CEFOS

Center for Public Sector Research

Göta Älv River Risk Governance

A case study of consensus-style regulation

Marianne Karlsson

CEFOS Report
2010: 1

UNIVERSITY OF GOTHENBURG

ISSN: 1653-1264

CEFOS – The Center for Public Sector Research at the University of Gothenburg was established in 1991 as part of a national long-term program for multidisciplinary research on the public sector.

CEFOS initiates and supports research on the public sector, with special focus on local and regional levels.

CEFOS' purpose is to bring researchers and groups of researchers from a variety of disciplines together in a creative and stimulating academic environment.

The author:

Marianne Karlsson has a MSc in Risk Analysis and works as a project assistant at CEFOS

CEFOS publications on the internet:

http://www.cefos.gu.se/publikationer/

Contact:

CEFOS
University of Gothenburg
PO. Box 720
405 30 Göteborg
Sweden

Tel +4631-786 41 42
Fax +4631-786 44 80
E-mail office@cefos.gu.se
Internet www.cefos.gu.se

Content

Acknowledgements

This report is build upon research undertaken within the research project 'Risk Decisions within the Transportation Sector' (TRANSAM). This work is funded by research grants from the Swedish Research Council, the Swedish Rescue Services Agency, the Emergency Management Agency, the Swedish Governmental Agency for Innovation Systems, the Swedish Road Administration, and the Swedish Maritime Administration. I am very grateful to Åsa Boholm for her support throughout the writing of this report. I also wish to thank Max Boholm, Hervé Corvellec, Peter Dellgran, Vicki Johansson, Ragnar Löfstedt and Henry Rothstein for constructive criticism and suggestions as well as the respondents who so freely shared their perspectives on the issue with me.

1. Introduction

In the field of risk research, the notion of 'risk governance' is increasingly used to portray synergies created when a multiplicity of actors impact risk decision-making. While research on risk regulation has for the last 25 years acknowledged that relationships between public authorities and private corporations shapes regulatory outcomes (e.g. Vogel, 1986) the idea of risk governance has gained momentum after the regulatory scandals such as the BSE in the 1990's, when the ability of governments to handle risks on their own and in discretion was questioned (e.g. Löfstedt, 2005, IRGC, 2009). Risk governance can be conceived as an overarching structure in which conventional components of risk analysis; risk assessment, risk management and risk communication are embedded in (Renn, 2008).

A departure for the study of risk governance has been the risk issue as such; once a risk has been identified an elaborate mapping of regulations and governance actors can commence and subsequently be branded a risk governance regime (Hood, Rothstein & Baldwin, 2001, Renn, 2008). An underlying tacit assumption is that the inherent character of a particular risk is, or should be, related to what governance arrangements unfold. This assumption is problematic. If risks are treated as separate entities which harbours their own logic of governance processes (Renn, 2008), the situated character of risk (Boholm, 2003) is overlooked, risks are decontextualized from wider societal structures and risk governance regimes tend to be regarded as isolated units. Moreover, by narrowing down risk governance to models enabling given or negotiated acceptable risk levels (Renn, 2008) or by backtracking policy origins and regulatory enforcement (Hood et al, 2001), well established practices not adhering to formal risk governance policy models fail to be acknowledged.

While risks, ranging from chemicals to natural hazards, interact in complex casual relationships (Boholm, M, 2009), little attention has been directed towards the interrelationships between risk governance regimes. This report addresses the current limitations of risk governance research by presenting a case study of three intersecting risk governance regimes existing within a geographically bounded area, a river valley.

Risk governance is according to Gunningham et al (1998) the application of key features of governance to decision-making on risk. Theories of governance implicate that the traditional role of the state has been modified through themes such as globalisation, deregulation and privatization and has been described as a shift from 'government to governance' (Rhodes, 1997). Rule by government may be thought of as vertical hierarchical authority deriving from a single actor, namely the state. In contrast, governance is generally described as horizontal networks consisting of multiple actors, including public authorities and private actors, participating in formulating public policy (Mört, 2004) hence blurring traditional regulatory-regulatee relationships (Sahlin-Andersson, 2004). In governance networks, negotiations between actors have been emphasised as central for policy

outcomes. Actors, moreover, participate in decision-making on a voluntary basis (Webb,2002), which Mört (2004) links to flexible regulatory outcomes that are not legally binding, commonly labelled 'soft-law' or 'soft-regulation'(Ahrne& Brunsson, 2004).

The shift from government to governance has, however, been criticised for being overly simplistic, and it has been argued that additional regulatory modes may coexist with a strong state that intervenes through traditional command-and-control interventions (e.g. Purvis, 2002, Sorensen and Torfting, 2005). Regulatory interventions resembling governance have also been observed in risk regulation. For example, Europe in general and Sweden in particular, have been known to embrace consensus-style regulation in contrast to adverisal style regulation common in America (Brickman et al, 1986, Kelman, 1981, Lundqvist, 1981, Löfstedt, 2005, Vogel, 1985). Consensus-style regulation is notably informal and flexible where a limited number of affected parties, including industry representatives participate in closed negotiations before a policy is drafted. Kelman (1981) relates the strong Swedish preference for consensus decisions to a historical tradition of subordination to elite authority. He further argues that regulatory institutions have developed in an 'accomodationst' style, thus bringing parties to negotiations, which in turn encourage agreement. Consensus-seeking regulation and a tradition of negotiations resemble risk governance, which in it simplest form is the interaction between public and private actors in decision-making on risk.

There are, however, several interpretations of risk governance. Renn (2008 p. 9) defines risk governance as "*the complex web of actors, rules, conventions, processes and mechanisms concerned with how relevant risk information is collected, analysed and communicated, and how risk management decisions are taken*".

Renn (2008) has developed a process-based model to risk governance, which is intended to enable regulatory authorities, industry and other affected stakeholders to optimize risk decision-making and subsequent risk management through designated phases or steps that balance and weights risks with regards to scientific findings as well as public/societal concerns. The risk governance process does according to the model start with a *pre-assessment* of the risk problem, where actors should agree on a common framing of the problem. The next phase in the model is the *risk appraisal,* where the risk is scientifically assessed as well as weighted with public concerns. The third phase consists of *risk characterization/evaluation*, where Renn (2008) has developed a risk classification system, where risks depending on nine factors adhere to six risk classes. The risk classes, named after Greek mythology carries inherent characteristics, which can through a traffic light model of risk tolerability, be found as normal, intermediate, intolerable or beyond definition risks. The aims of the subsequent *risk management* phase are to, through risk reducing measures such as regulatory intervention or supplementary knowledge, achieve outcomes, which makes the risk tolerable or acceptable. *Risk communication* should be an integral component in all phases.

This risk governance model almost exclusively focus on making risk managerial options available, through processes of deliberation and consultation. Renn's

key argument is that societal concerns need to be addressed as risk management decisions, characterized by high levels of uncertainty can only have sound outcomes if all affected parties have a say in the process. While Renn (2008) acknowledge that national and institutional cultures, values and traditions influence policy processes and outcomes, he yet argues that the model may be applied and adapted to most risk governance processes and thus offer greater global risk governance coherence.

If Renn (2008) depicts a normative ideal model of how risk governance ought to unfold Hood, Rothstein & Baldwin (2001) have developed an analytical framework based upon systematic empirical analysis of nine risk issues and their regulatory framework. They argue that an enhanced understanding of risk regulation requires a disaggregate of 'risk regulatory regimes' in a two dimensional manner; first differentiating between regime context and content, second focusing on the interplay and linkages between control components such 'information-gathering', 'standard-setting' and 'behaviour- modification'. Hood et al (2001) therefore puts equal attention to what information serves as basis for setting risk standards and subsequent enforcement. In their analysis a risk regulatory regime is narrowed down to items of legislation, where policy processes are backtracked to determine what interests or pressures were present when the policy was set.

