which is potentially more functional. Those that wish to remain in a state of impasse would be required to continue to increase perceptions of barriers, so that they remain significant enough to generate a high-conflict decision-making climate, in which there is significant risk of dysfunctional elements preventing consensus and implementation.

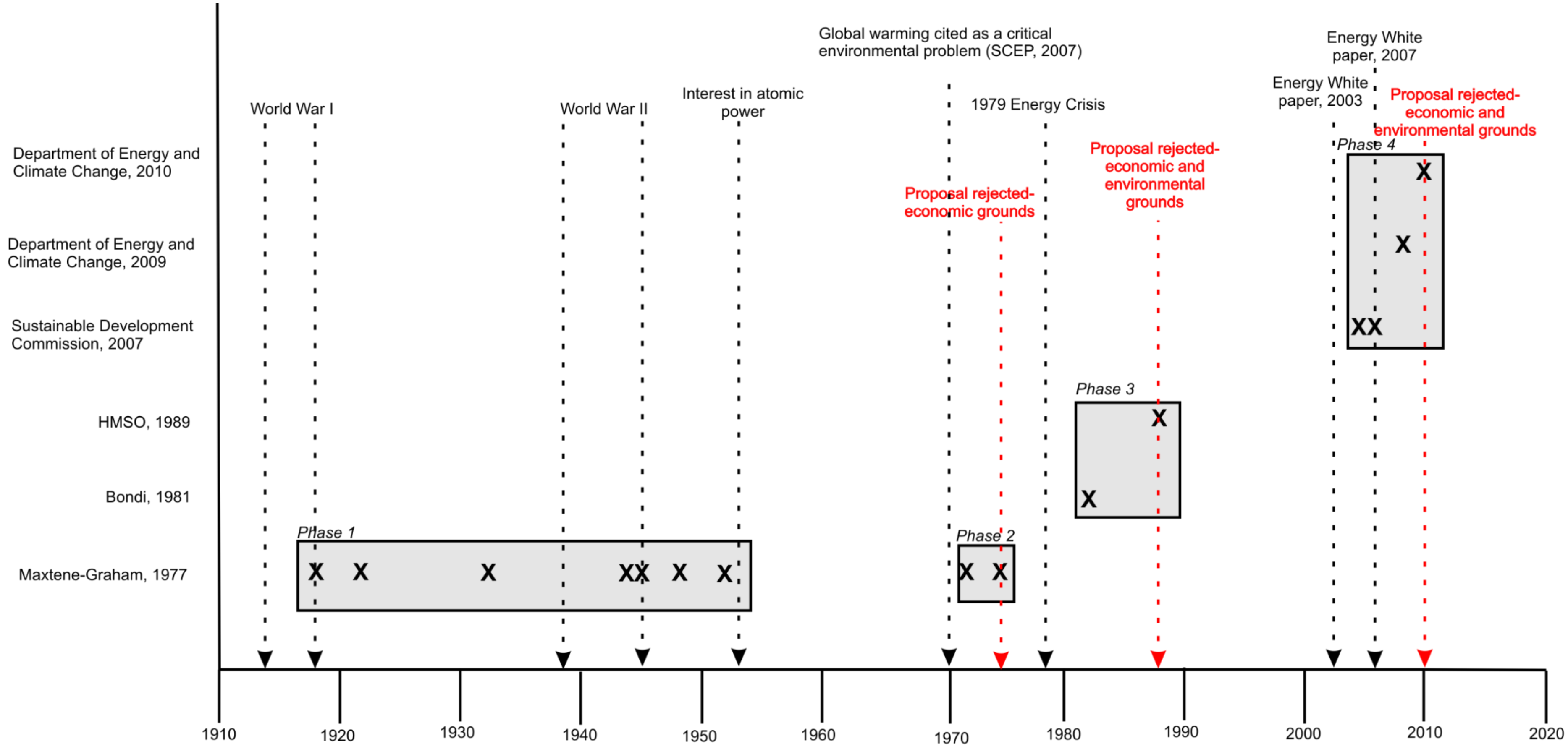


Figure 7.8- Timeline of proposals to develop the Severn Estuary in relation to external events in the UK. X denotes consideration or further investigation of tidal power in the Severn Estuary. Where reasons for rejection are known they are highlighted in red. Shaded boxes denote phases of consideration.

7.6 Discussion

The aim of this chapter was to identify and critically discuss the nature of environmental impasse, in relation to cases of enduring environmental conflict, using the proposed tidal development in the Severn Estuary as a case study. This was achieved using Lewin's (1951) force field analysis, to conceptualise factors which prevent movement towards a theoretical desired state of an agreed decision. It was possible to identify a holistic range of barriers associated with the Severn Estuary, as they were prevalent within associated literature. An attempt to identify opportunities (beyond potential for renewable energy generation) was noticeably more difficult. Whether this is due to the considerable importance of this one opportunity, or that barriers are more frequently discussed, is uncertain. While numerous barriers were identified, uncertainty, was noted as the most prevalent barrier to progression, supporting conclusions that it is a major obstacle for decision-making highlighted in the literature (see Corbin, 1980; McCaskey, 1982; Brunsson, 1985) and is a key characteristic in the development of environmental impasses.

Measuring these barriers and opportunities as forces yielded some interesting findings, particularly when scaled by the extent of argument space they occupy. Despite a wide range of barriers identified, over half of the argument space is occupied by issues of environmental impact (on fish, birds and the physical estuary) and financial uncertainty, making them a considerable force. While this suggests they represent the greatest perceived barriers, others may be underplayed due to the dominance of these key issues, and if removed, there is the potential for remaining forces to increase in magnitude as they are considered in more detail. Furthermore, the force field assumes that opportunities and barriers have an equal impact on decision-making. Perceptions of barriers and opportunities and the extent of their importance is a function of individual cognitive processes. It may therefore be the case that the impact of barriers is enhanced due to intangible factors; this is dependent on individual values, perceptions of probability and tolerance of risk (Kahn and Sarin, 1988). For the risk-adverse individual, perception of barriers may be significantly greater than to a risk-taker. The social characteristic of the individual may therefore have a significant impact on assessment of forces and is important to note. A further observation is the inverse relationship between opportunities and barriers by subject; the development offers numerous socio-economic gains, with a perceived small cost and vice versa with environmental issues. While this separation is oversimplified it highlights how debate over development in the Severn Estuary has become divided, environmental stakeholders against the development carry significant risk and have little to gain. With the opposite true for socio-economic concerns, bringing these factors into balance, and removing or redistributing risk among stakeholders may aid facilitation of implementation and reduce conflict during decision-making phases.

As driving and resisting forces are not in balance, the current situation does not represent a quasi-stationary equilibrium point as noted by Lewin (1951), suggesting the situation is unstable and that further change is imminent. Situations of environmental impasse are therefore not as stable as previously considered. Secondly, it highlights that movement towards a ‘desired state’ is impaired by significant barriers. To achieve change, Lewin (1951) noted two options to strengthen forces towards change or reduces resisting factors. Etzioni (1964) noted that each is associated with different secondary effects; that movement facilitated by removing barriers will result in significantly less tension, than that caused by increasing opportunities. In the Severn Estuary, it is possible to note that many of the barriers present, especially the larger ones, would be particularly difficult to remove (e.g. uncertainty, securing funding). Thus change may be required to be forced by strengthening driving forces. Consideration of the key driving forces, highlight that as demands for renewable energy and environmental concerns grow, opportunities will naturally increase over time. Thus even if barriers cannot be removed, opportunities are likely to increase with time, generating movement towards a desired state. However, according to Lewin’s (1951) theory this method of movement will involve increased conflict during the process of decision-making. The notion of changes in forces over time prompted a historical analysis of Severn Estuary, to establish whether the manner of alterations in driving and resisting forces could account for its long history of impasse.

Analysis of the force field highlighted that while the system was ready for change (due to imbalance of forces); theoretical problem ‘movement’ was away from the desired state, not towards it. In tandem with the historical analysis, it is possible to note that the situation is not stuck in a stable state as previously thought, but unable to overcome barriers. This backwards movement could therefore be attributed to the aftermath of past conflict episodes, where barriers remain but driving forces weaken. Drop in driving forces may be associated with a loss of momentum, caused by the government decision to shelve plans. It is therefore noted that while driving forces diminish, barriers remain until actively removed. This challenges Lewin's (1947) assumption that movement always generates an improvement in state; in the case of decision-making it is possible for change to occur, but it creates a more difficult environment for further movement. Thus persistent problems and environmental impasses develop. In the aftermath of conflict, residual forces are in this case negative, representing a more significant challenge in the future. In the case of the Severn Estuary tidal power proposal, numerous iterations mean that it is significantly more difficult to take a decision now, than when it was first considered in 1918.

The role of conflict within the establishment of these situations of impasse is clear. Conflict is recognised as both a consequence of differential forces and a cause, which is dynamic over time. At each iteration functional conflict elements yield greater understanding of the problem, allowing identification and consideration potential forces, and therefore are important in establishing the force field. However simultaneously, inability to resolve conflict, a product of a complexity and/or dysfunctional elements, influences perceptions of these forces and their resultant size. If unresolved, as in the Severn Estuary, at the next iteration the benefit of functional conflict elements is reduced, as understanding is already high and barriers exist from the outset. Within the force field, conflict is also present in the form of tension between the unbalanced forces which decision-makers experience as a consequence of the external debate. The ability to remove barriers and enhance opportunities will therefore alter the external conflict and reduce decision-making tension as a by-product. While decision-making tension sits in the middle of the impasse, it is possible to take strategic action to reduce this by exerting an influence on the force field and the external debate, the subsequent change in forces, potentially allows for shift and movement towards implementation.

In the Severn Estuary, many of the barriers presented were related to uncertainty surrounding environmental impact and financial concerns. Despite being the focus of considerable research over time, these barriers have been a distinct feature of this impasse throughout its history. While future advances in knowledge and technological advancement may enable the removal of these barriers, at present this course of action is unavailable to decision makers. Driving forces, however, will grow over time in tandem with increased demand for renewable energy and pressure to reduce carbon dioxide emissions as a response to climate change. Alterations in driving forces suggest that tidal power in the Severn Estuary will not remain dormant for long, and that a definitive decision will eventually be reached. However, dependent on the actions taken now, the path to that decision may be significantly different. If driving forces increase, which will inevitably happen over time, then the process of decision-making is likely to be associated with high tension and conflict. With the removal of key barriers unavailable, their reduction in tandem with removal of smaller resisting forces represents a potentially more successful course of action. To facilitate such an approach requires the management of change via a further more detailed assessment of barriers and opportunities, quantified by a larger proportion of the stakeholders engaged in the issue. It also requires a pro-active managerial response, to reduce resisting forces in a period of interlude prior to the proposal being formally reconsidered, to prevent further conflict. Given that such an approach is likely to incur significant costs (both financial and temporal) it is unlikely to be adopted prior to renewed interest in the Severn Estuary. However, without removal or reduction of barriers it is likely that decision-making will continue to be associated with conflict and therefore stuck in this situation of environmental impasse.

Furthermore, it is important to note that over time perception of barriers may shift as a function of external factors. For example, in the future issues of environmental uncertainty may not have diminished. When faced with a choice between environmental concerns and energy availability, in a world where energy is in short supply; attitudes may be significantly different in the future. While the barrier of environmental uncertainty is not removed, its resisting force may become obsolete over time. An interesting point to consider is that environmentally speaking, it may be better to accept an inadequate solution in a climate of high environmental concern; than risk development in a future where such issues do not feature in the decision-making process at all. Similarly, a shift may also occur if increased environmental concern may allow greater allocation of resources to remove barriers, allowing a development to occur but of a very different nature. The manner of the alteration in the relative forces is therefore also important.

7.7 Conclusions

The purpose of this chapter was to enhance understanding of emerging cases of environmental impasse, investigate the role of conflict within them and discuss their potential impact on the course of decision-making. To facilitate discussion, Lewin's (1951) planned change model was used as a conceptual tool to visualise the impasse by highlighting both barriers and opportunities associated with the decision, and their interactions. While arguably an over-simplification of a complex problem, the method prompted consideration of causes of stagnation, and the notion of opposing forces significantly enhances conceptualisation of impasse. Uncertainty, across numerous problem dimensions, was the most significant force identified, representing a considerable barrier to decision-making. Furthermore, inability to remove uncertainty was found to limit actions available to those who seek to facilitate change, and may be the cause of tenacious conflict in the future.

While this chapter provides insight into the nature of the impasse, its use as a conflict management tool to prioritise actions and facilitate change is limited by its manner of application (a constraint of the case study) and low participation. Poor participation may in part be attributed to a lack of current conflict surrounding the issue, suggesting that in this case, individuals only engage in conflict when required. This further reinforces the notion that conflict serves a purpose for those who engage in it. The role of conflict is highlighted as being dynamic over time, and noted to be both a cause and consequence of the impasse. At each iteration, failure to address the parameters of previous conflicts, result in them forming the antecedent conditions of the next, this supports the cyclical conflict pattern noted by Pondy (1967). Consideration of its role highlighted that decision-making conflict is influenced by wider stakeholder debate but is separate from it. To facilitate change in decision-making does not therefore require resolution of the wider debate, but sufficient change and/or consensus to reduce tension and allow strategic choice.

Whilst further work is needed to study its mechanics, it is proposed that the active management of change represents a conceptual tool for facilitating movement from situations of impasse through to implementation. One limitation of this approach would be that a change agent would be required, to determine the desired state, assess conditions and then accomplish that goal through a series of actions and interventions either singularly or in collaboration with other people. Although this approach facilitates transition through impasse to decision-making, whether the decision taken represents the best solution is a function of the desired state selected and the mechanisms selected to do so. In the case of the Severn Estuary, determining who decides in the face of such diverse attitudes will have inevitable implications for the solutions generated. However, given its long history of inability to transition from this state of impasse, it is clear that strategic action is required;

if a collaborative target state can be agreed a planned change approach may be successful. Whilst this chapter highlights a methodology for the facilitation of change, determining an unbiased notion of what that change and should be, limits its effectiveness. Many would argue that the nature of change should be towards a realisation of sustainable development, but whether this is tangible is uncertain. Furthermore, the process of change is noted to be time independent, and a function of numerous individual perceptions; an interesting consideration raised during this chapter is the notion that facilitation of sustainable schemes, potentially poorly now, may in time with hindsight represent a better solution than in the future, where such concerns may not feature at all.

Chapter 8 Discussion and Conclusions

8.1 Introduction

This thesis has critically assessed both the definition and nature of conflict and identified the extent of its impact on the course of decision-making. This has been achieved by conducting a focused literature review (Chapters 2 and 4) and three case studies (Chapters 5-7), which examine different parameters and problems situations, all of which link to advance understanding of environmental conflict. In this chapter, key concepts are drawn together to highlight the nature of environmentally sustainable hydropower debates, the role of conflict in decision-making and the facilitation of change, and to assess the advantages and limitations of the conceptual tools developed. Knowledge gained provides the basis for the re-conceptualisation of environmental conflict. This chapter therefore aims to:

- Critically evaluate and interpret the literature review and case study findings to distil common and individual elements of hydropower related conflict;
- Develop and justify a generalised model of environmental conflict and its role in decision-making; and
- Highlight and critically discuss conceptual tools developed in the course of this research.

This is in accordance with the aims and objectives outlined in Chapter 1. Each of these aims will be addressed separately in the following sections, followed by an outline of the challenges and limitations experienced.

8.2 Lessons from Comparing the Three Cases

Following analysis of hydropower conflict cases, it is possible to distil key features which are characteristic of these disputes. While each case is individual, common themes are highlighted and inferences as to the nature of environmental conflict made. Sustainable hydropower conflict is recognised to be equally characterised by facets of the problem and the responses of individuals within it. Comparison among cases also highlighted a distinct conflict process, further aiding identification of the impact of stakeholder disputes on sustainable decision-making.

8.2.1 Problem Based Characteristics

A fundamental characteristic of hydropower conflict is the incompatibility of main themes. Sustainable hydropower development has conflict potential at its core, caused by the contradictory function it serves as both a source of renewable energy and localised environmental damage. Inevitable tensions between these issues forms the root of hydropower conflict; dividing stakeholders based on their individual needs and/or interests. Across cases, a diverse range of stakeholder interests were highlighted; most were substantive concerned with beneficial outputs such as renewable energy production, money and enhanced fisheries, however procedural and psychological elements did feature. Such diverse interests create further divisions. Whether the interests presented in each case are compatible is dependent on the characteristics of the site and scheme, they determine whether multiple needs can be simultaneously addressed or if a trade off is required. This case specific nature explains why some developments are able to generate win-win solutions through traditional integrative bargaining processes whilst in others this serves only to further highlight incompatibilities and conflict ensues. Contradiction between the two main themes of hydropower therefore create baseline conflict conditions, the requirement to choose between goals divides stakeholders and is a fundamental part of the issue.