An important finding was that decision-making and enforcement components are often fragmented over several institutional bodies on different administrational levels; shaped by internal institutional factors as well as external pressures, such as business lobbies or media salience. Pressures were, moreover, found to impact the control components differently. If, for example, a business lobby could not influence standard- setting; compensation could often be found in terms of laxer enforcement. Indeed, the majority of the risk regulation regimes studied was far from coherent and often characterized by weak linkages between control components. Attitudes of the regulators and the organisational culture are furthermore emphasised as an important explanatory component that shapes risk regulatory regimes. Regulators may thus even be considered an interest group in its own (Hood et al, 2001). Risk regulation also tends to be path-dependent, as changes are often implemented incrementally to existing regulatory and institutional frameworks (Hood et al, 2001). These findings suggest that already existing regulatory standards coupled with institutional and organizational logics are highly influential in the workings of risk governance.

In this study, I will explore the actual practices of risk governance using theoretical perspectives from the governance literature with insights on how different factors influence regulation, derived from the literature of risk governance.

2. Aims and outline

This report aims to analyse risk governance structures and practices by using the geographical area of Göta Älv River valley as a point of departure. Three risk governance regimes for flooding, landslides and dam failure are an alysed, which are conjointly managed by several public and private actors, bounded by complex regulatory frameworks as well as the local administrative setting. Regulatory, administrational and organizational fragmentation is a key characteristic in Göta Älv, as river management is divided between public and private actors whose managerial duties are regulated by several different pieces of legislation. Key actors participate in all three governance regimes, yet operating with different regulatory demands and organisational logics. Risk of flood, landslide and dam failure are also anticipated to intensify as the area has been singled out as a key matter of concern for future climate change, requiring the implementation of climate adaptation measures (SOU:2006). As climate change will require a development of risk governance, it is pertinent to address current constraints and capacities in existing risk governance regimes. By focusing on actors' roles and regulation in the governance of Göta Älv, this study hopes to enhance the understanding of risk governance regimes and particularly linkages and interrelationships between regimes. It should be noted that this study is not a comprehensive exploration of risk governance practices in the area. This pilot study was undertaken during a limited time-period with the aims to identify governance regimes and key actors. Themes that emerged during this pilot study are planned to be developed and elaborated in further research.

The report is divided into six parts; a background section outlines the case, Göta Älv River Valley, the subsequent section presents the governance actors present in the river valley and following part concerns this study's research method. The report's empirical findings of the flood, landslide and dam governance regimes will then be presented. A result section will follow and a discussion over the result in the study will be this reports final part.

3. The case: Göta Älv River Valley

Situated in the south-west of Sweden the Göta Älv River connects Sweden's largest lake, Vänern, with Scandinavia's largest port in Göteborg; the second largest city in Sweden. During its journey to the sea Göta Älv River runs through a landscape of sharp falls, forest and lower lying fields. The access to water has historically drawn people to localize their homes and activities close to the river and shore near locations continue to attract residents. Archaeological artefacts and culture heritages are plentiful in the river valley and bear witness to the river's historical importance. The river and its also contain environmental as well as recreational values and is a popular tourist destination. Göta Älv is a crucial transport route that has existed for hundreds of years and serves a primary drinking

water supply for 700.000 people. Height differences (44m) between Lake Vänern and the sea have been regulated though extensive lock systems and have also been harnessed for hydropower. Sweden's first large hydropower station, Olidan was constructed in Göta Älv in 1921 and there are four large hydropower stations along the river today (Lindström, 1992). This geographical unit is thus construed of layers of meanings, functions, organisations and regulations (which will be presented further on), and also carries a number of risk dimensions, that will be presented below.

As Göta Älv is Lake Vänern's only outlet, flooding has always been occurring in the area. Flood risk management is mainly carried out through the controlled discharge of dams, regulated by the Vänern Water Decree of 1937. The decree lowered water levels on Lake Vänern through an increased discharge to Göta Älv (Tranberg, 2001). The regulation of Vänern rendered the occurrence of high water levels and hence flooding less frequent, but the construction of large dams also created the risk of dam failure. Since several communities are located downstream from major hydropower stations, dam failure would have catastrophic consequences. Flood risk management and dam safety are two closely interlinked risks in the river valley but the discharge rate to Göta Älv and variations in water levels also affect slope stability. Göta Älv is, in addition to being susceptible for flooding, also one of the most landslide frequent regions in Sweden due to its geological and topological conditions. Major landslides have occurred in the past, the last fatal event occurred in Tuve 1977, when nine people were killed when a block of houses was swept away (Alén et al, 2000). It has been suggested that variations in the water levels due to the regulation of Vänern brought may have been a contributing factor to slope instability (SOU:2006).

An overall complexity for risk management of the Göta Älv is that management measures can be in conflict, flood defences may, for example overload shore stretches and aggravate the risk for landslides and low-lying areas close to the sea may be put at risk through flood risk reducing measures upstream. Risk management of the river valley is hence characterized by complex interactions of risks and the significant of each risk must be conjointly agreed upon by a number of key actors.

The water system that constitutes Göta Älv and Lake Vänern has been singled out as particularly vulnerable to climate change according to the Swedish Climate and Vulnerability Inquiry (SOU:2006). Hydrological models used in the inquiry predict increasing precipitation, which is expected to render floods more frequent and intense. Flooding is currently a major problem in the area, which was highlighted in the flood events of winter 2000/2001 that caused extensive damage and disruption in the area. Many areas around Lake Vänern became flooded including the city of Arvika, which prompted the most challenging peacetime rescue operation in Sweden's modern history. The total cost of the Arvika floods alone is estimated to be 200M Swedish Kr (MSB, 2009). The Swedish Climate and Vulnerability Inquiry (SOU: 2006) concluded that climate adaptation measures to reduce the likelihood of similar events reoccurring were required immediately. Climate

adaption adds an additional level of complexity to Göta Älv and accentuates the complex risk interactions the current risk governance regimes have to consider.

4. Risk governance actors

The complexity of intersecting risks is matched by the administrative context of Göta Älv where several actors; governmental agencies, local authorities and private companies are conjointly managing different aspects of the three risks. In contrast to other risk issues often discussed in the risk literature, for example radon, (Hood et al, 2001) boundaries between management, regulation and enforcement roles are fuzzy and overlapping. The following section will outline the main organisational actors, their roles and responsibilities in relation to the risk management of Göta Älv.

Local municipalities

There are six municipalities situated along the Göta Älv River, from Lake Vänern to the sea the river runs through; Vänersborg, Trollhättan, Lilla Edet, Ale, Kungälv and Göteborg. After the falls in Lilla Edet, the area is flat and low-lying thus making downstream municipalities susceptible for flooding. Municipalities are in charge of land-use planning, according to the SFS 1987:10 Planning and Construction Act and the contingency service within their geographical area, according to the SFS 2003:778 Civil Protection Act. Therefore, municipalities are responsible for preventive measures and preparedness for hazards, such as landslides or major events such as dam failure. Potential risks to the municipalities functions and the health and wellbeing of their citizens have to be identified, analyzed and presented in a risk and vulnerability analysis according to SFS 2006:942 Ordinance of Emergency Preparedness. Land-use plans should, moreover, outline major risk related to land use, environmental quality and health aspects. Climate adaptation is directly relevant a local context, where the municipalities constitute a central actor for the implementation of climate policies and preventive risk management. However, the main responsibilities lie on several other public as well as private actors.

Vattenfall

Vattenfall[1] is a major international energy company and Europe's fifth largest electricity producer. Vattenfall was created in conjunction with the construction of Sweden's first large hydropower station, Olidan 1909, at the falls of Trollhättan in Göta Älv; the Swedish parliament then established Kungliga Vattenfallsstyrelsen (The Royal Water Board), which later became Vattenfall (Vattenfall, 2009). The company has a key role in the risk governance network since they own the rights

[1] Vattenfall's mother company Vattenfall AB is own by the Swedish Government

to use water for electricity production in Göta Älv and flood risk management is as previously mentioned contingent on the tapping ratio from Vänern to Göta Älv. Furthermore, Vattenfall owns and operates the main four hydropower stations in the river, which renders dam safety a key concern to the company. Vattenfall was until 1993 also responsible for Göta Älv fairway including the lock systems as well as hydropower stations. When the European electricity market was deregulated, duties related to the lock systems were delegated to the Swedish Maritime Administration. Vattenfall is responsible to fund 80% of the shore erosion protection, which may be explained by the company's previous commitments to fairway maintenance.

The Swedish Maritime Administration

The Swedish Maritime Administration (Sjöfartsverket) is a public services company in charge of fairways and maritime traffic in Sweden. The administration is divided into six regional Maritime Traffic Areas of which Vänern's Maritime Traffic Area including Göta Älv is one. It is foremost the responsibilities to maintain accessible and safe fairways that steers the administration with respect to flood, landslide and dam risk management. The lock systems, also known as channel dams, in Göta Älv are furthermore owned and operated by the Maritime Administration, which renders dam safety a key concern to the organisation (Maritime Administration, 2009).

The County Board

Sweden is divided into 21 counties, each administrated by a regional County Board, that serve as a link between municipalities and the government, parliament and central authorities, ensuring that national policies are enacted locally. The Västra Götaland County Board has a regional coordination responsibility for the county and one of the board's main functions is to supervise and monitor functions provided by local municipal authorities, as well as issuing licenses and inspecting the compliance of different laws and to monitor performance in various regulatory areas. Potential risks to the County Board's functions and the health and wellbeing of their citizens, within their geographical area have to be identified, analyzed and presented in a risk and vulnerability analysis according to SFS 2006:942 Ordinance of Emergency Preparedness. The County Boards are also responsible to coordinate emergency preparedness with local actors, and to enable regional crisis management cooperation as well as to compile a regional risk and vulnerability analysis (www.regeringen.se).

The Swedish Geotechnical Institute (SGI)

The Swedish Geotechnical Institute (SGI) is a governmental agency that since the 1960's, delivers expert competence regarding landslides and coastal erosion to local municipalities and County Administrative Boards. SGI has a special mission to monitor slope stability and supervise municipalities and the Västra Götaland

County Board in landslide related issues in Göta Älv river valley. The supervision consists of reviewing land-use documents and issuing recommendations in stability related issues. Monitoring duties include stability assessments as well as measuring ground movements, inspections and mapping of slopes and submarine topography. Since landslides are frequently occurring in the area and constitute a major risk, SGI participate in other forums concerning, for example, flood-reducing measures (SGI, 2009).

Svenska Kraftnät

Svenska Kraftnät is a state utility company, established in 1992, that runs and administrates the national electrical grid. Svenska Kraftnät has a central role in dam safety and is since 1998, the inspection guidance authority for dam safety, meaning that Svenska Kraftnät shall guide and monitor the inspection authority, in the case of Göta Älv, the Västra Götaland County Board. The mission includes annual reporting to the government on how dam safety issues progress in Sweden as well as information coordination and supplying of competence within the dam safety field (Svenska Kraftnät, 2007).

The nested character of the inspection authorities duties outlined above, where Svenska Kraftnät is monitoring the County Boards that in turn monitor the municipalities, is a typical characteristic of Swedish risk regulation. Authorities are therefore often interlocked since their regulatory responsibilities are overlapping.

Vänern-Göta Älv River Council

River Councils are an important component in the regional network development for questions concerning high water flows and dam safety. The Councils correspond to a larger body of water, such as Göta Älv and includes municipalities along the river, county boards, and dam owners along with other actors, for example the Swedish Road Administration. The main objectives for the River Councils are to enhance river knowledge and to create contact and cooperation between different actors. The river councils' responsibilities vary according to the local river's requirements but the River Safety Inquiry (SOU:1995) proposed the following tasks; to evaluate flood planning, to discuss dam safety issues with the dam owners and to coordinate emergency preparedness (Elforsk, 2006).

The departure of this study is the Göta Älv river valley and the associated risk governance regimes it harbours and while the governance actors, as we seen, have diverging roles, objectives and functions, they are all relate to the Göta Älv River. The water that runs in the river has several meanings and functions, depending on context and the focus of the actors. The river might be approached as a transport route or electricity generator but it is still a common denominator for all the actors involved. Göta Älv is therefore regarded as boundary object that has the capacity of 'bridging social worlds' (Star & Griesemer, 1989)

5. Method

This study approaches risk governance by focusing on a geographically bounded object, Göta Älv River. The river represents complex interactions of systematically interconnected risk issues (of which flood, landslide and dam safety are addressed in this report) under the conditions of regulatory, administrative and organisational fragmentation. Göta Älv River is a paradigmatic example of multi-risk regimes and interorganisational risk management.

This study is explorative in character and the data collected has been derived through qualitative research methods using interviews and participant observation. The main part of the empirical material consists of individual and semi-structured interviews of key actors in the risk governance regimes. The respondents were contacted after an initial documentary study of Göta Älv, where key actors and experts within organisations were identified. The key actors were contacted via phone or mail and the research area and issues of interest were described. In total 14 interviews were carried out between June and August 2009, lasting between 1 and 3 hours. Officials from the following organisations were interviewed; Ale municipality, Lilla Edet municipality, the SGI (Statens Geotekniska Institute), Svenska Kraftnät, the Swedish Maritime Administration (Sjöfartsverket), Trollhättan municipality, Vattenfall and Västra Götaland County Board (Länsstyrelsen Västra Götaland). The respondents are all key specialists on flood risk prevention, landslide alleviation and dam safety within their organisation. It should be noted that there are only a few officials directly involved in the risk management of Göta Älv and most of them have been interviewed in this study

As the respondents are managing different aspects of the river, the same questions were not posed to all of them. However, the main focus and aspects addressed during interviews were; the organisations' formal risk managerial duties (in relation to the risks addressed), execution and implementation of preventive measures, modes of cooperation with organisation, thoughts on risk managerial duties and practices in relation to other parties, such as other organisations and the public.

In addition to interviews, literature consisting of documents and reports were analysed to gain a deeper understanding of the administrative and regulatory framework, and risk managerial duties. Data also derived from a participant observation undertaking during a landslide inspection tour arranged in May 2009. The landslide tour, arranged by the Maritime Administration is a biannual event and is an integral part of SGI's monitoring of Göta Älv's shore stretches. On the inspection tour erosion protection and related stability issues are inspected from a boat. The landslide inspection tour included four officials form SGI, three from the Maritime Administration and two from Vattenfall. The inspection was judged importance as interaction between key actors and practical execution of the preventive regimes could be observed.

6. Risk governance regimes

The following section will outline three risk governance regimes in Göta Älv; flood risk prevention, landslide alleviation and dam risk management. The managerial strategies for the three risk issues are diverging but broadly the same actors participate in all three regimes, however, with shifting functions and roles. The empirical data will be arranged in broad categories; voluntary participation, responsibility and accountability, and expert management, following salient themes in governance theory (Rhodes, 1997, Mört 2004).