Examination of resultant disputes noted a diversity of themes involved, suggesting that sustainable hydropower development is highly complex. Despite this, fisheries' concerns were recognised as a distinct characteristic, repeatedly encountered across all cases examined. Fisheries elements are and have historically been a central feature of the hydropower debate; these concerns appear to act as a catalyst for conflict and represent an integral part of its development. Each case study displays different dimensions of the issue:

- River Garry highlights the socio-economic value (inclusive of intangible values) of some fish populations, and the consequences of poor development.
- Gordleton Mill highlights the difficulty in determining case-specific fish passage requirements and the considerable impact on financial viability of schemes.

- The Severn Estuary highlights uncertain impacts on and responses of fish populations to development, alongside complex legislative protection afforded to them and their effect on decision-making.

While many other hydropower lobbies exist, fisheries' issues appear to dominate conflict, highlighting the practical incompatibility of the environmental themes involved. The impact of fisheries' concerns appears to increase significantly as the scale of case study is reduced. Whether this is a general trend or a feature of the cases selected is uncertain, but scale-related facets of the hydropower debate have been previously highlighted (see Paish, 2002).

Consideration of the practical difficulties of fish passage in the context of actual cases highlights that the problem is multi-faceted; linked to available technology; and impacts on generation, financial implications, scientific uncertainty and social acceptability. Its numerous points of interaction within the debate serve to emphasise its impact and combined with the sometimes militant approach taken by fisheries interests (as highlighted in the case of the River Garry), make them a characteristic feature of the hydropower conflict. Whether such an approach is appropriate is subjective, but such methods aid the propagation of conflict from baseline conditions. Aggressive approaches are more likely to result in defensive responses, facilitating poor stakeholder relationships and increasing dysfunctional disputes. However, it is important to also note tenacious conflict may be required to facilitate real change and highlight flaws in the decision-making process. The issue of fisheries and hydropower is therefore highlighted as a characteristic of resultant conflicts (whether a positive or negative). Resolving this issue could remove much of the tension regarding environmentally sustainable hydropower; however due to the case specific nature of developments, ability to do so is limited. Although to an extent resolution is dependent on technological advancement and further scientific research, a key conclusion of this study is that there are wider factors beyond engineering capabilities that determine this issue, including differential values, ethical perceptions, financial implications and legislative compliance. In recognition of this, mechanisms to resolve this issue should draw holistically on all these factors, and not be limited to further study of technologies alone.

A further characteristic of sustainable hydropower conflict, noted in all three cases, is contradictory legislation and its impact on the nature of debate. Legislation is used within cases to differentially support arguments; at Gordleton Mill legislation was used to strengthen conservation concerns, in the Garry to simultaneously justify and condemn proposed actions, and in the Severn Estuary, highlighting legally protected areas served to reinforce the potential consequences of development. Stakeholders therefore use legislation as a tool within a conflict situation to enhance the validity of their claims and justify the points raised. In a case where legislation can be used differentially, this adds further complexity to decision-making, and the resultant indecisiveness creates an environment where conflict propagates further. Resolution of this disparity would remove the opportunity to use legislation in this manner and provide greater clarity as to how hydropower should be developed. However, this is likely to require the prioritisation of one theme, renewable energy production or environmental protection, over another and will itself have significant ethical and economic considerations. While a difficult action to take, clarification of legislative disparities will be crucial for the long term reduction of hydropower conflict, but is likely to generate short-term controversy. Navigation of this issue will have significant consequences of the future nature of hydropower development.

While the impact of legislative ambiguity can be noted in all three cases, it represents an arguably greater issue in the River Garry case, where achieving legal compliance is a clear driver of conflict. Whilst it is not possible to determine the extent to which conflict in the Garry can be attributed to legislation alone, its role is significant. Given that altering past schemes to meet modern legislative requirements results in such tenacious conflict, further future shifts may have similar effects. With hydropower facilities having long operational lifetimes, recognition of this advocates environmental sustainable developments rather than legally compliant schemes, to reduce potentially tenacious future conflicts, but relies on longer term perspectives when taking decisions.

While each case displays different elements, for all the disputes examined, uncertainty is another distinct conflict feature. Each case notes considerable gaps in knowledge, while some may be addressed by further study, others have arguably ethical or moral dimension which do not yield definitive answers. That such a large proportion of each hydropower case is unknown not only allows conflict to establish, but limits ability to take decisive action to resolve it. An interesting finding from the case studies was that attempts to address uncertainties not only incurred further project costs (both fiscal and temporal), but also often further complicated the issue. The gathering of information was recognised to be a collaborative, iterative process, with advances in understanding distilling new challenges to be addressed. In the cases examined, this did not distil a final optimum solution as intended, suggesting that traditional problem-solving techniques will not resolve these matters alone. Hydropower conflicts are therefore noted to be information intensive, and thus require wide participation to gain access to stakeholder knowledge.

8.2.2 People Based Characteristics

In addition to facets of the problem *per se*, analysis across cases highlighted that both the nature and course of conflict were significantly affected by the individuals involved, as hypothesised following literature review (see Chapter 2). In all cases, the presence of diverse perceptions, values and opinions among stakeholders was recognised, noted to affect the content and nature of the debate, and influence problem conception and the acceptability of proposed solutions. Although this impact varies, it is clear across cases that stakeholders themselves have a significant impact on resultant debates. The nature of this impact can be divided into the effects of group interactions and the influence of individuals.

Group interactions were noted to be significantly affected by the perceptions and opinions of individuals; this was most notable in the manner in which information was communicated. Following analysis of cases, communication of information was highlighted as the primary role of the stakeholder, enhancing understanding of the problem and is a functional benefit of dispute. Comparison of cases highlighted that this effect was more significant at Gordleton Mill; whether this is a function of development scale or the presence of a non-technical developer is uncertain. However, as a group activity, communication was recognised to be highly susceptible to stakeholder influence, whether purposeful via use of persuasive arguments or subconsciously via perceptions and opinions of others. Both the nature of communication and its content were noted to influence the course of debate, its manner determined by the characteristics of the individuals involved. At Gordleton Mill, stakeholder communication enhanced problem conception, but disproportional consultation, with an over-representation of fisheries concerns resulted in a distorted understanding of the problem. If alternative stakeholders had been consulted, assuming all other factors remain constant, a significantly different understanding of the problem may have been generated, and in turn a different decision taken. The composition of stakeholders, the number involved and range of interests represented, is therefore significant. Conflict also has dysfunctional effects on group interactions, highlighting incompatibilities, subsequently enhancing the complexity of the task and creating uncertainty. Interactions in the River Garry case highlighted a conflict associated with strong emotions, poor perceptions and a lack of trust between stakeholders; these exerted a significant influence on the course of the dispute via the impact on group interactions. The relationships between stakeholders were noted to be a product of perceptions of opponents, opinions held and the nature of past and present interactions. All are noted to have a significant impact on the nature and course of conflict; despite not being part of the problem *per se*. Interactions between the stakeholders involved is therefore recognised to be as significant in determining conflict development and outcomes as the parameter of the problem itself.

Characteristics of the individuals involved and the nature of their personalities are also highlighted to be crucial in shaping the behaviours exhibited, which affect the debate. In the case of the River Garry, the impacts of strong characters are evident and significantly influence the course of the debate, actions and behaviours exhibited are shaped by underlying perceptions of “right” and “wrong” and of opponents. The impact of the individual was definitively identified in this case by examining the contradictory actions of two individuals with the same role. The decision of one to work within the process and maintain communication channels was contrary to the decision of the other to take external action and provides a stark comparison which can be attributed to the different characters involved. This example explicitly highlights how underlying personalities, separate from the jobs they hold, can (and in this case do) significantly alter the nature of environmental conflicts. Such factors can also be highlighted at Gordleton Mill, albeit in a difference manner. Factors such as the need to assess the project in a cost-benefit manner, and inability to take a strategic decision, fundamental in this case, are a further function of personality of the decision-maker. This observation is perhaps best highlighted by stakeholders’ responses to risk. Presented with a difficult challenge that is largely uncertain, the decision to cease investigation at Gordleton Mill is arguably determined by the individuals’ psychological tolerance for risk and the manner in which they evaluate it. Another stakeholder presented with the same challenge may respond differently dependent on whether they are risk averse or not.

The observation that individuals influence the nature and course of conflict highlights how social elements unrelated to the physical facts of the problem can be fundamental in shaping outcomes, and is therefore recognised as a wider facet of environmental conflict and not limited to hydropower concerns. The conclusion that the composition of participants (number involved and interests held), the character of stakeholders and the nature of their interactions all influence the course of conflict is perhaps evident, but is a factor which often remains tacit when practically considering disputes. It is proposed that because such elements are so basic and obvious in nature, their importance is often underrepresented. Heightened awareness and consideration of the role of such factors may significantly aid minimisation of dysfunctional conflict elements and ease decision-making within disputes by actively managing them.

8.2.3 Process-based Characteristics

Comparison between cases highlighted a distinct conflict process. A key characteristic noted is that disputes are not static but dynamic over time, cyclical in nature and involve distinct shifts in problem conception and stakeholder involvement. Considering conflict as an isolated event is a common misconception that must be dispelled for effective dispute management to occur.

The nature of hydropower development conflict is noted to shift considerably over time across cases, characterised by short periods of rapid movement followed by long phases of stagnation. This delay is noted to have a significant impact on stakeholder involvement, with diverse participation as conflict emerges, which dwindles over time, often in correlation with a loss of momentum. At Gordleton Mill, intervention during a period of stagnation limited access to stakeholders as some had withdrawn from the problem. Similar losses were encountered in the River Garry case, particularly evident in membership levels of the local campaign group. Time is therefore noted to have significant impacts on the composition of stakeholders, affecting not only the number involved but the interests represented, which (as previously noted) has subsequent implications on the course of conflict. Analysis of cases, particularly those that cover longer timescales, highlighted that the problem situation shifts over time correspond to changing conditions, both internal and external. A distinct cyclical stop-start pattern, noted in analysis of the

River Garry and Severn Estuary, appears to be a distinct feature of unresolved conflict. Borrowing from Lewin's (1936; 1947; 1951) theory of planned change, it was possible to attribute these shifting conditions to progression towards a theoretical decision point. Recognition of the underlying process of conflict and its role in the facilitation of changes is a key finding of this study and is addressed further in subsequent sections. From this observation, it can be assumed that if unresolved, conflict will continue unless strategic actions are taken to break iterative dispute cycles.

Conflict is noted to move progressively through the five expression stages (latent-perceived-felt-manifest-aftermath) in accordance with Pondy's (1967) model. Clearly noted in the River Garry case, conflict is shown to escalate from an initial latent starting point. The higher escalation levels, where conflict is felt, were associated with a greater proportion of dysfunctional elements; the exact nature of this relationship is uncertain but this suggests that early intervention may aid successful dispute management. Cyclical conflict progression explains why cases exhibit such variations; each study is at a different stage. While conflict progresses to manifestation in the case of the River Garry, at Gordleton Mill, the dispute remains latent, stakeholders occupy conflict positions but interactions did not progress to active argument. In the Severn Estuary, analysis is limited by the nature of the study, but it is likely that conflict is at least perceived by those involved. A key question therefore is, if conflict is dynamic and cyclical over time why does only one of the cases exhibit full escalation?

Based on the cases examined, it is possible to highlight two key differences which may have influenced the capacity for escalation. The first is the timing of conflict expression in relation to development stage. At both Gordleton Mill and in the Severn Estuary, both projects are under consideration, there is therefore an option to cease development. In the River Garry, conflict expression is much later in its life-cycle (post-construction) at this stage proposals are inevitably constrained by existing infrastructure and the problem cannot be avoided. Timing of conflict expression is highlighted as important in the literature; process and task disputes at early stages of development (such as those in the case of Gordleton Mill and the Severn Estuary) are noted as positive attributes (see Jehn and Mannix, 2001), while those that persist at execution are negative. The need for hydropower redevelopment therefore creates a scenario whereby conflict establishes at an inopportune time, creating a predisposition towards dysfunction and escalation. It is therefore likely that the redevelopment of other schemes to meet modern legislative requirements will experience tenacious conflict. A key conclusion is that conflict at the proposal stages is more functional and less inclined to escalate (assuming resolution).

A further observation is that in the cases associated with lower conflict intensities, the decision is taken to abandon the schemes in favour of the pursuit of other projects, rather than resolve conflict. Both cases may have the capacity for dispute escalation, but conflict avoidance prevented it. Whether change is required or desired appears to therefore have distinct impacts on the conflict episode, this subtle distinction determines the urgency associated with making a decision. Cases of desired change (exhibited at Gordleton Mill and in the Severn Estuary), are noted to lead to conflict avoidance when faced with an irresolvable problem. In the case of the River Garry, a required change creates tension which makes conflict more tenacious, but will (eventually) force a decision. This highlights a paradox where urgency appears to be needed to navigate conflict and facilitate a decision, but simultaneously creates more tenacious dispute which makes it harder to reach consensus. A final variation between cases is the impact of taking a decision on conflict. At Gordleton Mill and in the Severn Estuary taking a decision (to not pursue further investigation at the time) resulted in the removal of conflict despite incompatibilities remaining. This suggests that conflict serves a purpose for stakeholders, no longer useful following determination. In these cases, the presence of conflict and inability to resolve it significantly effects the decision made; had dispute not occurred a hydropower facility may have been developed. Whether this is positive or negative is a function of perspective, but serves to highlight that conflict has altered the course of decision-making. The relationship between conflict and decision-making is therefore recognised to be highly integrated. In the case of the River Garry, the relationship is different, deciding to act stimulated conflict and enhanced the disparity among stakeholders and preventing action. This differential impact is attributed to the nature of the decision; at Gordleton Mill and in the Severn Estuary conflict is removed by no longer considering change, the decision is therefore unlikely to yield stakeholder objection and thus unintentionally achieves consensus. In the River Garry, the issue must be resolved, thus dispute continues until a decision which achieves at least a majority consensus is reached. Therefore to remove conflict there is a need not only to take a decision, but for it to be agreed among stakeholders to facilitate it.

It is therefore possible to highlight empirically, many of the theoretical conclusions distilled from a critical interdisciplinary evaluation of conflict literature (Chapter 2). Environmental disputes are recognised to not be inherently negative; each case notes both functional and dysfunctional elements. Using a broader, structured notion of conflict changes the manner in which it is conceptualised and the parameters considered in subsequent analysis. The alternative approach taken in this study, highlights that the constituents of hydropower development conflicts extend significantly beyond the parameters of the known problem. In the cases analysed, the problems related to hydropower development *per se*, e.g. the incompatibility of core themes, represent only one part of the conflict situation. Stakeholder characteristics, responses and interactions are also fundamental in determining the nature, course and outcomes of environmental conflict. Both the problem itself, and the people involved provide the baseline conditions for conflict and its potential progression over time. As theoretically discussed in Chapter 2, conflict is highlighted to have a distinct impact on decision-making within all the cases examined, serving a clear purpose for those who engage in it. At Gordleton Mill, it provides a means to gather information on a proposal, in the River Garry it serves to highlight stakeholders' perceptions of proposed changes and in the Severn Estuary it encourages innovation and prevents inappropriate development. It is therefore recognised as a distinct process which influences decision-making.

While each case of environmentally sustainable hydropower development conflict is unique there are therefore a number of common facets (see Table 8.1). These are concluded to be the key features of environmental conflict, characterised by parameters of the problem, the people involved and the dispute process over time. In the case of environmentally sustainable hydropower development conflict, problem based characteristics included, the incompatibility of core themes and associated legislation. These factors are specific to the challenge of environmentally sustainable hydropower development and represent key issues to be addressed to aid management of these specific conflicts. Other characteristics, regarding the people involved and nature of the conflict process, have wider implications and enhance understanding of environmental disputes. Clearly highlighted by detailed analysis of cases, is the significant role that individuals have in determining the nature, course and outcomes of conflict, greater recognition and understanding is therefore key to facilitating dispute management. Comparison of cases also highlighted a distinct conflict process; further comprehension of the course of dispute may also yield management benefits, including highlighting how to appropriately time interventions to maximise success.

Table 8.1- Summary of key conflict elements across case studies

	River Garry	Gordleton Mill	Severn Estuary
Problem based	Incompatible core themes Ambiguous legislation Uncertainty Ecological concerns (fish) Economic concerns	Incompatible core themes Ambiguous legislation Uncertainty Fish passage design Economic viability Scheme design	Incompatible core themes Ambiguous legislation Uncertainty Socio-economic impacts
People based	Lack of trust Poor communication High emotions Strong beliefs Differential interests	Lack of experience Nature of communication Imbalanced consultation Transfer of beliefs Tolerance of risk	Perceptions of problem Limited consultation Perceptions of risk
Process based	Clear stop-start pattern Cyclical escalation pattern Significant risk of future conflict Proposal creates conflict	Conflict stagnation No escalation Decision removes conflict	Clear stop-start pattern Periods of stagnation Decision removes the need for conflict

8.3 Identifying the Impact of Stakeholder Conflict on Decision-Making

Determining the impact of stakeholder conflict on the course of decision-making is the central aim of this study. Both theoretical and empirical examination of environmental conflict has yielded a range of inferences as to its constituents, functions and processes. Drawing on these conclusions, it is possible to create a generalised model of environmental conflict that highlights how conflict is fundamental in shaping the outputs generated. These outputs in turn have wider ramifications for decision-making and the realisation of change, which collectively aid the facilitation of sustainable development.