Flood risk prevention

The flood risk management of lake Vänern and Göta Älv does in many ways reflect the tension between structural engineering solutions and non-structural human adjustment solutions often referred to in natural hazards literature (cf. White 1942/1945). Water levels in Lake Vänern are regulated through the Vänern's water decree of 1937 that aimed to reduced flooding around the lake by controlling and harnessing the discharge to Göta Älv through hydropower stations. The decree of 1937 was designed to accommodate a range of stakeholder: fishers, farmers, private landowners, maritime traffic and dam owners. Negotiations preceding the regulation lasted for twelve years and the decree resulted in a 9,000 page long document (Tranberg, 2001). The decree granted Vattenfall the right to vary the tapping to Göta Älv between the afflux and the lower limit, with a reservation that limits the maximum discharge rate to 1,000m^3/s in order to prevent erosion and subsequent landslides. If Vattenfall exceeds the afflux or the lower limit, they are liable for flood damages that occur along the river.

The possibility to vary the discharge from the lake Vänern to the Göta Älv River is the main flood risk-reducing instrument in the region. If flood situations occur around Vänern an increased tapping will lower water levels in the lake. In contrast, if lower lying areas below Lilla Edet are threatened by flood risk from high sea levels, which slows down the river's discharge to the sea, tapping may be cut back. Although the controlled discharge to Göta Älv has reduced the occurrence of high water levels and subsequent flooding it may, however, have encouraged settlements and infrastructure development in naturally flood prone areas. During the flood events of 2000/2001, it became apparent that the regulation did not protect the area from extreme water levels, which raised concerns about the reoccurrence of similar events in a scenario of future climate change. The Swedish Climate and Vulnerability Inquiry (SOU: 2006) therefore argued that Vänern's Water Decree had created a false sense of security. Increasing precipitation and higher water levels currently pose great problems in the area and are expected to increase in the future, the Climate and Vulnerability Inquiry (SOU: 2006) therefore suggested two measures to mitigate the flood risk: to increase the discharge from lake Vänern to Göta Älv in order to lower Vänern by 10-15 cm and to adopt a more restrictive approach to land-use planning. More permanent solu-

tions to the flood problems are considered necessary and the possibility to build a water tunnel from Vänern to the sea has been suggested (SGI, 2006b).

Voluntary participation

The most direct climate adaptation measure, the increased tapping ratio, relies similarly to the current tapping regime on the voluntary participation of Vattenfall. The Inquiry suggested that the Decree of 1937 could still be used if the discharge rate could be maximized within the decree, as it would be very expensive, complicated and time-consuming to create a new water decree. During interviews with officials from Vattenfall, it emerged that Vattenfall and the Swedish Meteorological and Hydrological Institution (SMHI) had initiated the idea of a new tapping regime. The two organisations had calculated potential tapping strategies and brought the idea forward to a seminar preceding the Climate and Vulnerability inquiry. The suggestion was according to the official (V2) later incorporated into the inquiry and Vattenfall required that the new tapping should remain within the current water decree.

As a result of the inquiry the government ordered the County Board to commence negotiations with Vattenfall to see whether an agreement could be reached (Västra Götaland County Board, 2008). It should be noted that many diverging interest are at stake with a new tapping regime: Vattenfall will lose some of its electricity production if the tapping degree is increased, for the Maritime Administration too low water levels render fairways inaccessible, SGI will foremost be concerned about landslides as shore erosion will increase, the County Boards must consider all the interest in their county, including environmental values, and downstream municipalities will be concerned about flood risks in their area.

Despite losses of electricity production, (not surprisingly since the suggestion had been initiated by the company) Vattenfall agreed to participate in the new tapping regime without claiming compensations for their losses (Västra Götaland County Board, 2008). Vattenfall's main reasons were as following:

> *"We have a great responsibility in Göta Älv/ Vänern, we own the tapping regulation" (V2)*

> *"Vattenfall wants to be a good and responsible part of the society and voluntary cooperation in the regime was considered the easiest option. If we had chosen not to participate, they (public authorities) might formally have ordered us to do so and it would have been a longwinded, complicated and bureaucratic process"(VI).*

Reflected in the statement is a preference for flexible agreements and a reluctance to enter formal procedures that were conceived as overly bureaucratic, thus limiting the actors' ability to adopt a "practical approach to problems" (M4) (c.f Naess et al, 2005). The interviews suggest that informal dialogue between the County Board, the Maritime Administration, SGI, SMHI and Vattenfall appeared to have played an important role in enabling the voluntary regime. In particular, close working relationships between the Maritime Administration and Vattenfall

emerge as vital for the new regime to have materialized. The Maritime Administration is directly affected by changes in water levels as it may change the accuracy of the nautical charts (MA1). Preceding the formal agreement between Vattenfall and the County Boards deliberations were held between the Maritime Administration and Vattenfall (MA1). An official at the Maritime Administration commented on the cooperation:

> *"There is a close cooperation in Göta Älv, especially with Vattenfall; if I want something I just phone them. We call each other several times a week… We're dependent on them as they control the tapping and we also have several things in common. But it's also a personal thing; staff from the Maritime Administration gets along very well with staff from Vattenfall. The work on the river is easy because we have projects and interest in common. It could be much more complicated and bureaucratic"(MA2)*

Even if other actors, such as the municipalities, were left out of the discussions preceding the implementation of the new tapping regime, they still preferred informal communication paths, which emerge as an important factor to the success of the preventive regime as reflected in the following statement;

"We cooperate with the County Board and Vattenfall on a voluntary basis. It is informal communication and personal relations that enables this type of cooperation. You see, there are no formal channels through which we can communicate."(M4)

The inquiry did, as previously mentioned, also urge municipalities to adopt a stricter approach to land-use planning with regards to flood risks. However, exactly what this stricter approach should entail and how it should be implemented was unclear for the respondents. In Trollhättan municipality several new developments are planned to be located in the very close proximity to the river. One residential area was even planned to be placed on a low-lying island in the river. An official at the municipality expressed concern over the new developments:

> *"At the same time as the municipality tries to consider climate change, new housing developments are planned right in the river. I don't think it's especially wise to build there. Here in our municipality the work concerning risks is spread out over several departments so it's difficult to get "the whole picture". Information gets lost between departments" (M3).*

However, other officials (C1, C2) interpreted the location to be safe as water levels at that particular place could relatively easy be managed through tapping. Interpretations of what a strict land-use policy should entail seemed to vary considerably from department to department and from authority to authority. Municipalities have a strong economical incentive to develop areas in the close proximity to the river as waterfront housing is in high demand. Discussions concerning land-use planning and flood prevention therefore often focused upon the cost of implementing preventive measures. The respondents often argued that the municipalities did not have enough resources to rigorously adapt land-use planning

for future climate change. Municipalities believe that they can attract new citizens by developing areas close to the river and officials argued that if one municipality rejected such plans from a developer, a nearby municipality would accept the proposal and people would move there instead. The potential loss of tax revenues and an attractive edge to the municipality is therefore in conflict with a more rigorous approach to land-use planning. This result supports previous research (Granberg & Elander, 2007, Langlais, 2007, Storbjörk, 2007), which indicates that voluntary climate adaptation policies fall short of other interests, such as economic incentives to attract citizens.

Responsibility and accountability

Issues of responsibility and accountability emerged as a common thread throughout the interviews as the current regulatory framework relating to flood prevention was in general perceived as vague. The legislation that most directly relates to responses to natural events, SFS 2003:778 Civil Protection Act, refers to intervention by the rescue services prompted by extraordinary and sudden events. However, in large water systems such as Lake Vänern and Göta Älv, flooding is a slow event whose onset can be relatively easily predicted. It is foremost the County Boards' responsibility to coordinate preventive measures within the region and the current legislation was perceived as problematic in that regard:

> *"It takes around two months for a flood to materialise which means that yes when the flood finally hits us we can use the rescue services but before that it's difficult to mobilise them for preventive measures." (C2)*

Support for the implementation of preventive flood measures, such as an increased early tapping, could nevertheless be found in another piece of legislation. The SFS 1998:808 Environmental Code allows Vattenfall to exceed the current water decree if there is an imminent risk for human lives and property. Officials at the County board (C1,C2) stated that they sometimes ask Vattenfall to increase the tapping if they consider the flood risk to be high, which they did on occasion in 2006/2007. However, this preventive regime encountered problems recently, as a court found Vattenfall liable to compensate property owners that had sued the company. The court order (Vänersborgs tingsrätt, 2009) concluded that Vattenfall had acted correctly according to the Environmental Code, but was nevertheless liable to compensate property owners according to Vänern's Water Decree. An official (C1) expressed concerns that this may lead to reluctance from Vattenfall to follow the County Board's recommendations regarding tapping. Officials from Vattenfall commented on the court order in the below statements:

> *"It is not a positive thing when you agree to do something that was regarded as the right thing to do and then you have to pay for it. I think that we might have to carefully consider doing similar things in the future. It would be better if they (County Boards) assumed the entire responsibility in such cases (V1)"*

"We will not agree to similar measures in the future only if it is very acute and an overall more serious situation." (V2).

However, if the County Board assumes responsibility over the tapping, which they may do according to the SFS 2003:778 Civil Protection Act, liability for damages would fall on them instead. An official (C2) stated that central policies that exempted them for economical liability would be desirable.

Expert Management

While it has been argued that the new tapping regime may threaten environmental values in the area (Hammarström, *Expressen*, 2008-03-17), the implementation of the tentative tapping regime did not meet any objections from the respondents in this study. Respondents contributed the success of the implementation partly to the Vänern- Göta Älv River Council, where the issue was discussed before implemented. As have been noted the River Council consist of representatives from key actors from the region, which all have an extensive knowledge within their specific fields. Officials claimed that the actors represented in the Council know each other well (MA2, S1, C1,C2) and that there was an extensive collective knowledge gathered in the forum (C1). The River Council appears to play a major role in the flood risk prevention as the key actors get a chance to voice concerns about how potential measures such as the tentative tapping regime will affect them and how those effects may be mitigated. This is reflected in the statement below:

"There is good dialogue in the River Council. Everyone consulted us and listened to our opinions and concerns when the new tapping regime was implemented. We all know each other very well and which makes everything easier" (S1).

Issues relating to regulatory constraints and risk trade-offs were according to officials (C1), often addressed within the Council and solutions to existing problems could often be found after discussions and negotiations. An official stated:

"We interpret and negotiate around the existing regulation… Experience and gut feeling play an important role in extreme situations. We don't have time to analyze all the statistics; we just have to act (C2).

As expressed by the official, the collective expertise and experience assembled in the Council appears as key to implementation of measures. However, only one of the six Göta Älv municipalities, Ale, is represented in the River Council, as a County Board official put it: *all municipalities couldn't be there (C1).* Information emerging from discussions should be forwarded to other municipalities in the area, yet a municipal official was not aware that the tentative tapping regime had been implemented.

"*We have said that we don't think that it's possible to tap that much, but we can't influence the tapping grade (M3)*

In another municipality, similarly not represented, in the River Council, located in a particular vulnerable low-lying location a more accommodationist approach was voiced;

> *"We have problems with our location; we're in between the sea and lake Vänern…but we can't resist the tapping regime too much, we must see the whole picture, of course there's a flood risk here but compared to what? It's worse up-stream".(M4)*

It should moreover be noticed that in addition to the municipalities, the public is also excluded from the decision making process. This is a typical characteristic of the Swedish regulatory process, which largely relies on expert management (Löfstedt, 2005). The negotiations preceding the new tapping agreement were informal and characterized by a few, selected parties, reaching agreement, (Kelman, 1981, Lundqvist, 1980). The respondents did, moreover, express a preference towards flexible types of solutions over bureaucratic formal ones, which can furthermore explain their willingness to accept regulatory policies formed by a few actors.

In the tapping regime, Vattenfall appeared as a key player, at the same time initiating and enabling the new flood preventive measure. However, consultations with other central stakeholders such as the Maritime Administration and SGI were necessary in order for the preventive measure to materialise. The County Board emerge in this regime as a facilitator and negotiator between stakeholders. The municipalities did not play a prominent role in decision-making preceding the tapping regime but did instead have a main role in decision-making regarding land-use planning. As we will see in the landslide prevention case, the implementation of the new tapping regime partly triggered a new mission for SGI.

Landslide prevention

Climate change is expected to aggravate slope stability in the Göta Älv River valley as wetter winters and drier summers are anticipated to bring larger fluctuations of groundwater levels as well as increasing shore erosion. The Climate and Vulnerability Inquiry (SOU:2006) concluded that supplementary knowledge of slope stability was essential for further climate adaptation. SGI has therefore been commissioned to extend their current mission with additional landslide assessments in the Göta Älv river valley. The new mission started in spring 2009 and will be carried out over three years. While stretches of the river area were analysed and mapped during the 1960's, many areas remain uninvestigated, for example the submarine terrain of the river. Land-use has changed in the region during the last forty years, which may have affected stability. The new mission is also related to the tentative tapping regime, as an increased discharge to Göta Älv will increase erosion in the channel.

Landslides are, however, a familiar phenomena in the region with several landslides occuring annually, although the majority remain small and shallow (SGI, 2006a). Historically, several major landslides have occurred in the river valley, the first documented one as early as 1150. The most severe landslide occurred at Intagan in 1648 and led to the death of 85 people (SGI, 2006a). In recent history, three major landslides have occurred: Surte in 1950, killed two people and led to extensive damage, Göte in 1957, killed three people and the destruction of many houses and the previously mentioned landslide of Tuve in1977, when a whole block of houses was swept away, killing nine people (Alén et al,2000). Landslides have shown to be catastrophic in the past and preventive measures are vital to mitigate potential consequences. According to estimates it is also cheaper to prevent even small landslides than to pay recovery costs from such events (SOU: 2007).

Voluntary participation

Similarly to the flood risk prevention regime, landslide alleviation in the context of Göta Älv is largely contingent on actors' voluntary participation; however this regime lacks the inclusion of Vattenfall. Land-use planning carried out by local municipalities, is the most effective way to prevent landslides. To assist the municipalities' work SGI can review the land-use plans according to their specific Göta Älv mission. The reviewing service is, however voluntary, as it the municipalities' responsibility to initiate contact with SGI is. Out of the municipalities participating in this study, Lilla Edet and Ale regularly consult SGI in their planning processes (M1, M2, M4). Moreover, if the municipalities chose to get a review from SGI, it is voluntary to follow their stability recommendations. An official from SGI described the relationship with the municipalities in the following way:

> *"It works well most of the time, but of course some municipalities are more active than others. They also follow our recommendations most of the time but problems occur when there is already something established on an existing site." (S1)*

It also became apparent that an informal engagement served as an important component of the landslide prevention regime. When the Maritime Administration's pilots drive up and down the river, they simultaneously observe the shores and river for changes that indicate that a landslide has occurred. If changes are observed, an official at the SGI is contacted, and may visit the site if observations indicate something serious. The landslide observation mission was according to officials (MA1, MA2) introduced by a former manager and is now incorporated into the preventive regime in the river valley. Officials considered the constant surveillance of the river as an important component in the landslide prevention regime (SI, C2). This example further supports the importance of key individuals in preventive regimes (c.f Gustavsson et al, 2009; Neuval & van der Brink, 2009).