Key findings from both a review of relevant literature and case study analysis are drawn together in a series of conceptual models which highlight the complex processes involved and their potential implications. Each model represents consideration of the impact of conflict at different scales of resolution:

- Micro scale: Model A- The Conflict System- This conceptual model highlights the inputs, throughputs and outputs of conflict as a process, considering its constituents and function.
- Meso scale: Model B- Required Change and Conflict- based on the patterns of conflict highlighted during comparison of cases, this model highlights the role of Model A in the facilitation of change. Stages of the model are also linked to conflict escalation and associated with decision-making steps.
- Macro scale: Model C- Consequences of Change- highlights the impact of Model B on the development of environmental management strategies and the realisation of sustainable development.

An overview of these models (Figure 8.3) highlights how the three models link together, and follows a discussion of each model independently in subsequent sections.

8.3.1 Model A: The Conflict System

To understand the impact of stakeholder conflict on the course of decision-making it was first necessary to examine the nature of the dispute process itself and determine both its causes and consequences (Figure 8.1). Causes of the dispute were recognised to be inputs to the process, constructed from the characteristics of both the problem situation (highlighted in blue) and the people involved within it (highlighted in red). These two factors form the structure of the conflict by determining the nature of its components across the dimensions: needs/interests, structures, power, communication, information, emotions and values. As conflict is recognised as being dynamic over time, history and timing are incorporated into the process via feedback loops and progression through the various models. Links between these components are indicated via arrows; highlighting how elements of one component have the ability to influence others (e.g. values shape emotions, which in turn influence the manner of communication, impacting on the information shared). Consideration of these links highlights the significant impact of individual worldviews and perceptions of importance in determining the input characteristics. Changes in stakeholder composition will therefore directly influence input conditions.

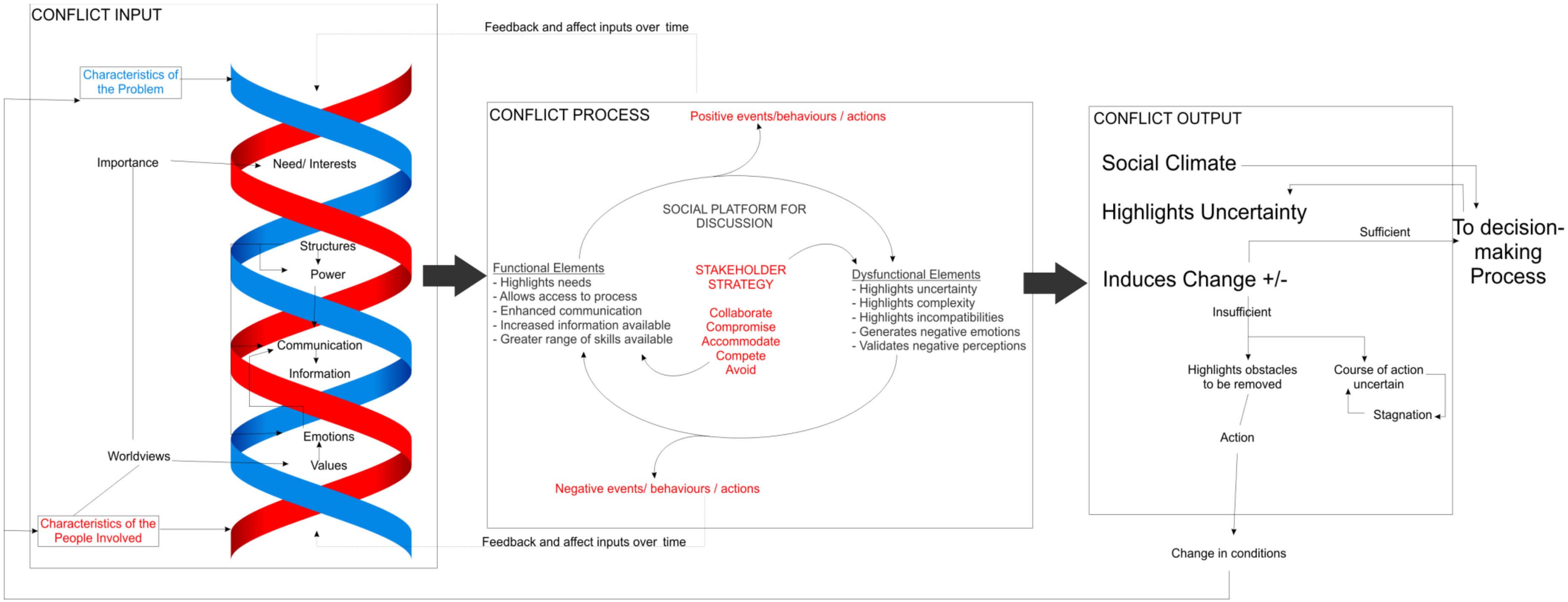


Figure 8.1- Model A: The Conflict System. A conceptual systems model of the conflict process, developed based on both theoretical and empirical study findings.

The conflict processes provides a social platform for discussion of the case. Engagement in this process is recognised to yield a number of functional (e.g. highlighting tacit needs, perceptions, and opinions) and dysfunctional elements (e.g. negative emotional responses). Whether the conflict process yields functional benefits or serves to increase dysfunctional interactions is dependent on the people involved and their individual response to dispute. Five common conflict strategies are identified in the literature (see Blake and Mouton, 1964; Rahim and Magner, 1995): competition (forcing a win-lose scenario), avoidance (ignoring that the problem exists), accommodation (conciliation of one or more groups), compromise (negotiation which generates losses and gains for both sides) and collaboration (allows a win-win scenario). Each individual stakeholder will select (consciously or unconsciously) one of these strategies which will determine the course of action they undertake within the conflict process and the nature of interactions. Not only will the strategy selected affect the cyclical progression of conflict, its severity and nature will also be determined by the comparative choices of other stakeholders. Stakeholders who all select a collaborative conflict style will generate a different conflict process to those that all adopt a competing one or each select different strategies. This will influence the nature of the debate and determine the net balance between functional and dysfunctional elements.

As conflict continues iteratively, there is the capacity for both positive and negative events, behaviours and actions to occur. These are products of interactions not final outputs of the system, and thus are internal within the process. These factors feedback to influence input conditions by changing understanding of the problem or perceptions of opponents. Recognition of this feedback is key, highlighting that the process of conflict can directly influences the factors that create it. This feedback loop highlights why conflict is dynamic over time as the process is self-affecting. The nature of these feedbacks are determined by stakeholders, therefore it is possible to note that inputs will be increasingly influenced by social dimensions. Over time the characteristics of the problem may become obscured by the characteristics and relationships of the stakeholders involved.

The primary output of the conflict system is that it induces change; this may include alterations in understanding, information availability and behaviour, or shifts in emotions, values and perceptions. The nature of the change is dependent on the net balance between functional and dysfunctional elements, and may be either positive or negative dependent on subjective interpretations. The degree of change may be sufficient to allow a decision to be made. The term resolved is not utilised, as it was noted in empirical findings that decision-making can take place without achieving resolution. However, it is important to note that for some cases sufficient change will only be facilitated via conflict resolution. Where the degree of change is insufficient, the process may highlight actions such as obstacles to be removed to allow future movement (e.g. in the case of sustainable hydropower development, conflict highlights the need for legislative change) or remain uncertain and conflict stagnate. Taking strategic action to remove obstacles identified by the conflict process creates a change in external conditions altering input factors. In cases where stagnation occurs, further movement is dependent on independent shifts in external conditions caused by factors unrelated to the conflict process.

Further outputs of conflict are transferred on to affect decision-making processes. Within environmental disputes, the conflict system is recognised to highlight significant uncertainties, increased awareness inevitably weakens decision-making. Furthermore, the social climate within which interactions have occurred, including both functional (e.g. information sharing) and dysfunctional elements (e.g. individualistic strategies) are transferred onto the decision-making process, affecting conception of the problem. Generation and evaluation of relevant options (key stages within decision-making) will be significantly affected by these variables, and in turn will have subsequent impacts on selection and implementation stages. Conflict is therefore recognised to not only induce change to facilitate decision-making in complex scenarios, but to significantly impact on the climate within which it takes place.

Greater understanding of the conflict system prompts consideration of how the process could be manipulated to generate different outputs. Based on the conceptual model, three methods are available; changing input problem characteristics, altering input stakeholder traits or altering the internal processes. The first, changing problem dimension is arguably limited. In the case of achieving environmentally sustainable hydropower, while legislative issues could be addressed, the fundamental incompatibility of core themes could not be altered. In comparison, altering the characteristics of the people involved is much easier by changing the composition of stakeholders involved. However, much of an individual’s character may remain tacit and ability to predict their response is limited, although this approach would yield a different outcome, directing towards a given goal would be difficult to facilitate. Influencing the internal process, by guiding stakeholder interactions, defining collaborative strategies, and actively attempting to maximise functionality and minimise dysfunctional elements, would also alter the nature of outputs produced. Arguably this represents the greatest strategy for successful output alteration, as in time internal feedback between the process and inputs would achieve change across all dimensions.

The conceptual model of the conflict process therefore highlights four key factors:

- Conflict creates change, which induces shifts that facilitate decision-making; it therefore has a clear function.
- Conflict directly influences the climate in which decision-making takes places.
- The conflict process is predominately determined by stakeholders; over time this will increases making outputs more susceptible to subjective biases.
- Over time the nature of change will fluctuate, it may move from positive to negative and vice versa.

8.3.2 Model B: Required Change and Conflict

As the conflict system is dynamic, the nature of outputs fluctuates over time and may move from being beneficial to detrimental and visa versa. These fluctuations are highlighted empirically to create periods of rapid movement followed by pause and/or stagnation. The conflict process is therefore noted to influence the progression of change and course of decision-making. To further identify the impact of stakeholder conflict, this pattern is investigated and a theoretical explanation proposed. It is suggested that incremental changes (generated by Model A) brings the situation (or status quo) closer or further to a point where a decision can be taken. The role of both decision-making and conflict processes are therefore considered in the facilitation of change, this is outlined conceptually in Model B (Figure 8.2) using Newtonian principles and the laws of motion. Concepts from Newtonian principles are used as an analogy to aid conceptualisation of the wider implications of the conflict process, the notion of changes in forces is used to highlight the differential impacts of different combinations of functional and dysfunctional elements on the facilitation of change. It is important to note that the required change model (Figure 8.2) highlights the impact of conflict on the delivery of change. It is envisioned that the process of conflict (outlined in Model A) occurs within the status quo area of Model B. Therefore, while the model may appear to be deterministic in nature it is in fact closer to a stochastic process as each case could evolve in several different directions dependent on the interactions and outputs of Model A over time. It is not intended that Model B infer that the path of conflict is in anyway ascertainable, Newtonian principles serve as an analogy to highlight the differential impacts that different combinations of functional and dysfunctional conflict elements could have on the facilitation of change.

The theoretical considerations that underpin the development of Model B are based on Lewin's (1951) model of planned change, relating the outputs of conflict to a series of resisting and driving forces that must be unbalanced to induce movement and achieve change. In Lewin's (1947; 1951; 1980) work these forces are exerted by opportunities and barriers which may be tangible (e.g. problem-based drivers) or intangible (e.g. cognitive drivers), and are created by the dynamics of the group. It is proposed that the conflict process both highlights these forces and determines their relative strength determining the nature of progression in achieving change. It has been highlighted that in environmental conflict scenarios, while change may be desired, it is more frequently required, a necessity rather than a wish. Consideration of this distinction highlighted that a model of required change would involve more steps than an "unfreezes-movement-refreeze" process, and would be interwoven with both conflict and decision-making processes. Building on the constructs of Lewin's (1951) model, a six stage model of required change (Figure 8.2) was developed to highlight the impact of conflict outputs.

The model is a two-dimensional conceptualisation of the facilitation of a required change, using the concept of forces (generated by conflict) acting on an object to highlight how movement towards a new state is induced. The current situation (or status quo) is denoted as an object (A), its position moves dependent on the forces acting on it in accordance with Newton's laws of motion. The model tracks the nature of the force field (the constellation of forces) and the movement of A in response to a requirement to change. Each stage of the model is discussed independently, followed by consideration of its potential implications in the management of change

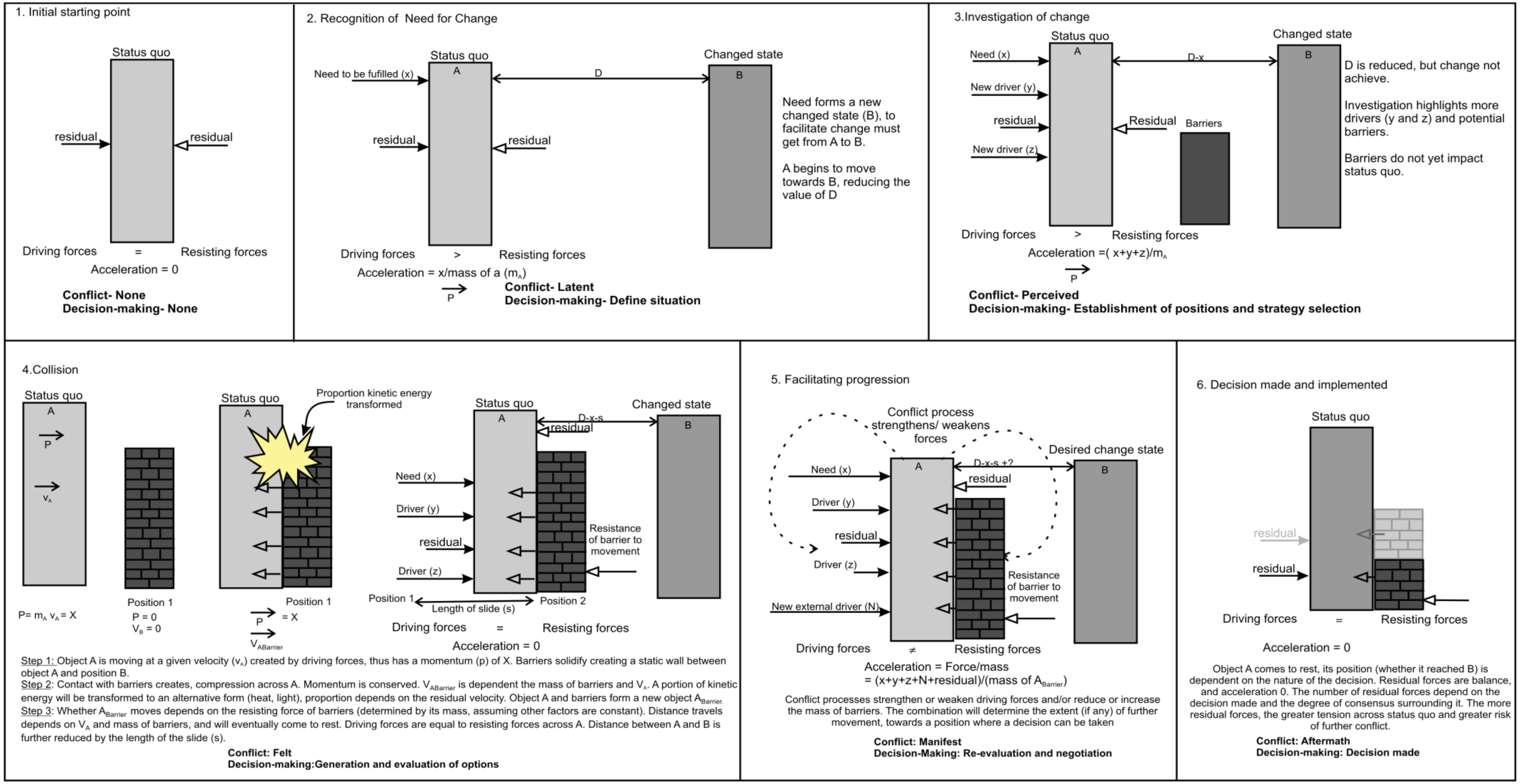


Figure 8.2- Model B: Required Change and Conflict. A conceptual model of the facilitation of required change, developed following comparison of case. The model considers the roles of both conflict and decision-making in inducing movement towards a required changed state, using Newtonian principles and the laws of motion.

1. Initial Starting Point

During the first phase of the model the status quo (A) is at rest, residual forces are balanced and hold the status quo in its current position in accordance with Newton's first law: *every body persists in its state of being at rest or of moving uniformly forward unless acted on by an external force.* As both driving and resisting forces are equal there is no movement, A remains in its current position with an acceleration of 0 change distance /unit time. This phase represents a pre-conflict stage and baseline conditions for change.

2. Recognition of the Need to Change

A change in conditions (internal or external to A) identifies a need which must be fulfilled to address a growing requirement. In the case studies involved these needs include need for renewable energy, or to meet legislative change. As the status quo (A) does not address this in its current position, the need for change and movement towards a state which does is recognised. Thus creating a required state (B) which represents a new status quo position which addresses these new concerns, e.g. a facility which generates renewable energy or system which meets legislative requirements is in place. The distance between the current position (A) and the required new position (B) is denoted by D, the exact value of D is dependent on the need identified and the extent of change required to facilitate it. This distance is theoretical and cannot be measured in reality.

The identification of a new need simultaneously creates a driving pressure to realise it (force x), unbalanced forces now act on A, causing acceleration and movement once resistance is overcome. In accordance with Newton's second law, *the relationship between an object's mass m, its acceleration a, and the applied force F is F = ma*. The mass of A is assumed to be constant throughout this model; therefore increases in forces will yield relative acceleration. As these forces are controlled by the conflict processes with Model A, dispute determines the speed of movement. This initial movement can be attributed to the investigation of change caused by the initial stages of the decision-making process. To determine how to move from A to B requires definition of the situation and the gathering of information, often via stakeholder consultation. The engagement of people yields latent conflict; while present it has not been expressed.

3. Investigation of Change

As the required change is investigated, further opportunities which could be achieved by its facilitation may become apparent, creating additional drivers (forces y and z) generating a further increase in acceleration. The number of opportunities identified will be case and conflict specific. Potential barriers are also highlighted by the investigation of change, they do not yet affect A as attempts have not yet been made to remove them, but will influence future movement if not eliminated. Awareness of barriers and the extent of their importance of mass is determined by the conflict process within Model A. In identifying these barriers and opportunities, several full or partial iterations of Model A may have occurred, outputs will determine the number and strength of additional driving forces and the mass of barriers. As movement towards change accelerates, internally decision-making process such as establishment of positions and individual strategy selection occurs, causing conflict to move from latent to perceived as incompatibilities emerge.

4. Collision

Collision between barriers and opportunities occurs when attempts are made to develop a tangible course of actions. Plans which maximise an opportunity, are often constrained by one or more barriers creating tensions. This often occurs as decision-making progresses to the generation and evaluation of potential options, bringing A into direct contact with the barriers it faces. They therefore become a physical obstacle to change (depicted by barriers forming a wall).

Using the fundamental principles of motion it is possible to map the nature of this theoretical collision. Object A enters the collision moving at velocity $v_{A,}$ determined by the driving forces created in previous stages. As a moving object, A has both momentum (p) and kinetic energy (KE). The ‘wall’ is stationary; its mass is determined by the total number and cumulative strength of barriers. It is assumed that the ‘wall’ represents a static unbreakable object, which will not deform on contact. The collision is assumed to be inelastic (the two object do not bounce apart but remain in contact), this has a number of implications:

1. Kinetic energy is not conserved in inelastic collisions; some will be converted into other forms such as heat or light, and may lead to deformation of objects. The exact

amount lost depends on the nature of the collision. In the conceptual conflict model, the transformation of energy influences the dispute process, energy may be released in the form of frustrations and emotions, deformations may include the breakdown of structures or communications, or the loss of participants, which have dysfunctional effects. Conflict is now felt by those involved.

2. The force of A hitting the ‘wall’ creates an equal and opposite force across A, in accordance with Newton’s third law: *To every action there is always an equal and opposite reaction*. Object A now experiences balanced forces and will no longer continue to move once it has come to rest. This arguably represents a pause in proceedings where following vocalisation of conflict; parties reassess the situation prior to attempting to move forwards.

3. While kinetic energy is reduced, momentum is conserved; the momentum of $A_{Barrier}$ (status quo and the wall) is therefore equal to the momentum of A before the collision. Therefore $A_{Barrier}$ may continue to move to some extent towards B following the collision dependent on the nature of the ‘wall’.

As the wall is a static object, there is a resisting force that must be overcome to induce its movement; the size of that resisting force (F_{res}) will determine the distance travelled under conserved movement. The resisting force is a product of the mass of the barrier, acceleration, the roughness of the contact surface and contact length between the floor and the object. As all other parameters can be assumed to be constant in all conflict scenarios the resisting force is determined by the total mass of barriers. A small resisting force will not change momentum; $A_{Barrier}$ will slide until friction brings it to a halt. For an infinitely large resisting mass, there would be no net velocity and therefore no movement following collision, in this scenario all kinetic energy would be transformed and it would remain at the point of impact (indicated position 1 on Figure 8.3).

The distance moved will therefore be less the larger the mass of the wall, and will determine the change in kinetic energy. The position that the object come to rest at (position 2) is therefore dependent on:

- The momentum of A before the collision (a function of velocity), as this determines the momentum of $A_{Barrier}$ after the collision.

- The mass of the wall (a function of barriers identified), as this determines the size of the resisting force.

Both of these factors are directly controlled by the conflict system (Model A), occurring within A, which serves to both identify opportunities and barriers and determine their relative strength (as a force or a mass). The point at which $A_{Barrier}$ stops is therefore dependent on the nature of the conflict process, determining the extent of further work to be done to realise changed state B. Once it comes to rest, driving forces equal resisting forces generated by the wall, acceleration is therefore 0 change distance /unit time. There is therefore a post-conflict expression stagnation, as an aftermath effect of dispute.

5. Facilitating Progression

Following collision to move A to position B is now much more difficult, fused with the ‘wall’; it has a larger mass requiring a greater force to generate movement. This represents an impasse state, similar to what is seen in the Severn Estuary case study. The resisting force of $A_{Barrier}$ is now greater than in previous accelerations, and therefore requires either a larger driving force or reduction in mass (as all other factors are assumed to be constant) to facilitate movement. As the mass of A is assumed to be constant, this reduction in mass can only be facilitated by decreasing the size of the ‘wall’. Barrier removal or increasing driving forces can only be achieved via the conflict process outputs or changes in external conditions. The nature of interactions within Model A will strengthen or weaken driving forces and the mass of resisting barriers, the net balance will determine whether further movement is possible and acceleration, thus the combination of the change is also important (see Table 8.2).

Table 8.2- Potential change combinations generated by the conflict process

Driving forces **Barriers**	**No Change**	**Increase**	**Decrease**
No Change	No movement	Movement	No movement
Increase	No movement	No movement	No movement
Decrease	Movement	Movement	No movement

Conflict outputs may fluctuate over time, potentially creating corresponding periods of movement and intermission towards a desired change state, as noted in empirical studies. While either the strategy of barrier removal or strengthening driving forces will facilitate movement, they are associated with different levels of difficulty. Pushing against barriers is difficult, particularly as they do not diminish with each movement phase and may increase in mass over time as proximity to a final decision grows (e.g. perception of risk may grow significantly as the decision becomes imminent). While it is possible to increase driving forces, for any given case there are a limited number of opportunities and therefore a limited number of forces. Though it is possible to manipulate the strength of these forces (via Model A), prolonged conflict is over time likely to exhaust or reduce their strength. Removal of barriers represents a potentially more successful strategy to facilitating movement from existing driving forces. Lewin (1951) yields similar conclusions in his planned change model. Reduced resistance to movement also lessens compression across A, reducing tension and increasing the chances of achieving consensus. Conflict, and therefore incremental changes in movement, will continue until resolved or a decision is taken.

6. Decision Made and Implemented

Taking a decision requires selection of a logical choice for subsequent action from available options. Most decision-making techniques involve comparing opportunities (driving forces within the model) with barriers (the ‘wall’ within the model), considering future outcomes and/or implications and determining which is best. The decision taken is therefore dependent on the force field surrounding A at the time of decision-making, a function of the conflict process (Model A). Both theoretical and empirical investigation has highlighted that dependent on the conflict process there are a range of potential decision scenarios (Table 8.3) which may be taken, and are not limited to simply resolved or unresolved. Each has an impact on the final movement and the manner in which the status quo stabilises.

Table 8.3-Potential decision options available and subsequent implications for final movement stage, as determined by the conflict process.

Conflict Status	Problem Status	Decision Option	Impact on Movement
Resolved	Problem solved	Decision A- fully achieved goal, full consensus.	A moves to position B via implementation force
	Trade off	Decision B_1-B_x- Goal partially achieved, partial consensus. Depends on social climate.	A moves towards B, distance is determined by the trade off selected
Unresolved	Abandon problem	Decision C- goal unachieved, full consensus.	No movement, forces are diverted into other projects.
	Problem remains	No decision. Conflict continues or stagnates until change in external conditions.	A stays in current position, awaits shifts in forces via conflict

Each scenario will come to rest with driving and resisting forces balanced. If the issue is resolved and change agreed and implemented only residual forces will remain a product of conflict aftermath. If the problem is abandoned to avoid conflict, driving forces will be removed but barriers will remain. Should the need for future change increase or reoccur, residual barriers will influence its implementation from the beginning. Where conflict remains unresolved, progression to stage six may not be achieved but stagnation over time may give the impression of stability, as in the case of the River Garry. As prolonged conflict is more likely to be dysfunctional in nature, should shifts in external conditions occur, facilitation of change (which may require shifts in attitude and perceptions) may be considerably more difficult.

Model B is assumed to be an open steady state non-conservative system (Figure 8.3). Any changes in external conditions (e.g. in legislation, or shifts in economic climate) will enter the system as inputs. While some may pass through the systems without having an effect, leaving as outputs, others may cause reactions with existing conditions within the boundary volume. Reactions may occur in the conflict system (within object A) and/or change the nature of the required change state (object B). These reactions in turn may create alterations in the force field surrounding A or effect the distance between A and B. It is recognised that as an open system, the ability of mass and energy to cross the boundary may further complicate the theories used to describe internal relationships outlined, exposing them to external influence. In this case, the use of forces and associated fundamental physical principles serves as an analogy to communicate the nature of a social science problem to a scientific audience. To retain simplicity and conceptual strength it is assumed that the system remains constant as a whole, a disturbance from outside may act as a stimulus which the system as a whole then adapts to. Adaptation may require shifts in internal systems.

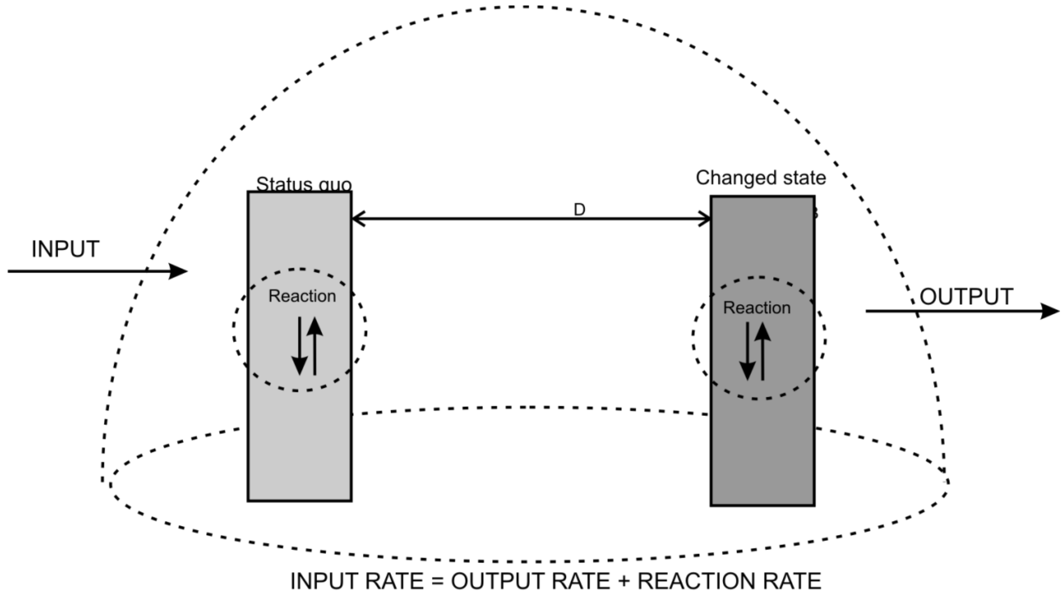


Figure 8.3- Mass balance systems diagram of the open system surrounding the required change model. A steady state non-conservative system is assumed to retain simplicity and conceptual strength.

Using the notion of objects, collisions and forces provides a conceptual analogy which allows visualisation of a proposed theoretical model of the impact of conflict on the facilitation of change. Its conception is based on observed conflict patterns from empirical study and highlights the numerous impacts that the nature of the conflict process has on the facilitation of change and determination of decisions. The model accounts for long histories of iterative conflict patterns (e.g. the case of the Severn Estuary) and accounts for differences in dispute severity and escalation. For example at Gordleton Mill, conflict was insufficient to create adequate forces to deliver change; initial acceleration generated movement but without the support of further forces, lead to a loss of momentum over time prior to a collision. In the case of the River Garry, the considerable nature of barriers faced lead to a collision in which large amounts of kinetic energy were lost in the form of vocalising views and breakdown of communications structures. This suggests that movement under conserved momentum following collision was limited, and generating further movement will be difficult, as encountered in the aftermath of this case study.

Using this model, inferences can be made as to the potential impacts of different pathways through conflict. Disputes which occur earlier on in the process of decision-making are often associated with high functional benefits; in the model this would yield rapid movements due to faster acceleration which would allow greater movement under conserved momentum following collision. Conflict in the later stages linked to dysfunctional behaviours would increase the perceived mass of barriers, increasing amount kinetic energy lost if it occurs prior to collision or increasing the difficulty of restarting movement post collision. Assuming that the amount of energy transformed is proportional to the level of dysfunction experienced, it may be possible to reduce it by controlling the nature of the collision. Increased awareness of opportunities early on in the conflict, combined with a proactive approach to potential barrier removal would significantly alter the collision characteristics, increasing the distance carried under residual momentum and reducing energy conversion, and risk of dysfunction. However, in manipulating the characteristics of the collision care must be taken not to move too quickly, not allowing time for potential barriers to be identified increases risk of an uninformed decision. Similarly, acting too late to remove barriers would be ineffective, the importance of adequately timing interventions is therefore crucial. The model therefore highlights the importance of the preliminary stages of the model, those which are not frequently perceived to be part of conflict. A proactive response to dispute would enable effective management interventions prior to collisions, but requires understanding and recognition of conflict as a process to achieve it.

The conceptual model also clearly highlights the role of conflict as a mechanism for inducing further change once the system comes to rest. While it influences movement throughout the model, its role in stage 5 where it serves to facilitate progression highlights its potential as a means to achieve the required state. The role of conflict is therefore noted to be paradoxical over time, highlighted to create the conditions which stop movement and subsequently provide a method which facilitates it. The ability to manipulate the conflict system (Model A) at this point may have significant benefits for cases of prolonger conflict or environmental impasses (such as the River Garry and the Severn Estuary) as a mechanism to facilitate change, further work is needed to identify whether this is possible in reality. The conflict system is also recognised to determine the state of the force field (net balance between forces) at any given time, its nature at the time of decision-making is a key factor in shaping the decision made. A key observation in the model is that the relationship between conflict and decision-making is not one of cause and effect, but two distinct processes overlaid on top of each other. Both process are however not mutually exclusive, conflict facilitates change but decision-making initiates it, both are therefore required in the realisation of change. Decision-making processes therefore create the conditions for conflict to propagate; dispute in turn creates the environment in which a decision must be taken. Stakeholder conflict is therefore recognised to be an integral to decision-making, with a fundamental impact on the decision taken. Following conflict, the nature of the decision taken will be dependent on conception of the problem, the state of the force field, the perceived future implications and the degree of opposition, all of which are controlled or influenced by the conflict system. As conflict is dynamic the decision taken will also be dependent on the stage of the dispute in its evolution; timing is therefore significant in determining the nature and realisation of change.

The conceptual model therefore highlights three key factors:

- Conflict and decision-making facilitate wider change.
- In times of stagnation, conflict provides a mechanism to induce further movement.
- Conflict is integral to decision-making, though separate processes they are not mutually exclusive.

8.3.3 Model C: Consequences of Change

Following a decision, its implementation determines the nature and direction of environmental management strategies, which have macro-scale impacts for the realisation of sustainable development. Model C (Figure 8.4) considers the long-term implications of the conflict and decision-making process outlined within Models A and B, and represents an amended version of the proposed conceptual framework presented in Chapter 1 (Figure 1.1).

The model identifies the potential inputs to the required change system (Model B); factors such as human needs and environmental degradation, as identified in the original conceptual framework remain. These input factors may independently or collaboratively shift within the status quo, recognition of the need to adapt to changing conditions, creates a pressure to facilitate it, activating the process of required change. Once a decision is taken via the required change model (Model B) and the embedded conflict system (Model A), it is implemented forming the basis of environmental management strategies and subsequent actions. Dependent on the nature of the issue, the strategy taken may or may not have implications within the field. Gordleton Mill represented a flagship case for hydropower in the New Forest; failure to achieve it may prevent alternative local schemes from being developed. At the River Garry, when a decision is taken, it will set a precedent for redevelopment across Scotland, determining the future of Scottish hydropower. Failure to develop in the Severn Estuary may have significant impacts on the investigation of other tidal schemes available at other sites within the UK. While the decisions taken are specific to the case examined, it is possible to note much wider ramifications of the environmental management strategy selected.