Responsibility and accountability

During the study, issues of responsibility and accountability were salient within the landslide prevention regime. In particular, boundaries between the municipalities' and the private property owners' responsibility were recognized as problematic (S1, C2, M4, M1). As previously noted by an SGI official, problems arise when an area that is already developed is recommended to undergo further stability analysis by SGI. A stability analysis is estimated to a minimum of 100. 000 Swedish Kr and should be funded by the property owner as they are responsible for the property. If the analysis concludes that further stability measures are required, governmental funds are available to perform those measures. Getting the initial stability analysis carried out appeared to be the biggest obstacle in the landslide prevention regime, as clarified by an official:

> *"The technical expertise within landslides and landfall exists. We know where a landslide might occur and what measures we could take to ensure stability, the difficult part is to decide who's responsible for what and who's going to pay it". (S1).*

The absence of clear national policies stating how the municipalities should act in preventive stability measures was perceived as problematic and the 'grey zones' left the municipalities to interpret issues of responsibility. For example, Lilla Edet and Ale, two neighbouring municipalities, had interpreted their responsibility in regards to landslide prevention differently. In Lilla Edet, the property owner (for private properties not industrial ones) only have to pay 10% of the initial analysis, as the municipality funds 10% and the rest is made available through government funds. In the neighbour municipality of Ale, a different policy has been designed where the property owner has to fund the whole cost for the initial analysis. It should be noted that none of the interpretations are wrong but rather depend on which piece of legislation the municipality emphasized and how they interpret issues of responsibility regarding stability.

Nevertheless, the two municipalities faced similar problems when encountering sites characterised by multi-ownership and where the property owners were reluctant to fund a stability analysis. However, in Lilla Edet, the problem was only encountered at industrial sites. Multi-ownership sites posed problems as several property owners first have to agree that a stability analysis was necessary despite the high costs involved and second, divide the expenses between them. Public authorities cannot order a property owner to undertake preventive measures, which means that stability measures sometimes end at the very first stage of the preventive regimes. If the situation is acute the rescue services may evacuate the site but this was, according to the interviewees, extremely rare (S1, C2, C3). The different preventive strategies prevailing in the area could in the long term aggravate stability (S1). Solving stability issues are according to officials at SGI mostly about resources and political will. Reflected in the interviews was the belief that landslide alleviation needed more central resources and national directives:

"The political will must come from a higher level than the municipalities. It must be considered to be of great importance for the society (S1)".

The official at SGI was concerned that landslide alleviation is considered costly and difficult to manage by local and regional authorities. Landslide mitigation is invisible, in contrast to flood prevention where embankments are salient and may contribute to a feeling of safety. This could contribute to flood risk measures being prioritized more than landslide alleviation (S1).

Information

The landslide prevention regime does to a large extent rely on the outcomes of dialogue with the property owners, which is often undertaken conjointly by officials from SGI and the municipalities. The municipalities did in general perceive their duties to inform citizens about stability issues as highly problematic. In particular, officials were concerned that information would unnecessarily worry the citizens without offering any means to mitigate the problem. None of the municipalities did actively inform about landslides, mainly because they did not know how much, and what kind information they should provide not to worry citizens. Information regarding stability issues could negatively affect property value, as clarified by an official in the statement below;

"If we for example let someone know that their area should undergo a stability analysis or that there could be a problem, we might lower the value of the property. We therefore chose to inform on a case-by-case basis, as each case is unique" (M2).

Despite Göta Älv River valley's long history of landslides the officials perceived the property owners' landslide awareness to be low and stability issues were in general not prioritised:

"I think stability is a low priority when it comes to buying a house, I mean you inspect the roof, makes sure that the area is nice but you don't inspect the actual ground that the house is built on, do you? " (M1)

"The property owners don't think the issue is especially important and don't really want to know…they look at the neighbourhood and the house itself when they buy a house, not the stability." (M4)

The low awareness was, by the officials, perceived to be related to divisions of responsibility, as the public in general believed that the government was responsible for stability issues. Despite the lack of clear national policies, an official from SGI, had noted that governmental authorities often thought that municipalities were more active in stability issues (S1). Research has shown that different organisations and institutions understand and perceive risks in diverse ways (e.g. Hutter, 2001, Turner and Pidgeon, 1997, Weir, 1996), since over time beliefs and per-

spectives develop as a result of particular organisational settings. Organisational boundaries can therefore impede communication between different actors, which is why fragmented risk management regimes are often put forward as a contributor to disaster (Hutter, 2001;2005, Turner and Pidgeon, 1997, Weir, 1996).

Expert Management

SGI has an unchallenged national expertise within stability issues and the management of expertise characterizes the landslide alleviation regime in Göta Älv. SGI's recommendations are seldom challenged because of their validity, as highlighted in a statement from a municipal official:

> "*Half of our land-use planning costs are to stability investigations; we have a close relationship with SGI. They look at our plans, and we have full respect for SGI* (M4).

An important part of SGI's expert knowledge derives from practical experience in the river valley, as the ability to evaluate a slope derives from capacity to observe changes and relate them to previous experiences and events. SGI has also a well-established presence in the different risk governance regimes. For example, the annual landslide inspection tour provides continuity in their work as well as establishing and maintaining contact with other important actors in the regime. During the landslide inspection tour officials at SGI were left to monitor the shorelines without any involvement from members of staff from Vattenfall and the Maritime Administration, and recommendations from SGI were in general accepted and implemented. A senior member of SGI had participated in the landslide tours for over ten years, gradually introducing other members of staff from the SGI. The landslide inspection tour may be viewed as a forum for establishing contact and cooperation, which may be regarded as as important as the actual inspection in the landslide prevention regime. An official at SGI highlighted the importance of cooperation with other actors:

> "*A major part of our work is to create channels for communication and dialogue so that the involved parties know the issue and background well.*" (S1)

In addition to the landslide inspection tour, the River Council also functions as a network for cooperation as mentioned in the flood case. Similar to the flood prevention regime, stability related issues could often be solved since the representatives knew each other so well. An official from the County Board stated that an earlier issue regarding funding for landslide mapping could be solved because "*we understand each others situation and negotiations regarding costs were greatly facilitated by that (CB2).*"

The role of the stability expert, SGI, is very prominent in the Göta Älv river valley as they are consulted regularly by the County Boards. It should however be

noted that the SGI is an agency with limited power, which may not enforce recommendations.

It is relevant to note that SGI's new mission was closely linked to the implementation of other climate adaptation measures in the area, such as the tapping regime. Knowledge of slope stability can thus be seen as prerequisite to other risk governance regimes. In the landslide prevention regime, the municipalities played a very prominent role as they could create their own policies for preventive measures. SGI appeared as a major expert, consulting and supporting the municipalities when approaching private property owners. The Maritime Administration through its continuous shore observation emerges as an important component to safeguard the river, even if this practice is not aligned with formal divisions of duties and responsibility. As we will soon discover the Maritime Administration participate in the dam risk governance regime but will assume a different role.