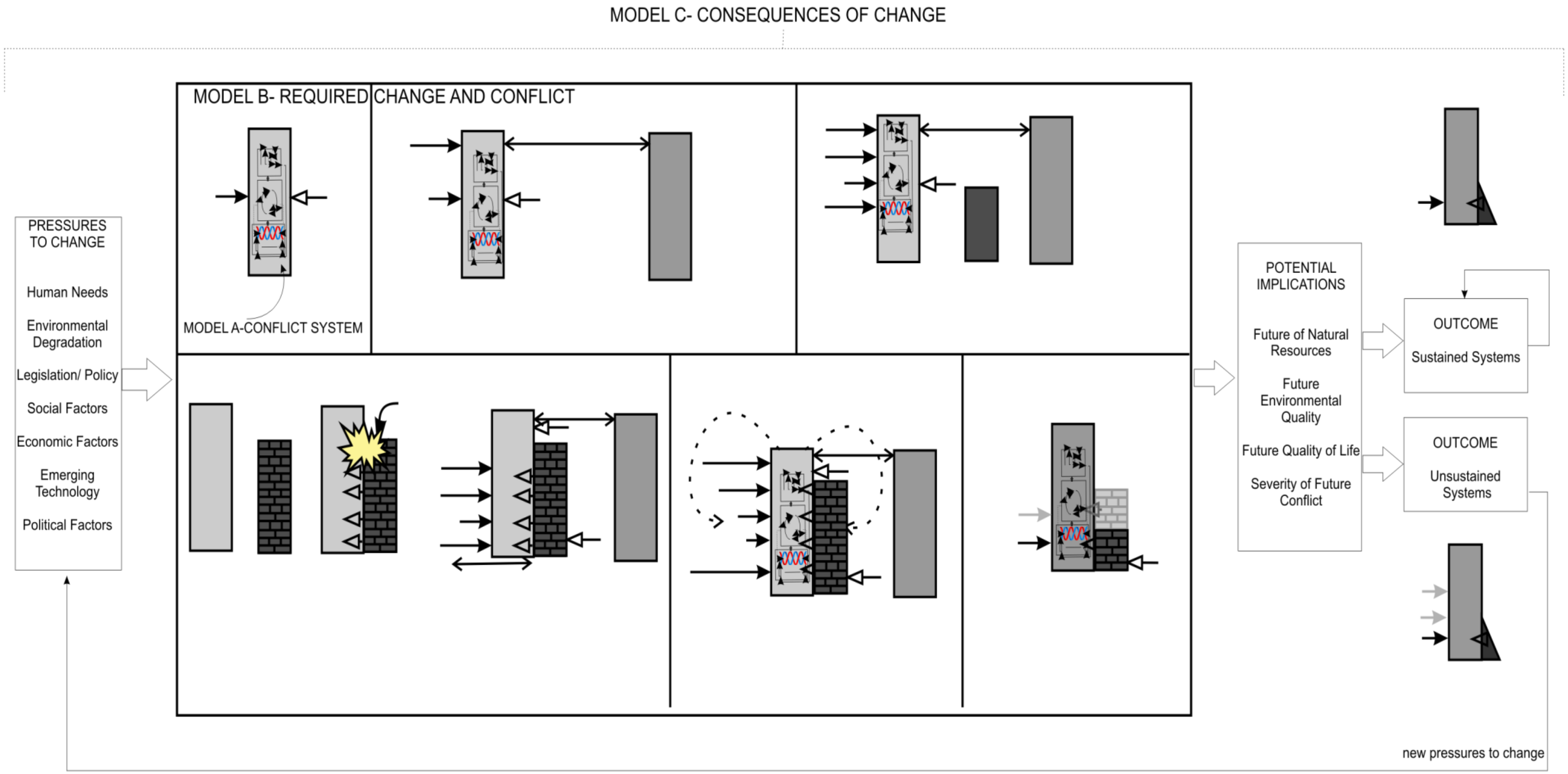


Figure 8.4- Model C- Consequences of change. A conceptual model of the wider implications of conflict on achieving sustainable development. The figure also highlights the relationship between models, how Model A is embedded within Model B, which forms the centre of Model C.

As subsequent actions are implemented they in turn have implications for the factors such as the future quality and quantity of natural resources. The net balance of implications over time of a given environmental management strategy will determine whether the long-term outcome of stakeholder conflict generates sustained systems in which forces are balanced, or unsustainable systems which are unstable and will in time require future change. Should this feedback occur, input conditions are determined by the consequences of the previous iteration. If significant steps towards the realisation of sustainable development principles are not achieved, the pressure to change will have significantly increased over time, further (perhaps more difficult) decisions will be required via (potentially more tenacious) conflict due to the shift in relevant forces.

Comparison between the initial conceptual framework proposed in Chapter 1 (see Figure 1.1) and the model considering the long-term consequences of change (Figure 8.4) highlights significant differences in the internal processes. In the conceptual framework, conflict was denoted as a step within decision-making, the product of disagreement, in practice it is found to be a separate system embedded within the process. A further distinction is that conflict is recognised to be continuously present throughout decision-making, from problem definition to option selection, though largely tacit in initial stages. Conflict is not therefore a step in a linear process, but a continual flux in the iterative course of decision-making, this allows for decisions to be taken despite resolution (not possible in the original conceptual framework) as noted in empirical studies. The notion of a conflict sphere (depicted in Figure 1.1), within a decision-making process, in a given environment is therefore replaced with a dispute system (Model A) inclusive of its settings, embedded in a system of required change (Model B) which yields decisions. This fundamental difference in model design highlights that stakeholder conflict has a significantly greater impact on decision-making than initially hypothesised and in turn important implications for the realisation of sustainable development.

8.3.4 Summary

As the three models are embedded within each other, it is possible to identify the significant impact that stakeholder conflict has on achieving sustainable decision-making. Realisation of sustainable development is dependent on the implementation of appropriate management strategies, which are shaped by the decisions taken, highlighted to be a product of the change process, which is constantly influenced by conflict; a function of the problem and people involved. Consideration of each model in turn has yielded discussion of potential methods to manipulate the outcome towards a desired decision, all of which stem from the ability to direct the conflict system. It is therefore proposed that the current and future proximity of the status quo to the theoretical end point of sustainable development is the product of multiple conflicts. While many factors are highlighted to be involved due to the high complexity of such issues, realisation and facilitation of sustainable development is arguably highlighted to be dependent on the individuals who make the decisions to reach it, their individual characteristics and their interactions over time. Effective management of conflict is therefore a critical point for the realisation of sustainable development. The ability to better direct the course of individual conflicts, regardless of size, provides the opportunity to make small scale changes which may inadvertently lead to cumulative leaps in sustainable environmental management.

8.4 Moving Forward from Conflict

8.4.1 Developing Conceptual Tools

In identifying the impact of stakeholder conflict on achieving sustainable decision-making, a number of conceptual tools have been developed to aid exploration of disputes as outlined in the secondary study aim. In accordance with the ethos of this study, conceptual tools have been designed based on a Mode 2 style approach, intended to yield accessible methods for practitioners. In the course of empirical study, a distinct lack of appropriate tools and the need for environmental conflict management techniques was noted. While conceptual tools developed (outlined in detail below) in the context of this study are used to investigate conflict, they each have significant potential in the field of environmental dispute management.

The Conflict Assessment Helix

If conflict is to provide a mechanism in the management of change towards sustainable development, there is a need for a distinct shift in attitudes and perceptions of conflict. This starts with an holistic understanding of its nature. The helix (see Figure 2.3 presented in Chapter 2) was developed to provide conceptual clarity around the term environmental conflict, by creating a structured framework to consider disputes. Attempts to navigate literature and present an overview highlighted that inability to define and communicate the nature of conflict limits its conceptualisation and may in turn constrain management strategies. The conflict helix is successfully demonstrated to structure consideration of disputes, via its use to arrange facets of an interdisciplinary literature review. Both the conflict assessment helix and associated literature review are intended to provide a working definition of the nature of disputes for practitioners, to be used as a tool to guide their understanding of what parameters may be involved in creating disagreements.

The conflict assessment helix also serves as a diagnostic tool, highlighted empirically in Chapter 5, where it is used to structure investigation of the River Garry case. The ability to draw parallels between the scientific foundations of the helix, and an existing case was noted to enhance understanding of the dispute and simultaneous provide empirical validation of the framework. As a conceptual tool, the conflict assessment helix yields further potential to guide strategic actions, and facilitate successful resolution of disputes. Conflict management should theoretically aim to focus on addressing the top section of the helix (structures, power, needs, interests, information and communication) and seek to control other components (emotions, values, history and timing). While this notion is supported by other conflict resolution tools, further work is needed to empirically validate the success of the helix in such a role.

Integrated Soft Systems Methodology and Force Field Analysis Model

Soft Systems Methodology (SSM) was found to provide structure to complex problems, allowing holistic exploration and detailed analysis. However, during the application of SSM, a number of limitations of the methodology were noted. While there are a number of established techniques (rich pictures, root definitions, conceptual modeling) which are recognisable elements of SSM, there is no defined method as to how it should be used. The implication of this is that the analyst/researcher is of fundamental importance to its progression, and this was experienced during the application of SSM to the Gordleton Mill case study (Chapter 6). SSM is not prescriptive, and within its framework there is considerable room for choice. A major limitation of SSM is therefore that it is can potentially be heavily influenced by the analyst. SSM is specifically designed to be flexible, allowing heterogeneous applications which fit the problem, but as a result its use is inevitably affected by the analyst's perceptions. While this was recognized and reduced by stakeholder consultation and validation, there are some stages in the methodology where the analyst must to a degree interpret the problem, in particular selecting relevant systems from the problem situation to be taken forward for conceptual modelling.

Davies and Ledington (1991) noted that it cannot be assumed that the analysts understanding is 'truer', free from subjective perceptions, or is more accurate than those of the stakeholders. To address this, an adaptation of the methodology is proposed (Figure 8.4), based on the original seven stage methodology of SSM, with additional activities from Force Field Analysis (Lewin, 1951). The purpose of developing this methodology is to place greater control over the progression of SSM with stakeholders, and reduce analyst input. It is hoped that a more self sustaining methodology will provide a greater tool for management of environmental conflict and one that stakeholders themselves can implement.

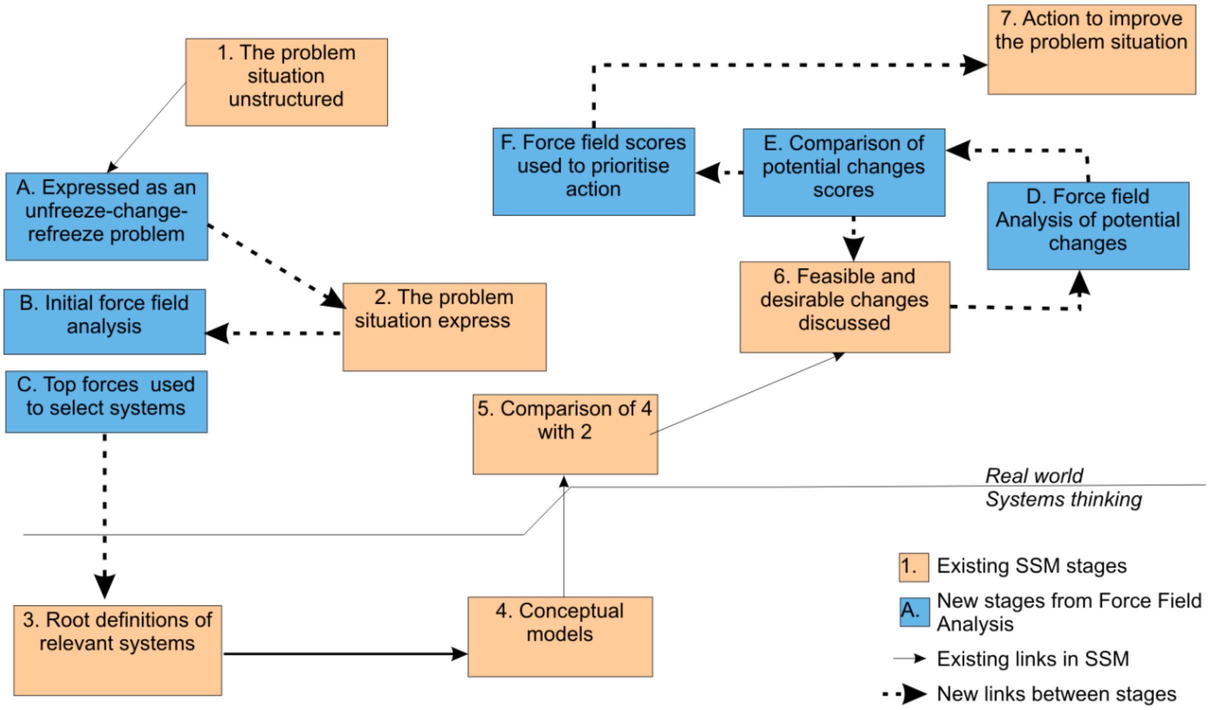


Figure 8.5-An adapted environmental conflict methodology developed based on limitations experienced during empirical studies. The seven stages of Soft System Methodology with integrated activities from Force Field Analysis (adapted from Lewin, 1951; Checkland, 1985).

As discussed, Lewin's (1951) force field analysis (FFA) provides a framework for problem solving and the implementation of change. Diagnosis of the problem using this method recognizes the presence of opposing and supporting forces of change and measures their relative strength (as highlighted in Chapter 7). It is proposed that simultaneously undertaking FFA at various stages of SSM would aid problem definition, and allow stakeholders to place subjective values on concerns identified. These values can then be utilised as a tool to select relevant systems. While determining the threshold value will remain in the analyst control, such an approach removes the need for the analyst to distil key themes, thus systems taken forward for conceptual modeling would represent the top stakeholder perceived opportunities and barriers, not the analyst interpretation of the greatest.

A further weakness highlighted throughout the study was that while SSM significantly increased understanding and altered problem conception, it did not facilitate decision-making. SSM identified a set of potential changes but with no consideration of their feasibility. The conceptual models developed in SSM are not the output of the process; they are not designed to be implemented but to stimulate debate (Checkland, 1985). Therefore SSM provides no method to prioritise or optimise actions and facilitate change. As SSM supports discussions of potential actions, FFA could be used to measure the opportunities and barriers associated with that change, allowing comparison among options. Where multiple actions are required, it could also serve as a method to prioritise actions, identifying those which are likely to yield the most significant change; providing a tool for long term conflict management.

Having identified these modifications it was intended that the new hybrid methodology be validated by application to the River Garry case study. However, due to a number of barriers experienced (see Chapter 5), stakeholder participation was too low to facilitate its use. Testing of this methodology and its additional development therefore represents an area of further work to be considered.

8.4.2 Challenges and Limitations

As pressures on the environment grow and management becomes more complex, the need to address conflict and ability to adequately manage disputes will become increasing important in determining future conditions. If successful conflict management is to be achieved, a number of challenges and limitations experienced in the course of this study must be overcome.

A key challenge identified within this research is the need to effectively communicate what is known about conflict, to enable a shift in its conceptualisation and greater attention to the proactive management of disputes. This thesis attempts to begin to dispel common misconceptions of conflict by highlighting its impact and the fundamental importance of attempting to ensure functional interactions. It is important that environmental management practitioners recognise that conflict is not necessarily negative, and that better control of interactions may yield potentially significant benefits. Conflict, proactively managed, could allow the emergence and implementation of more innovative decisions in response to current environmental issues. However, this is dependent on whether such notions of conflict are accepted and adopted by practitioners. If not, practitioner attitudes will inevitably limit the impact of this work and similar studies, and reactive responses to conflict will continue in existing patterns. Practitioner attitudes and perceptions of the approach and conceptual tools themselves, will therefore determine the usefulness of conceptual tools developed, and in themselves may present a significant barrier.

Where the need for new approaches to conflict is acknowledged, translating recognition to practical action requires both conceptual tools and stakeholder participation. While within the context of this study, practical tools for conflict management have been suggested, they are of little use if they are not adopted by practitioners. In attempting to validate conceptual tools a number of barriers to stakeholder participation were highlighted, particularly within the River Garry study (see Chapter 5). These barriers were highlighted to be a function of both external application of the methodology and the stakeholders themselves. The disparity noted between the recognition of the importance of the production of tools for practitioners, and an unwillingness to openly participate, represents a significant challenge for the future of environmental conflict management. For conceptual tools to aid conflict management, they must be tested and refined within the context of existent disputes and validated to become an accepted methodology and tool. This requires practitioners to overcome any reservations associated with unfamiliar methodologies and perceived risks. Further work is needed to identify and address concerns and enhance practitioner confidence in conflict management tools, but this requires participation and thus may be constrained by the stakeholders themselves.

Within the context of this study, the methods utilised have been applied externally. If methods were internally applied, many issues experienced, such as fears of confidentiality risks, would potentially be removed. However, internal application generates further challenges; it increases the risk of bias. Determining who leads the process could have implications for stakeholder invitation and strategy selection and there is potential risk of manipulation of the conflict process for individual gain. While the purpose of this study was to identify the impact of stakeholder conflict on decision-making, its intention was that knowledge gained be used to enhance the process. However, without appropriate structures in places there is potential for conceptual tools to be used to the detriment of decision-making. While establishing methods and gaining stakeholder acceptance is crucial, regulating the potential manner of use is a further challenge, and one that requires further study and consideration.

8.5 Conclusions

The principal aims of this thesis have been to evaluate the impact of stakeholder conflict on achieving sustainable decision-making, using the issue of hydropower development as a case study, as well as to develop conceptual tools to aid exploration of the social dimensions of disputes. Based on both theoretical and empirical research (presented in Chapters 2-7), the previous chapter highlighted and discussed the nature, role and potential implications of stakeholder conflict, as well as discussing the conceptual tools developed and possible challenges in implementing them. The overall conclusions to be taken from this work, in relation to study objectives are outlined in the following sections.

8.5.1 Main Conclusions

The review of conflict and decision-making literature in Chapter 2 showed that environmental conflict had much broader parameters and theoretical implications than many would recognise under the common usage of the term. Conceptual ambiguity and lack of a commonly agreed definition were highlighted as factors that currently limit application of active conflict management principles and use of existing established techniques from other disciplines. Current ambiguity regarding the classification of environmental conflict scenarios highlighted this. The creation of a framework for structured conceptualisation and diagnosis of conflict represented an attempt to address this ambiguity. It has been demonstrated, via critical evaluation of literature, that conflict is not inevitably negative, and is a misconception that must be discredited. It is recognised that conflict provides a platform for expression of information, opinions and emotions, which in turn may yield functional and dysfunctional consequences for decision-making. The net balance between the two effects is recognised to be case specific and subjective, with consequences for both the individual and the collective. It was established that the impact of the individual, both their interests and character, had the potential to significantly alter the course of conflict and the decision taken. Variables such as perceptions, behaviours and personalities, alongside interests and values dictate activities within the conflict process.

Examination of examples of hydropower conflicts throughout Chapters 5, 6 and 7, established that the theoretical parameters highlighted via the critical review of literature had empirical merit. It was determined that environmentally sustainable hydropower development represented a complex dilemma, requiring choices over ecological, economic and social dimensions to be made. Variables such as emotions, worldviews, behaviours and other cognitive functions were recognised to influence the nature and progression of dispute. The assessment of conflict cases at a range of spatial and temporal scales established the capacity for escalation, stagnation, project abandonment and the development of impasses as potential dispute outcomes. Cases demonstrated resolution is not required for decision-making to occur, but conflict does directly influence the nature of that decision.

Via comparison of case studies, it has been established that environmental conflict is comprised of both the problem itself, and the characteristics of the people involved. Features of the sustainable hydropower development problem were recognised to be: incompatibility of core themes and associated legislation, the dominance of fisheries' concerns and inherent uncertainties. These should be regarded as priority areas for conflict management specifically within the field of hydropower development. Other features such as social characteristics and behaviours attributed to the people involved have been noted to give conflict its bespoke qualities. These elements must be recognised as fundamental components of environmental conflict if dispute management is to be achieved. Comparison of cases established that conflict adheres to a distinct cyclical process which is dynamic over time, characterised by rapid movement and subsequent periods of stagnation. The iterative nature of conflict has been attributed to functional and dysfunctional changes in both internal and external conditions. Progression from conflict to decision-making is therefore recognised to not be a linear process that always results in resolution. It has been observed that the nature of conflict at the point of decision-making and the content of the choice determined whether further dispute occurred or was abandoned. This suggests that conflict serves a functional purpose for the stakeholders involved.

A three-tiered conceptual framework illustrating the impact of conflict on decision-making and the facilitation of required change in environmental management has been developed and amended following empirical study. It was established that conflict represents a mechanism for change (both positive and negative); its local impacts were recognised to have wider implications. It was illustrated that each tier of the model is embedded within its successor; therefore decision-making is significantly influenced by the nature of stakeholder conflict. This is noted to allow the impact of conflict to propagate beyond the boundaries of a specific dispute and influence environmental management strategies. The framework therefore offers an alternative manner of thinking about the function and role of environmental conflict. It is proposed that conflict represents a critical point for overseeing the course of environmental management and the potential facilitation of sustainable development. It has been demonstrated that the conflict system is heavily influenced by stakeholders, recognised to determine both input factors and internal processes. Realisation of sustainable development may therefore be dependent on the people involved within environmental debates.

The identification, application and further development of methodologies has yielded a number of conceptual tools for conflict management. The practical applications of these tools include conflict diagnosis, problem structuring and facilitation of collaborative discussions. It is intended that they be implemented to manage conflict processes, to attempt to ensure positive interactions at this critical point. Validation of these potential functions represents an area for further research. In accordance with the ethos of this study, tools have been selected and further developed so as to be directly available and accessible to environmental practitioners, intended to enhance stakeholder understanding of disputes. With stakeholder perceptions and worldviews recognised as a fundamental component of environmental conflict, mechanisms which facilitate change in these characteristics may represent the only avenue for altering the nature of disputes and their subsequent outcomes. It is proposed that this will become increasingly important as characteristics of the problem shift as environmental pressures grow.

This programme of study identified the impact of conflict to highlight its potential capability to facilitate sustainable decisions, if appropriate dispute-based management strategies can be adopted. The extent of success of such an approach will be dependent on participant acceptance of unfamiliar methods. Potential challenges have been discussed and inability to achieve acceptance recognised as a potential limitation to the use of conceptual tools and successful conflict management. Translating recognition of the need for new approaches to environmental conflict situations highlighted in empirical studies into practical action has been identified as a barrier that must be removed. Despite the identified limitations, the notion of conflict as a critical management point for the realisation of sustainable development has significant potential, and conceptual tools developed are useful additions to environmental dispute managers. This research was intended to highlight the possible capabilities of stakeholder conflict management, further study is needed to refine and advance its conclusions.

8.5.2 Recommendations for Further Research

A number of recommendations for further research or policy action are provided below:

1. Conflict represents a critical management point for sustainable development, it is therefore necessary to establish appropriate techniques within the wider field of environmental management.
2. Further research is required to validate the models developed is required to aid stakeholder acceptance of the approach.
3. There is a need to determine who is responsible for leading and promoting conflict management. Environmental regulators represent an evident choice, but this role is not yet explicitly part of their remit.

8.5.3 Recommendations for Practitioners

Based on the findings of this work a number of recommendations for practitioners are provided below:

1. Establishing an understanding of the holistic nature of conflict is a necessity, it underpins successful management.
2. It is strongly recommended that the social principles outlined in this study are embraced. Equal focus on the issue and the people involved is essential.
3. The range of potential conflict scenarios is virtually infinite; practitioner should be familiar with a range of tools to use as applicable.
4. Attempts to address conflict must incorporate a range of viewpoints and encourage learning and reflective practice, providing a path to continual improvement and conflict management.

A key barrier to effectively managing conflict is that it is often diagnosed unconsciously, responded to emotionally and choices are often made based on poor diagnosis without actively assessing the dispute. To effectively address conflicts, practitioners must explore why conflict is occurring, identify barriers to settlement and highlight actions to manage or resolve the dispute systematically and collaboratively. A conflict road map is presented (Figure 8.6) which recommends a basic course of action for practitioners to ensure effective diagnosis and intervention. It is intended that Figure 8.6 provide a guide to systematically addressing conflict prior to or after manifestation, it does not represent a formula which will resolve all disputes.

Figure 8.6 A Conflict Roadmap to Guide Practitioner Actions

8.5.4 Contributions to Existing Knowledge and Thinking

As a result of this thesis a number of original contributions were made:

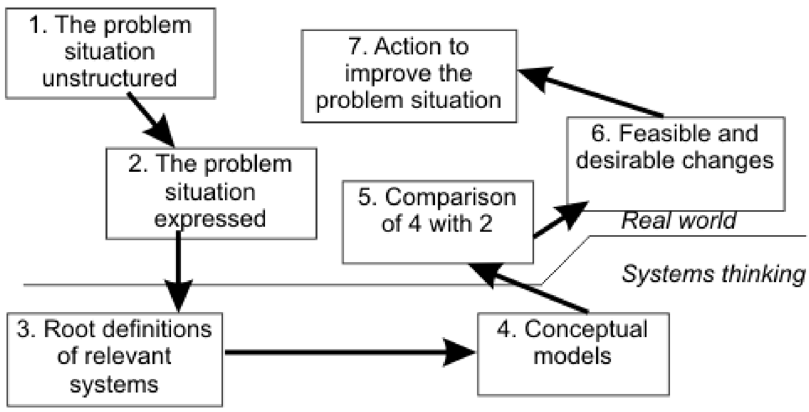
- The study presents a new approach to the conceptualisation of environmental conflict, which broadens understanding of the parameters involved, the extent of its impact and its potential importance. This shift in comprehension is intended to subsequently yield practical changes in management approaches to environmental conflict.
- Critical review of conflict literature draws from interdisciplinary sources which were analysed to generate a holistic understanding of the dispute process. As many reviews do not extend beyond a given discipline, this represents a novel contribution;
- In recognition of current limitations, a conceptual framework for conflict definition and diagnosis was created, (Chapter 2) and validated (Chapter 5). As a practical conceptual tool it represents a contribution to both methodology and practice;
- The first published case (to the extent of the authors' knowledge) of the use of soft systems methodology as a tool for environmental conflict management in the UK, and first known application to the issue of hydropower development globally. See Watkin, L., Kemp, P.S., Williams, I.D. and Harwood, I.A. (2012) Managing sustainable development conflicts: the impact of stakeholders in small-scale hydropower schemes. *Environmental Management*. 49, 6: 1208-1223;
- Based on both theoretical and empirical findings a conflict system model was developed (Chapter 8), which allows in depth understanding and conceptualisation of disputes and contributes to environmental dispute theory;
- Formulation of a framework of embedded models (Chapter 8) reflecting the wider impacts of conflict on the realisation of required change and sustainable development represents a further contribution to theory. Highlighting conflict as a critical management point for sustainable development may in time yield practical contributions;
- Based on limitations experienced during application, an adapted conflict methodology is developed (presented Chapter 8), this represents a methodological contribution;
- The study recognises stakeholder conflict as a potential mechanism for the realisation of sustainable development, representing a novel theoretical and potential practical approach to the facilitation for sustainable decisions in the future.

8.6 Closing Remarks

This research demonstrates the parameters of stakeholder conflict which affect the course and outcomes of environmental decision-making. Conflict is recognised as a complex process, multiple factors interact to influence its nature, role and progression over time. Faced with an increasing number of complex environmental dilemmas globally, it is concluded that changing the nature of decision-makers' interactions represents an overlooked avenue towards the realisation of sustainable development. Incorporation of conflict-based approaches to environmental management could yield significant benefits and facilitate significant change. While active investigation on the nature of environmental problems is crucial, translation of findings into tangible actions remains the product of interactions between people and therefore representing a parallel research strand. Recognition of the potential conflict holds as a mechanism to achieve sustainable change is crucial for the future of environmental management.

Appendices

<u>Appendix 1: Detailed outline of the Severn Stages of Soft System Methodology</u>



Stages 1 and 2

The first step in SSM is to acknowledge, explore and define the situation. The best studies have been characterised by collecting multiple perceptions of the problem situation, building up the richest picture of the problem situation as possible. While a seemingly crude tool, making drawings to indicate the many elements of any human system is a key feature of SSM. Its rationale lies in the fact that human affairs are always a complicity of multiple interacting relationships and pictures are a better medium for their expression (Checkland, 2000). In a practical sense, overt mathematics will render analysis incomprehensive to most participants thus graphical representation has the greatest potential. Diagrams can display intricate networks of influence, causality, similarity or compatibility (Rosenhead and Mingers, 2001). The function of stages 1 and 2 is to display the situation so that a range of possible and hopefully relevant choices can be revealed (Checkland and Scholes, 1999).

Stage 3

Having fully mapped the problem situation, SSM then moves into the conceptual world. The primary activity in this stage is to define the situation. For relevant systems a root definition, a concise description of a human activity system, which captures a particular view of it and may include constraints in the definition, is developed (Checkland, 1999). Checkland provides guidelines in the mnemonic CATWOE (Customer, Actor, Transformation, Weltanschuuang, Owner, Environment) to develop a clear definition of purposeful activity to be modelled. Several root definitions may be developed for each of the human action systems identified.

Stage 4

For each root definition a conceptual model is built, which identifies the minimum necessary activities for that system and the relationship between them. It is important to note that at this point it is a theoretical model and must not be influenced by knowledge of the “real” world. The model should cover all aspects of the root definition; it should not be possible to remove elements from the root definition without altering the model. Checkland (2000) recommends that models are hand drawn and that initial expression is simple, allowing progression to stage 5 and then iteration through the stages.

Stage 5

The purpose of stage 5 is to generate debate over change. There are four methods to do this; using the conceptual model as a basis for ordered questioning, comparison with a historic case study, highlighting differences from present reality or modelling existing reality and directly overlaying.

Stage 6

The purpose of stage 6 is to define possible changes that are arguably desirable and feasible having regard to the situation under examination and given the prevailing attitudes and power structures. This should be done as a debate among concerned participants. The changes can be of three kinds: procedural changes (how activities are done within the structure), structural changes (organisational groupings, responsibility); or attitudes (changes of influence, learning, values and norms). These are generally speaking listed from least to most difficult.

Stage 7

In stage 7, actions are taken to improve the problem situation based on the results of stage 6. The end product of this stage is a new problem situation that can again be tackled using the methodology in a cyclical fashion.

Appendix 2: Table of Current UK River Campaigns and Associated Issues Championed.

Coverage	Campaign name	Feature issue
National	Our Rivers	Management
	Save our Waterways	Navigation
	River Access Campaign	Access
	Swimming in Lakes and Rivers	Recreation
	The End of the Line	Fisheries
	Surfers against Sewage	Pollution/recreation
	Marine Conservation Society	Fisheries
	Fight the Funding cuts: SOS 2010	Funding
England	Save our Severn	Hydropower
	Stop the Barrage now	Hydropower
	Save the Ribble	Hydropower
	Save the Levels	Development
	Save Independent Punting	Recreation
	Save Radley Lake	Bank development
	Angling Trust: Foremark Reservoir Campaign	Fisheries
	Action for the River Kennet	Management
	Thames 21	Pollution
Wales	Campaign for the Protection of Welsh Fisheries	Fisheries
	Gower Save our Sands	Dredging
Scotland	Save the Garry	Hydropower
	Save the Doon	Hydropower

Appendix 3: Table of Stakeholder Organisations by Category and the Associated Stakes.

	Stakeholder Name	Nature of Stake
GOVERNMENT	Department of Environment, Food and Rural Affairs	Responsible for some regulatory controls over range of topics: agriculture, coastal protection and flood defence, tourism, recreation and access and fisheries.
	Department of Energy and Climate Change	Responsible for all aspects of UK energy policy, and for tackling global climate change on behalf of the UK.
	Natural England	Champions the conservation of wildlife and geology throughout England.
	Forestry Commission	Responsible for the protection and expansion of Britain's forests and woodlands.
	Office of Gas and Electricity Markets	Promote competition and regulate monopoly companies which run the gas and electricity networks.
	Local Government	Responsible for the delivery of a wide range of services and functions within constituency.
	Planning Inspectorate	Process planning and enforcement appeals and hold examinations into development plan documents.
	Scottish Government	Responsible for the day-to-day issues in Scotland: health, justice, environment and sustainable development.
	Sustainable Development Commission	Government's independent adviser on sustainable development.
	Environment Agency	Governments lead advisor on environmental issues in England and Wales. Numerous themes: flood risk, water management, biodiversity and conservation.

	Stakeholder Name	Nature of Stake
REGULATOR	Environment Agency Scottish Environmental Protection Agency Northern Ireland Environment Agency	Responsible for granting applications, setting environmental criteria and licensing for hydropower developments.
DEVELOPER	Corporate-mixed generation	Responsible for the hydro schemes.
	Corporate- hydropower	Responsible for delivering product to customers.
	Private Developer	Responsible for delivering profits to shareholders. Responsible for sustainable use of the environment.
FINANCE	Commercial Banks	Responsible for lending and repayment of loans.
	Private Funded Companies	Responsible for providing money or services in return for profit.
MEDIA	Newspaper, Television, Internet	Responsible for informing the general public on stories of interest.
LEGAL	European Union	Responsible for numerous directives which influence on hydropower development.
	Central Government	Responsible for numerous laws which influence on hydropower development.
	Environment Agency	Enforce numerous environmental laws.

	Stakeholder Name	Nature of Stake
COMMUNITY	Property Owners	Have ownership over dwellings and associated land. Maybe riparian owners.
	Local residents	Will be impacted by local benefits/damages.
	English Heritage	Responsible for matters related to scheduled monuments, listed buildings and registered parks.
	Tourist Board	Responsible for enhancement of tourist opportunities.
	National Farmers Union	Promotes successful and socially responsible agriculture.
	General Public	May influence decision making via purchasing behaviour.
CUSTOMER	Electricity Customers	Require reliable service. Require cost to be maintained or lowered.
	Indirect-flood defence	Require schemes to maintain or enhance flood defence.
	Indirect- recreation	Require schemes to maintain or enhance facilities for recreation.
	Indirect- water management	Require schemes to maintain or enhance water available for alternative purposes.