Dam Risk Management

Water regulation in Sweden is essentially carried out through hydropower systems and 50% of Sweden's total energy derives from hydropower. In Göta Älv there are four large hydropower dams (generating 1.5TWh) and six lock systems (channel dams), along with many smaller types of water reservoirs. As previously noted, by using dams to regulate water systems, the flood risk is to a certain extent mitigated but instead replaced by the risk of dam failure. There are a few dam failures with severe consequences every year internationally. Sweden has been spared from major dam failures, however, a few minor ones have occurred, notably, Noppikoski in 1985, Sysslebäck in 1973, and Aitik in 2000, a mining dam. At Sysslebäck, the failure led to one death besides extensive damage to roads and buildings. In Noppisko, the Hansjö power station was damaged along with roads, bridges and woodlands (Elforsk,2006). A main problem associated with dam risk management is that dams were constructed a long time ago, thus rendering it difficult to know what floods they have been dimensioned for and how material has been affected many years later (Berntsson, 2001). Dam safety has been highlighted as an important issue with regards to future climate change as increasing water levels in rivers and lakes affect dams and other water reservoirs (Svenska Kraftnät, 2001, SOU:2007, the Swedish National Audit Society , 2007).

Dams are regulated mainly through the SFS 1998:808 Environmental Code, which stipulates that the dam owner must take preventive measures to ensure that human health or the environment is not compromised. The dam owner is, moreover, strictly liable for any damage caused in the event of a dam failure. The legislation is based upon a system of self-regulation where the dam owner is responsible to develop a functioning system of preventive measures, which is then inspected by the County Board. The hydropower systems and certain lock systems in Göta Älv have been classified as hazardous facilities and are therefore subject to the SFS 2003:778 Civil Protection Act, which stipulates that facility owners have to provide emergency preparedness that could include certain material

or staff as well as a risk analysis. The municipalities are responsible to inspect the compliance of the SFS 2003:778 Civil Protection Act.

Voluntary participation

In contrast to the flood and landslide prevention regimes, a strict regulatory framework bounds the dam regime. However, the Environmental Code does not offer any guidance on what preventive measures are required to ensure sound dam safety. This gap between hard standard and practical execution has been filled with guidelines issued by the hydropower industry that offers a system of preventive measures. The guidelines, RIDAS, were developed and ratified in 1997 by Swedenergy, the hydropower companies' branch organization. RIDAS provides definitions for dam safety assessment and aims to provide the dam owners with systematic system of self-regulation (RIDAS, 2004). The voluntary component of dam risk management consists of the adaptation of RIDAS, which has evolved as the principle prevention tool for dam safety in Sweden (Berntsson, 2001). Certain key features of RIDAS, the comprehensive dam review and consequence classification on dams, have been judged so valuable by Svenska Kraftnät that they have been integrated into the County Boards monitoring and inspection of the dam owners' system of self-regulation (Svenska Kraftnät, 2007).

The voluntary guidelines were put forward as a major improvement in Swedish dam safety as RIDAS provide a more coherent and systematic approach to dam risk management across member organizations especially to companies that had not previously focused so closely on dam safety issues. (SV2). This appeared to be validated in the local context of Göta Älv, as officials highlighted the importance of sound structures for inspections and reviews (MA1, MA2). Whilst RIDAS is considered an important tool in the dam risk governance regime, Vattenfall has in-house dam risk management systems far more extensive than RIDAS (Berntsson, 2001) as the voluntary guidelines only include *" half of the things a dam owner have to do and big changes have occurred within the international dam safety field (V1)"*. Preventive dam risk management is thus contingent of the dam companies' voluntary participation, which has been acknowledged by a report from the Swedish National Audit Society (2007).

Responsibility and accountability

The Swedish system of dam safety depends not only on the dam industry's voluntary participation but also on the inspection authorities' capacity to inspect and monitor the dam owners' system of self-regulation. This has been addressed as a limitation to the current dam safety system in Sweden by the Swedish National Audit Society (2007), which argued that the current legislation in the area could be misinterpreted by the inspection authorities. The inspection duties of dams are regulated by two pieces of legislation that in some regards overlap, County Boards are inspecting dams according to the SFS 1998:808 Environmental Code, and municipalities inspect hazardous facilities, which most large dams have been

classified as, according to the SFS 2003:778 Civil Protection Act. Officials at Svenska Kraftnät described the problem in the following terms:

> *"A clear direction in the dam safety area may be missing. We therefore aim to clarify certain principles within the area. As it is now, dam owners as well as inspection authorities may misinterpret the legislation. There is an ambiguity about the division of roles and responsibility … A closer cooperation between different actors is required to solve these issues. (SK2). "*

In the Göta Älv River, the division of responsibility between the inspection authorities, the County Board and the municipalities, was not perceived as problematic as the actors had interpreted dam inspection duties to be the sole responsibility of the County Board (C2, C3, M3, M4). A municipality official did, however, express concerns for dam safety issues as he stated:

> *"I think dam safety was out of focus for some time after the deregulation, they are just power companies wanting to sell electricity…if we see an error we contact Vattenfall, but we don't if we spot deficiencies in their dam safety" (M3)*

Dam safety is not only contingent of the dam owner's ability to maintain and prevent dam failure, but does in addition also rely on land-use in the proximity of dams. This has been an issue often neglected by planners and other officials, which have been argued to overestimate dams' flood mitigating capacities and therefore construct on land in the proximity to dams (Svenska Kraftnät, 2001). This problem was accentuated in the aftermaths of the 2000/2001 floods when local authorities were criticised for not keeping natural riverbeds open. Svenska Krafnät (2001) argued that dam safety in the future, especially with regards to climate change, could be compromised if land-use plans fail to consider the need for discharge to be released. Officials at Svenska Kraftnät argued that appropriate land-use planning is a societal responsibility, and a dam owner could hardly be held responsible if housing is put in places known to flood (SK2).

Information

In contrast to other high-risk systems, such as nuclear power stations or petrochemical facilities, there are no warning systems for people living in the close proximity of a large dam. While officials in general thought that people living close understood that a failure would have devastating consequences, no information on potential action or evacuation procedures are actively distributed to the public.

> *"It is difficult to inform people about dam safety correctly…yes, potentially a dam failure would have huge consequences but we must at the same time inform them about the safety work that we do (V1)".*

Risks, including dam failure, should be outlined in land-use documents according to the SFS 1987:10 Planning and Construction Act, as well as emergency preparedness plans according to the SFS 2003: 778 Civil Protection Act. However, in Trollhättan municipality, the emergency preparedness plan containing information on how to act in the event of a dam failure, had after careful considerations not been made public on the municipality's website, since it was believed that information of a potential dam failure would scare people (M3). In addition, the potential use of such information would according to officials be limited since if a dam of Trollhättan would fail there *'would be little time to save anything'* (M3).

However, the general public was (by the officials) understood to have a low awareness of risks associated with dams. Officials ascribed that to historical reasons. Dams and the electricity they produced were a prerequisite for Sweden's industrialisation, and have hence existed for hundreds of years constituting a familiar element within the local environment.

Expert management

Dam risk management in Sweden is highly characterized by expert management, which was reflected in the risk governance regime of Göta Älv. Dam safety developments have largely been carried out by the dam industry alone and competence within the dam safety field is unmatched by public authorities. These two factors have been pointed out as deficient in the Swedish system of dam safety (Svenska Kraftnät, 2008, National Audit Society, 2007). An official perceived this as problematic at a national level:

> *"A strong societal function that is qualified to meet the dam industry would be highly desirable. Currently the dam industry does not perceive it valuable to discuss things with county boards and municipalities since they are a great deal more competent than the public authorities. The dam industry has to explain different terms and concepts, which is not so constructive for them to do. (SV1)"*

The local context in Göta Älv in many ways, reflects the national situation where Vattenfall competence (claiming to be world leading within the dam safety field, V1) is unmatched by the inspection authorities.