FISHERIES	Salmon Fisheries Boards (Scotland)	Represent and promote the interests of Scottish salmon and sea trout fisheries.
	Environment Agency	Responsible for maintaining, improving and protecting fisheries.
	Angling Trust	Represent all game, coarse and sea anglers and angling in England.
	Salmon and Trout Association	A UK-wide charity with an interest in conserving the aquatic environment for fish.
	Fishing Clubs/ Fishermen	Require maintenance or enhancement of associated fisheries.
	Stakeholder Name	Nature of Stake
	Friends of the Earth	Champion sustainable development. Favour renewable energy technologies.
	Wildlife Trust	Conserve a range of the UK's habitats and species. Potential ecological lobby.
	Royal Society for the Protection of Birds	Focused on protection for birds. Position is scheme dependent.
	Greenpeace	Champion global environmental issues. Favour renewable energy technologies.
	Consultancies	Provide expertise and engineering, project and construction management services.
	Research Institutions	Provide expertise, guidelines and technical environmental solutions.
	Local Action Groups	Consists of interested volunteers from the public, private and voluntary sector. Champion a range of pro and anti hydropower issues.
	Recreation	Require schemes to maintain or enhance facilities for existing recreation activities.
	Archaeology	Require schemes to identify and protect existing features of archaeological importance.

Appendix 4: Register of Legislation which Impacts on the Development and Maintenance of Hydropower Electric Power Schemes.

International Legislation

Field	Legislation
Water	Water Framework Directive (2000/60/EC)
Energy	Renewables Directive (2001/77/EC)
Planning	Environmental Impact Assessment (97/11/EC)
Conservation	The Habitats Directive – The Directive on Conservation of Natural Habitats and of Wild Flora and Fauna (92/43/EEC)
	The European Communities Directive on the Conservation of Wild Birds (79/409/EEC
Fisheries	Freshwater Fisheries Directive (78/659/EEC)
	The Eel Regulation (1100/2007/EC)
Climate Change	Kyoto protocol

UK Legislation

Field	Legislation
Water	Water Act 2003
Energy	Renewables Obligations order 2002 White paper on energy 2007 Energy Act 2008 Electricity Act 1989
Planning	Town and Country Planning Regulations 1999 Planning Policy Statement 22: Renewable Energy
Conservation	Conservation Regulations 1994 Wildlife & Countryside Act 1981
Fisheries	Salmon & Fresh Water Fisheries Act (SAFFA), 1976 Marine Bill 2008
Climate Change	Climate Change Act 2008 Climate change and Sustainable Energy Act 2006

		Key areas influencing hydropower development	Relevance
WATER	Water Framework Directive (2000/60/EC)	The purpose of this Directive is to establish a framework for the protection of inland surface waters, coastal waters and groundwater which: (a) prevents further deterioration and protects and enhances the status of aquatic ecosystems (b) promotes sustainable water use based on a long-term protection of available water resources; (c) aims at enhanced protection and improvement of the aquatic environment, (d) contributes to mitigating the effects of floods and droughts Under Article 4.1 Member States shall protect, enhance and restore all bodies, including all artificial and heavily modified bodies of water, with the aim of achieving good ecological potential and good surface water chemical status at the latest 15 years from the date of entry into force of this Directive (2015). Under Article 4.5 Member States may aim to achieve less stringent environmental objectives when the achievement of these objectives would be infeasible, and all the following conditions are met: (a) the environmental and socioeconomic needs served by such human activity cannot be achieved by other means. (b) the highest ecological and chemical status possible is achieved (c) no further deterioration in the status occurs Under Article 4.7 Member States will not be in breach of this Directive when, failure to prevent deterioration from high status to good status of a body of surface water is the result of new sustainable human development activities and all the following conditions are met: (a) all practicable steps are taken to mitigate the adverse impact on the status of the body of water; (b) the reasons for those modifications or alterations are specifically set out and explained in the river basin management plan required under Article 13 and the objectives are reviewed every six years; (c) the reasons for those modifications or alterations are of overriding public interest and/or the benefits to the environment and to society, and Under Article 9 Member States shall take account of the principle of recovery of the costs of water services, including environmental and resource costs, having regard to the economic analysis. Member States shall ensure by 2010, that water-pricing policies provide adequate incentives for users to use water resources efficiently	It is the WFD's "no deterioration" requirement that needs to be considered when developing and operating hydro schemes. Under the Directive, Members States can be permitted to allow deterioration in the status of a water body where a number of conditions can be met and it can be proven that the benefits of doing so outweigh the benefits of maintaining that status. As the Article identifies the benefits to the environment and society on the one hand, and to sustainable development on the other, it is necessary to compare the economic, environmental and social benefits provided by the hydropower scheme to the economic, environmental and social benefits of maintaining the status. As it can be difficult to identify the benefits of maintaining the status, the approach taken to date has been to take the economic, environmental and social costs associated with the scheme development and operation to represent the benefits of maintaining the status.

		Key areas influencing hydropower development	Relevance
WATER	Water Act 2003 Amends the Water Resources Act 1991	Subject to the following provisions, no person shall— (a) abstract water from any source of supply; or (b) cause or permit any other person so to abstract any water, Except in pursuance of a licence granted by the Authority and in accordance with the provisions of that licence. No person shall— (a) begin, or cause or permit any other person to construct or alter any impounding works at any point in any inland waters which are not discrete waters; or (b) cause or permit the flow of any inland waters which are not discrete waters to be obstructed or impeded at any point by means of impounding works, Unless: (a) a licence under this Chapter granted by the Agency to obstruct or impede the flow of those inland waters at that point by means of impounding works is in force; (b) the impounding works will not (or, as the case may be, do not) obstruct or impede the flow of the inland waters except to the extent, and in the manner, authorised by the licence; and	Hydropower requires an abstraction licence; to obtain one there is an application charge of £135 plus any additional costs occurred in processing applications. In addition an annual subsistence charge is incurred; the amount varies based upon volume and source of water abstracted, season and region. There is no annual charge to impound. If in obtaining either licence, the application requires advertising for comment, an additional £100 will be charged in addition to advertising costs.
ENERGY	Renewable Energy Directive (2009/28/EC) Amends: (2001/77/EC) (2003/30/EC)	To ensure increased market penetration of electricity produced from renewable energy sources in the medium term, all Member States should be required to set national indicative targets for the consumption of electricity produced from renewable sources. For the UK targets require by 2020: • 20% of energy across the EU to be renewable • 15% of energy in the UK to be renewable Member States shall, not later than 27 October 2003, ensure that the origin of electricity produced from renewable energy sources can be guaranteed as such within the meaning of this Directive according to objective, transparent and non-discriminatory criteria laid down by each Member State.	The Renewable Energy Directive (RED) imposes stretching renewable targets, which include hydropower for 2020 across the EU. Require development of mechanism to prove renewable electricity targets are met.

<table>
<tr><th></th><th></th><th>Key areas influencing hydropower development</th><th>Relevance</th></tr>
<tr><td>ENERGY</td><td>Renewables Obligations Order 2009</td><td>Transposes directive into UK law. Each designated electricity supplier shall produce to the Authority evidence showing -

(a) that it has supplied to customers in Great Britain such amount of electricity generated from eligible renewable sources as is determined under article 6; or
(b) that another electricity supplier has done; or
(c) that, between them, they have done so.

A renewable obligation certificate (ROC) shall be regarded as the evidence or part of the evidence required from the designated electricity supplier. ROCs are to be issued to the operator of the generating station by which the electricity to which the ROC relates was generated. One ROC is issued for each megawatt hour (MWh) of eligible renewable output generated.

The buy-out fund relating to a relevant obligation period shall be divided amongst each of those designated electricity suppliers which, in respect of that period, has complied (in whole or in part) with its renewables obligation by producing to the Authority certificates. Each such supplier receives that proportion of the buy-out fund which is equal to the proportion which the electricity covered by the certificates it has produced to the Authority.

Renewable Obligation targets 2009-2015 (%)
<table>
<tr><th></th><th>England and Wales</th><th>Scotland</th><th>Northern Ireland</th></tr>
<tr><td>2009</td><td>9.1</td><td>9.1</td><td>3.0</td></tr>
<tr><td>2010</td><td>9.7</td><td>9.4</td><td>3.5</td></tr>
<tr><td>2011</td><td>10.4</td><td>10.4</td><td>4.0</td></tr>
<tr><td>2015</td><td>15.4</td><td>14.4</td><td>6.3</td></tr>
</table>
Introduces a banding system whereby number of ROCs per MWh varies dependent on generating technology. Scheme extended through to 2037.</td><td>Electricity suppliers meet the obligation by purchasing renewable electricity from accredited suppliers, a ROC is provided for each MWh purchased.

ROC’s demonstrate supplier’s compliance with annual obligation, their price may fluctuate but value of electricity remains the same. Currently the average ROC price is £52.90 (07/07/09).

Suppliers unable to purchase enough ROC’s can buy out. The current buy-out price set by OFGEM is £37.19 per megawatt hour (for period 2009-2010).

Acts as an incentive to take part and exceed targets

Hydropower remains 1 ROC for 1 MWh</td></tr>
</table>

		Key areas influencing hydropower development	Relevance
ENERGY	White Paper on Energy – Meeting the Energy Challenge 2007	Sets out the Government's international and domestic energy strategy, its four main aims: • to cut the UK's carbon dioxide by some 60% by about 2050, with real progress by 2020. • to maintain the reliability of energy supplies. • to promote competitive markets in the UK and beyond, • to ensure that every home is adequately and affordably heated. The UK will need around 30-35GW of new electricity generation capacity over the next two decades as many of the UK's current coal and nuclear power stations, built in the 1960s and 1970s, reach the end of their lives and are set to close. Renewable energy is an integral part of the Government's strategy for reducing carbon emissions as renewable energy resources produce very little carbon or other greenhouse gases. Renewables can make a contribution to security of supply, by diversifying the electricity mix and reducing the need for energy imports This White Paper confirms intention to strengthen the Renewables Obligation, increasing the Obligation to up to 20% and proposes the introduction of a banding system which was implemented in 2009; to encourage development and deployment of a broader set of renewable technologies. Based on projections proposals to strengthen and modify the RO will see electricity supplies from renewable sources tripling between now (2007) and 2015 to around 15% of the total electricity supplied. The RO and the Climate Change Levy exemption is projected to provide around £1billion of annual support for deployment of renewable electricity in 2010, rising to around £2billion of annual support in 2020.	Renewable energy development features heavily in plans to achieve government aims.
	Energy Act 2008	Support the rapid increase in renewables needed to meet our ambitious 2020 renewable targets. These measures include: - Strengthening the Renewables Obligation (RO). - Introducing Feed in Tariffs for small and community scale low carbon electricity generation. - Enabling the Renewable Heat Incentive, to support renewable heat projects of all scales. - Supporting the growth of offshore renewables by strengthening and extending our regulatory regime for offshore electricity transmission. This will be key to connecting large scale offshore renewables projects to the onshore electricity network	The Act reforms the RO by 'banding' it to pull through more investment in technologies which are further from commercial deployment (such as offshore wind) and reducing the level of support to more established technologies, such as co-firing. This will improve the efficiency of the mechanism.

		Key areas influencing hydropower development	Relevance
ENERGY	Electricity Act 1989	Formulating any relevant proposals, a licence holder or a person authorised to generate or supply electricity— (a) shall have regard to the desirability of preserving natural beauty, of conserving flora, fauna and geological or physiographical features of special interest and of protecting sites, buildings and objects of architectural, historic or archaeological interest; and (b) shall do what he reasonably can to mitigate any effect which the proposals would have on the natural beauty of the countryside or on any such flora, fauna, features, sites, buildings or objects.	In addition the act provides core legislation for planning consents for the construction and operation of generating stations.
PLANNING	Environmental Impact Assessment (97/11/EC)	This Directive shall apply to the assessment of the environmental effects of those public and private projects which are likely to have significant effects on the environment Member States shall adopt all measures necessary to ensure that, before consent is given, projects likely to have significant effects on the environment by virtue inter alia, of their nature, size or location are made subject to an assessment with regard to their effects. The environmental impact assessment will identify, describe and assess in an appropriate manner, in the light of each individual case and in accordance with the Articles 4 to 11, the direct and indirect effects of a project on the following factors: • human beings, fauna and flora, • soil, water, air, climate and the landscape, • the inter-action between the factors mentioned in the first and second indents, • material assets and the cultural heritage. Projects of the classes listed in Annex II shall be made subject to an assessment, in accordance with Articles 5 to 10.	The EIA Directive requires environmental impact assessment to be carried out before consents for development are granted for certain types of projects which are judged likely to have significant environmental effects Annex II includes Installations for hydroelectric energy production
	Town and Country Planning Regulations 1999	Transpose Environmental Impact Assessment (EIA) framework into UK law.	Hydropower schemes with a generating over 0.5 megawatts must be screened by the planning authority. Schemes (less than 1MW) are not always required to provide an EIA, but an assessment is likely to be required to accompany the licence applications.

		Key areas influencing hydropower development	Relevance
PLANNING	Planning Policy Statement 22: Renewable Energy 2004	Renewable energy developments should be capable of being accommodated in locations where the technology is viable and environmental, economic, and social impacts can be addressed satisfactorily. Small-scale projects can provide a limited but valuable contribution to overall outputs of renewable energy and to meeting energy needs both locally and nationally. Planning authorities should not therefore reject planning applications simply because the level of output is small. Planning permission for renewable energy developments likely to have an adverse effect on sites of international and national importance for nature and heritage conservation. Permission should only be granted once an assessment has shown that the integrity of the site would not be adversely affected.	Provides guidance for local authorities in regards to planning permission for renewable projects
CONSERVATION	The Directive on the Conservation of Wild Birds (79/409/EEC	The Birds Directive provides a framework for the conservation and management of, and human interactions with, wild birds in Europe. The Birds Directive is implemented through the Wildlife & Countryside Act 1981 and The Conservation (Natural Habitats, &c) Regulations 1994. Areas requiring protection to support wild bird populations are designated as Special Protection Areas (SPA).	There is potential for negative impacts from hydropower schemes although this varies dependent upon size and location to SPA's.
	The Habitats Directive – The Directive on Conservation of Natural Habitats and of Wild Flora and Fauna (92/43/EEC)	Aims to maintain biodiversity by requiring Member States to take measures that maintain or restore natural habitats and wild species of favourable conservation status, and by introducing robust protection for habitats and species of European importance. If the impacts of a scheme are such that an appropriate assessment is required, Member States must ensure that a balance is struck between social, environmental and economic considerations.	Potentially hydropower impact: Annex 1- habitats: • Callitricho-Batrachion vegetation • Floating vegetation of Ranunculus of plain and sub mountainous rivers • Rivers with floating vegetation often dominated by water-crowfoot Annex II- species • Austropotamobius pallipes - White-clawed (or Atlantic stream) crayfish • Petromyzon marinus- Sea lamprey • Lampetra planeri - Brook lamprey • Lampetra fluviatilis- River lamprey • Alosa alosa- Allis shad • Salmo salar- Atlantic salmon • Cobitis taenia- Spined loach • Cottus gobio- Bullhead

		Key areas influencing hydropower development	Relevance
FISHERIES	Freshwater Fisheries Directive (78/659/EEC)	This Directive concerns the quality of fresh waters and shall apply to those waters designated as needing protection or improvement in order to support fish life. The aim of this Directive is to protect or improve the quality of those running or standing fresh waters which support, or which, if pollution were reduced or eliminated, would become capable of supporting, fish belonging to: (a) indigenous species offering a natural diversity; (b) species the presence of which is judged desirable for water management purposes by the competent authorities of the Member States. Within the Directive: • salmonid waters-belonging to species such as salmon (*Salmo salar*), trout (*Salmo trutta*), grayling (*Thymallus thymallus*) and whitefish (*Coregonus*); • cyprinid waters- to the cyprinids (*Cyprinidae*), pike (*Esox lucius*), perch (*Perca fluviatilis*) and eel (*Anguilla anguilla*). Member States shall, for the designated waters, set values for the parameters listed in Annex I, in so far as values are listed in column G or in column I. They shall comply with the comments contained in each of these two column	The Directive seeks to protect fresh water bodies identified by Member States as waters suitable for sustaining fish populations. For such waters it sets physical and chemical water quality objectives for salmonid waters and cyprinid waters. The Directive will be repealed in 2013 by the EC Water Framework Directive.
	The Eel Regulation (1100/2007/EC)	The European eel stock is outside of safe biological limits and current fisheries are not sustainable. It is recommended that recovery plans be developed for the whole stock of European eel and that exploitation and other human activities affecting the stocks be reduced as much as possible. The objective of each Eel Management Plan shall be to reduce anthropogenic mortalities so as to permit with high probability the escapement to sea of at least 40% of the silver eel biomass relative to the estimate of escapement that would have existed if no anthropogenic influences had impacted the stock. An Eel management plan may contain structural measures to make rivers passable, temporary switching off of hydro-electric turbines.	The requirements in the UK will be fulfilled by the production of management plans at River Basin District (RBD) level, and monitoring to assess the efficacy of these plans. The plans will reinforce the focus on the acceptability of fish pass design for eel migration, both upstream and downstream.

		Key areas influencing hydropower development	Relevance
FISHERIES	Salmon & Freshwater Fisheries Act (SAFFA), 1975	Where in any waters frequented by salmon or migratory trout— (a)a new dam is constructed or an existing dam is altered to create increased obstruction to the passage of salmon or migratory trout, or any other obstruction to the passage of salmon or migratory trout is created, increased or caused; or (b)a dam which from any cause has been destroyed or taken down to the extent of one-half of its length is rebuilt or reinstated, the owner of the dam or obstruction shall, if so required by notice given by the water authority and within such reasonable time, make a fish pass for salmon or migratory trout of such form and dimensions as the Agency may approve as part of the structure of, or in connection with, the dam or obstruction, and shall thereafter maintain it in an efficient state. Screening applies in any case where— (a)by means of any conduit or artificial channel, water is diverted from waters frequented by salmon or migratory trout; and (b)any of the water so diverted is used for the purposes of a water or canal undertaking or for the purposes of any mill or fish farm; Where this section applies, the responsible person shall, unless an exemption from the obligation is granted by the Agency, ensure (at his own cost) that there is placed and maintained at the entrance of, or within, the conduit or channel a screen which, prevents the descent of the salmon or migratory trout The responsible person shall, unless an exemption from the obligation is granted by the Agency, ensure (at his own cost) that there is placed and maintained across any outfall of the conduit or channel a screen which prevents salmon or migratory trout from entering the outfall. Currently there is discussion over modernisation of SAFFA to include criteria from the Water Framework Directive and Eel Regulation.	The Act requires that owners/operators of hydropower schemes on migratory rivers should, at their own expense, ensure that upstream and downstream fish passages, respectively, are catered for by the construction of appropriate fish passes, screens and by-washes.

		Key areas influencing hydropower development	Relevance
FISHERIES	Marine and Coastal Access Act 2009	Special procedure for applications relating to certain electricity works This section has effect in cases where a person who proposes to carry on an activity must first make both— (a) an application for a marine licence to carry on that activity, and (b) a related application for a generating station consent. (2) A "related application for a generating station consent" is an application for a consent under section 36 of the Electricity Act (consent for construction etc of generating stations) in relation to— (a) the activity for which the marine licence is required, or (b) other works to be undertaken in connection with that activity. In the Salmon and Freshwater Fisheries Act 1975 (c. 51), section 1 is amended as follows for "salmon, trout or freshwater fish" substitute "salmon, trout, eels, lampreys, smelt, shad, freshwater fish and any specified fish in any waters".	The Bill simplifies the consenting of wind, wave and tidal projects (of 100MW or less in output) by ensuring only one administrative process is used to consider all the marine elements of an application. The Bill modernises powers for the management of migratory and freshwater fisheries. In particular the Marine and Coastal Access Bill introduces a new licensing and authorisation system for fishing activities, and gives the Environment Agency powers to make emergency byelaws to respond to unforeseen threats to fish stocks.
CLIMATE CHANGE	Kyoto protocol	The Kyoto Protocol is an international environmental treaty with the goal of achieving "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." It establishes legally binding commitments for the reduction of carbon dioxide, methane, nitrous oxide, sulphur hexafluoride, hydrofluorocarbons and perfluorocarbons. Under the Kyoto Protocol, industrialized countries agreed to reduce their collective green house gas (GHG) emissions by 5.2% from the level in 1990.	The U.K. is a signatory to the Kyoto Protocol. This commits the UK to reduce its emissions of greenhouse gases by 12.5 per cent between 1990 and 2012. This target driver policy.
	Climate Change Act 2008	It is the duty of the Secretary of State to ensure that the net UK carbon account for the year 2050 is at least 80% lower than the 1990 baseline.	Renewable energy development will help achieve these targets.
	Climate Change and Sustainable Energy Act 2006	The Secretary of State must, during the period beginning with 1st November 2008 and ending with 31st March 2009— (a) designate one or more national micro generation targets, and (b) publish a statement of that fact together with a copy of the target or targets Amends sections of the Electricity Act 1989 to include green certificates and the renewables obligation for micro generation.	States various measures on micro generation. Provide access to ROC's for small generators.

Proposed changes to the Salmon and Freshwater Fisheries Act, 1975.

Current provisions	Amendments proposed
Duty to make and maintain fish passes	
When any new dam or similar is built, or any works take place that increase the obstruction in existing dams or similar, that prevent the migration of salmon or sea trout the owner/ occupier must build and maintain fish passes	Extend to all fish. This will include eels, shad, smelt and lamprey, together with those fish species that need to access other parts of the water course to complete their lifecycle. Extend to widen circumstances in which a pass can be required. Extend to place duty on current owners/occupiers to maintain fish passes.
Environment Agency power to construct and alter fish passes	
The Environment Agency has the power to construct and maintain, and abolish, alter or replace a fish pass.	Extend to include all species above. Extend to include power for the Environment Agency to require fish pass in extant obstructions. Extend to take ownership of structures where this is not known Remove curtailment on the Environment Agency to act if this affects milling power.
Consents and approvals for fish passes	
The Environment Agency may issue provisional or final approval for each fish pass, and the applicant will be liable for any associated costs.	Extend so that an approval can have conditions attached, including one requiring application for Final Approval Extend so that a structure not originally built as a pass can be approved as one
Sluices	
Sluices for drawing off water which would otherwise flow over any dam in waters frequented by salmon or sea trout must be closed on Sundays and whenever the water is not needed for milling.	Repeal – to be dealt with via the provisions for fish passes and screens.
Screens	
Screens must be provided to prevent salmon or migratory trout accessing water channels which prevents their migration, or to prevent the egress of fish from a fish farm.	To be extended to all migratory species. Environment Agency to be able to specify form and dimensions of screens. Clarify that responsibility to maintain screens lies with the owner of the conduit even if the Environment Agency placed it. Remove pre 1923 exemption
Agency power to use screens etc to limit movements of salmon and trout	
The Environment Agency has the power to insert screens, and to widen any watercourse where a screen is placed in order to ensure that the flow of water is not prejudicially diminished.	Extend to include all species above. Extend to take ownership of structures where this is not known

Source: Consultation on modernisation of salmon and freshwater fisheries legislation; new order to address the passage of fish: Annex A. (Defra, 2009)

Appendix 5: Stakeholders Identified for Potential Participation the Severn Estuary Survey

- ABPmer
- Allerton Environmental Group
- APEM Ltd
- Aquatronics Ltd
- Associated British Ports
- Association of Severn Estuary Relevant Authorities
- Atlantic Salmon Trust
- Avon Wildlife Trust
- Barnt Green Fishing Club
- Barry Yacht Club
- Berkley Town Council
- Berrow Parish Council
- Brean and Berrow Residents Association
- Brean Parish Council
- Brean Land Yacht Club
- Bridgend County Borough Council
- Bristol & Gloucestershire Archaeological Society
- Bristol Channel Association of Sea Anglers
- Bristol Channel Counter Pollution Association
- Bristol Channel Yachting Conference
- Bristol City Council
- Bristol City Museum and Art Gallery
- Bristol Naturalists Society
- Bristol Port Company
- Bristol Ornithological Club
- British Energy
- British Waterways
- British Wind Energy Association
- Business West, West England Strategic Partnership
- CADW: Welsh Historic Monuments
- Caldicot and Wentlooge Levels Drainage Board
- Campaign to Protect Rural England
- Cardiff Council
- Cardiff Harbour Authority
- Environment Agency-Cymru
- E-on UK
- Falmouth Friends of the Estuary
- Farming and Wildlife Advisory Group
- Forest of Dean District Council
- Forestry Commission
- Frampton on Severn Parish Council
- Freight by Water
- Friends of the Earth
- Glamorgan- Gwent Archaeological Trust
- Gloucester City Council
- Gloucester Harbour Trustees
- Gloucestershire Association of Parish and Town Council
- Gloucestershire County Council
- Gloucestershire Wildfowlers Association
- Government Office for the South West
- Greenpeace
- GWE Business West
- Gwent Angling Society
- Gwent Wildlife Trust
- Halcrow Group Limited
- Halcyon Marine Hydroelectric Corporation
- Horizon Nuclear Power
- Highways Agency
- JBA Consulting
- Institution of Civil Engineers
- Joint Nature Conservation Council
- Malvern Wells Parish Council
- Marine Fisheries Agency
- Monmouthshire County Council
- Nailsea Town Council
- National Assembly for Wales
- National Association of Boat Owners
- National Farmers Union (South West)
- Sedgemoor District Council
- Sedgemoor/Bridgewater Harbour Authority
- Severn Barrage or What?
- Severn Estuary Coastal Group
- Severn Estuary Conservation Group
- Severn Estuary Fishermans Association
- Severn Estuary Levels Research Committee
- Severn Estuary Partnership
- Severn Estuary Research Group
- Severn Rivers Trust
- Severn Tidal Power Group
- Shawater Ltd
- Severn Trent Plc
- Somerset County Council
- Somerset Wildlife Trust
- South Gloucestershire Council
- South West of England Regional Development Agency
- South West Regional Assembly
- South West Tourism
- Sports Council for Wales
- Standing Conference of Severnside Local Authorities
- Stop the Barrage Now Campaign
- Stroud District Council
- Sully Community Council
- Surfers Against Sewage Campaign
- Sustainable Development Commission
- Sustrans
- Tewkesbury Borough Council
- The Bristol Port Company
- The Environment Council
- The Vale of Glamorgan Council
- The Wye and Usk Foundation
- Tidal Electric Ltd
- Tidal Lagoons Ltd

Cardiff Naturalists Society
CEFAS
City and County of Swansea Council
Civil Engineer Contractors Association
Cleeve Parish Council
CoastNet
Commercial Boat Operators Association
Confederation of British Industries
Conwy Council
Council for British Archaeology
Council for the Protection of Rural England
Country Land and Business Association, Avon/Somerset
Countryside Agency for the South West
Countryside Council for Wales
Crown Estate
DEFRA
Department of Business Innovation and Skill
Department of Communities and Local Government
Department of Energy and Climate Change
Department of Transport
Devon Conservation Forum
Devon County Council
East of England Rural Forum
Eco Reef Group
EDF Energy
English Heritage
Environment Agency

National Farmers Union (Wales)
National Grid
National Trust
Natural England
Natural Environmental Research Council
Neath Port-Talbot County Borough Council
Newport City Council
Newport Harbour Commissioners
North Devon & Somerset Coastal Group
North Somerset Flood Risk Action Group
North Somerset Council
OFGEM
Parents Concerned about Hinkley
Perpetual Power
Portishead Cruising Club
Ramblers Association
Renewable Energy Association
Royal Institute for Chartered Surveyors
Royal Yachting Association
RSBP
RSBP-Cyrmu
RWE nPower Renewable
Salmon and Trout Association
Save our Severn
Scottish and Southern Energy
Seaview Lads Fishing Club
SeBAS

Town and Country Planning Association
Trust for the Promotion of Environmental Awareness
UK Business Council for Sustainable Energy
UK Chamber of Shipping
University of Bristol
University of Cardiff
University of Glamorgan
Wales Coastal and Maritime Partnership
Wales Tourist Board
Water Power Engineering
Welsh Assembly Government
Welsh Ornithological Society
Welsh Water (Dwr Cymru)
Welsh Yachting Association
Wentloog Wildfowling & Conservation Association
Wessex Water
West Somerset District Council
Westminster Dredging Company Ltd
Weston-Super-Mare Town Council
Wildfowl and Wetlands Trust
Winterbourne Parish Council
Wildlife Trust
Wotton-under-Edge Town Council
World Wildlife Fund
WS Atkins
Wye Valley Society

Appendix 6: Questionnaire sent to Stakeholders via Postal Survey

<u>Hydropower in the Severn Estuary</u>

The feasibility of harnessing the Severn Estuary for power generation has been periodically revisited over the last 30 years. Recently the UK Government discarded plans to develop the Severn Estuary for hydropower, but it has been suggested that plans may be readdressed in the future. This questionnaire focuses on the views of the stakeholders regarding both current and future decision making.

Section A

1. Which of the following statements most closely represents your position on hydropower in the Severn Estuary? *(please tick one answer)*
   - o There should be no hydropower development in the Severn Estuary at all.
   - o Hydropower in the Severn Estuary should be fully considered, but not necessarily developed.
   - o If an appropriate agreed solution can be found, hydropower should be developed.
   - o Hydropower in the Severn Estuary is an important resource which should definitely be developed.
   - o Do not know

2. Prior to the Government's decision, were you aware of the difficulties that have arisen in developing an agreed solution in the Severn Estuary? *(please tick one answer)*
   - o Yes
   - o No (*skip to Q12*)
   - o Do not know (*skip to Q12*)

3. How important is the issue of hydropower development in the Severn Estuary to you? *(circle the appropriate number)*

Not at all important				Extremely important
0	1	2	3	4

Section B

The following section assesses different elements of the Government's recent decision. *(circle the appropriate number)*

	Strongly disagree	Tend to disagree	Neither agree nor disagree	Tend to agree	Strongly agree
4. To what extent do you agree with the Government's decision to discard plans to develop the Severn Estuary for Hydropower?	0	1	2	3	4
5. To what extent do you agree the decision was supported by evidence?	0	1	2	3	4

	Scientific literature	Theoretical model	Data-based model	Economic analysis	Anecdotal	Historic	Case study based	Expert opinion	None
6. What type of evidence were you provided with to validate the decision? *(tick up to 3)*									

	Governmental (central/ regional)	Local Authority	Specialist Agency (e.g. DEFRA)	Industrial	Specialist Consultant	Trade Association	Academic	Interest Group	Action Group	Media	Other	None
7. What type of stakeholder informed you of the decision regarding the Severn Estuary? *(tick all that apply)*												

Section C

The following section asks for your opinions on development of the Severn Estuary. (*please include any information you feel is relevant*)

8. What was the cause of debate over development of hydropower in the Severn Estuary?

9. Should development of hydropower in the Severn Estuary be revisited, what actions should be taken to resolve any potential debate?

Section D

The following section assesses potential difficulties and opportunities associated with the development of the Severn Estuary for hydropower.

10. Please rate the extent to which you feel the following factors would be a barrier to reaching an agreed strategy for hydropower development in the Severn Estuary in the future. *(circle the appropriate number or symbol)*

Factor	Not at all a difficulty				An extremely large difficulty	Not aware of factor
Variable energy generation amounts	0	1	2	3	4	X
Pattern of power delivery to the grid	0	1	2	3	4	X
Uncertain project costing	0	1	2	3	4	X
Funding availability	0	1	2	3	4	X
Technology available	0	1	2	3	4	X
Existence of other renewable technologies	0	1	2	3	4	X
Potential impact on shipping	0	1	2	3	4	X
Potential impact on tourism	0	1	2	3	4	X
Reduction in recreational opportunities	0	1	2	3	4	X
Impact on local archaeology	0	1	2	3	4	X
Potential impacts on local jobs	0	1	2	3	4	X
Potential drops in water levels	0	1	2	3	4	X
Loss/ weakening of the Severn bore	0	1	2	3	4	X
Potential damage to the physical estuary environment	0	1	2	3	4	X
Impact on bird populations	0	1	2	3	4	X
Impact on migratory fish populations	0	1	2	3	4	X
Current environmental legislation	0	1	2	3	4	X
Uncertain extent of impacts	0	1	2	3	4	X
Number of people involved	0	1	2	3	4	X
The decision- making process	0	1	2	3	4	X
Involvement in the decision- making process	0	1	2	3	4	X

11. Please rate the extent to which you feel the following factors could be an opportunity to reaching an agreed strategy for hydropower development in the Severn estuary. *(circle the appropriate number or symbol)*

Factor	Not at all an opportunity				An extremely large opportunity	Not aware of factor
Generates renewable electricity	0	1	2	3	4	X
Provides a domestic source of supply	0	1	2	3	4	X
Positive impact on the local economy	0	1	2	3	4	X
Long operational lifetime	0	1	2	3	4	X
Opportunity for local development	0	1	2	3	4	X
Positive impact on the local job sector	0	1	2	3	4	X
Improved transport links	0	1	2	3	4	X
Reduction in CO_2 emissions	0	1	2	3	4	X
Increased flood protection	0	1	2	3	4	X
Potential increases in tourism	0	1	2	3	4	X
Potential improvements in turbidity	0	1	2	3	4	X
Potential improvements in turbidity	0	1	2	3	4	X
Potential increase in biodiversity	0	1	2	3	4	X
Increase in recreational opportunities	0	1	2	3	4	X
Current energy legislation	0	1	2	3	4	X

Please return this survey in the pre-addressed envelope provided.

Thank you for completing this questionnaire.

ID number:

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