> *"The inspection authority does in general have difficulties understanding the dam safety issue and related information…there is no one to ask about dam safety issues, even internationally it is difficult. " (VI).*

The Maritime Administration expressed similar viewpoints:

> *"We send them (the County Board) annual reports but not for all our dams. It's difficult to know what we should send them. For example, if we send them the reports for the extended dam inspection, will they read them? The contingency services inspect our fire extinguisher at the lock but never inspect the lock system, that's sort of where the benchmark is. The county boards are not so active. You trust the other*

actors to be honest and to do their work; I think that is typically Swedish don't you?"(M2)

Officials at the County Board admitted that they could not verify the dam owners' technical competence (C2, C3), as reflected in the statement below:

"Dam inspection is mostly a resource issue. There are around 2,000 dams in our county alone and we don't really have the technical competence that would be required for sound inspections. I don't think dam safety is an especially prioritised issue. There are experts that we may hire but it's expensive and not a cost that most county boards can afford. "(C2)

Meanwhile, officials argued that they were only supposed to review the dam owners' system of self-regulation, which had been found highly satisfactory within Vattenfall as well as the Maritime Administration. The historical ties between Vattenfall and the Maritime Administration along with the specific climate for dam safety have enabled an extraordinary cooperation between the two organisations. Whilst, other actors, such as the County Board, are involved in tapping regimes and issues relating to flood and landslide risk management, dam safety is principally an issue dealt with by the two organisations alone.

Vattenfall and the Maritime Administration have as previously mentioned historical ties to each other, and did on the landslide inspection tour, called themselves "*the two owners of Göta Älv*". Since lock systems and dams are often interconnected, the two actors often carry out dam safety measures conjointly. In addition to these joint systems, an emergency preparedness plan for dam failure is currently being formulated by the two organisations. During the landslide inspection tour the members of staff from Vattenfall and the Maritime Administration appeared to know each other very well and referred to dams as *Göran's dam* or *Bengt's dam.* Respondents also frequently mentioned that the two organisations used to be "*one*" and "*glued together*". For example, when major dam upgrading was carried out in Göta Älv, two members from Vattenfall and the Maritime Administration decided what dams to prioritize and negotiated costs associated with that. An official from the Maritime Administration explained:

"We trust Vattenfall; they are somewhat public and have a moral or a status that means that they are not only after profits. It works well but if a foreign company bought Vattenfall every decision would have to be settled in the Environmental Court. We get along fine, but what if we didn't? "(MA2)

The relationship between Vattenfall and the Maritime Administration shaping the dam risk governance regime can be viewed as an outcome of Swedish consensus-style regulation. Löfstedt (1996; 2005) has previously observed similar close working relationships between key actors in other Swedish regulatory areas such as nuclear energy and chemical regulation. He found that the limited range of regulatory actors enabled these kinds of close personal working relationships. Private

as well as public actors in Sweden often enjoy high levels of public trust, which Löfstedt (2005) argues is a prerequisite for this particular style of regulation.

Experience

Dam risk management is characterised by expertise through experience (Hartford& Baecher, 2004). The importance of practical experience rather than theoretical knowledge was highlighted during interviews. When the Maritime Administration hires consultants from Vattenfall, they often picked older members of staff that have more experience. The main rational being that the consultants have to be able to observe deficiencies and at the same time suggest measures to resolve them (MA2). Although Vattenfall has adopted a formal and standardised risk-based approach to dam safety, it was still emphasised that changes had to be implemented incrementally based upon practical knowledge on how the dams function today. Experience and intuition were judged as equally or more favourable by officials:

> "*You can't calculate everything theoretically it just doesn't work*" (MA2)

> *"I mean risk analysis have existed for a long time but in different shapes, for example when the flows were high in Dalslandskanal a retired old man went out and stood on the dam to feel how it rattled, and after that he was determined that the dam was able to withstand those flow levels. His father had worked with that dam all his life and there was a nail in the mountain on the other side that marked the highest water level. The combination of the nail and the old man constituted a risk analysis."(CB2)*

The example above demonstrates that an understanding of knowledge is acquired through practice, consisting of clues, such as the nail combined with 'sensory experiences' (Gherardi&Nicolini, 2002) such as the feeling of a dam. These competencies cannot be described or simply communicated; rather they must be practiced in order to materialise (Gherardi&Nicolini, 2002).

In the Göta Älv risk governance of dams, Vattenfall has an expert role which through a long history of cooperation, also has spilled over on the Maritime Administration. Since their expertise is left unmatched by public authorities such as the County Board and the municipalities, the two dam owners could largely determine the direction for the managerial strategies. The municipalities were not present in this regime and the County Board only played a minor role.

7. Conclusions

The fragmented risk governance regimes in the Göta Älv river valley did in large part succeed to carry out preventive measures despite the diverse objectives the actors represent and the different regulatory complexities. If we apply Hood et

al's (2001) control system components to the risk governance regimes of Göta Älv, we find that boundaries between enforcement and regulated parties are often fuzzy and overlapping. Formal duties are furthermore often not consistent with practical execution. However, even if control components are fragmented the linkages between them cannot be considered weak as informal practices fill gaps and interlink administrative fragmentation.

Key to the working of the fragmented regimes thus emerge as flexible and voluntary agreements within a coherent group of actors with close working relationships. The core actors consisting of experts from Vattenfall, the County Board, the Maritime Administration and SGI, can be seen, as an enduring governance network stretching over the geographical unit of Göta Älv, comprised of actors participating in multiple risk governance regimes although assuming different functions in each regime. This was demonstrated by the example of the Maritime Administration, which appears as a crucial stakeholder in the flood risk regime, having an informal monitoring role in the landslide regime and an expert role within the dam safety regime.

In the case of Göta Älv the application of an ideal risk governance model (Renn, 2008), which through designated phases leads to risk decision-making is unrealistic. We found, for example, in the implementation of the tapping regime, that risk decision-making is clearly delimited by existing regulations like the Vänern Water Decree of 1937 and organisational requirements, such as the necessity to maintain the navigability of nautical charts. Certain criteria thus bound the scope of negotiations from the off-set (Boholm,2009a). To recommend the inclusion of certain governance actors or stakeholders (Renn, 2008) for risk decision making also appear as problematic. The governance network in Göta Älv had been formed over a long period of time based on interdependencies evolving into close workings relationships.

Networks stretching over several organisations may be viewed as a 'communities of practice' (Wegner, 1998, Wegner et al, 2002). Participants that actively engage in an activity, eventually evolves in a certain type of practice that enables social learning. An important component in a community of practice is processes of collective negotiations, where participants conjointly negotiate understandings of their particular situation. Through negotiations accountability is also divided between the participants Wegner, 1998). The governance network of Göta Älv may be perceived as a community of practice that continuously negotiate understandings of risk issues whilst carefully considering each other's expertise, facilitated by consensus seeking traditions. Themes that emerged in the risk governance regimes will be discussed in the following section.

Voluntary participation

The prevalence of voluntary participation in the risk governance regimes, often at the initial level of implementation of the preventive measures appeared in all three regimes. Governance networks are often characterised by voluntary participation (Mört, 2004), which in the case of Göta Älv rendered the regimes flexible,

and can be perceived as a crucial characteristic of fragmented risk management where different actors must be given room to adjust their particular objectives to the 'overall plan'. The reluctance to introduce a new water decree in the tapping regime is concurrent with is Hood et al's (2001) findings, which demonstrated that regulatory regimes tend to be path dependent and that changes are introduced incrementally.

Regulatory outcomes of governance has been noted to often result in 'soft-law', this was particularly notable in the dam safety regime. The dam industry fills the gap between the hard-law objective and practical implementation with specific yet flexible guidelines. RIDAS function as a compliment to a non-specific hard-law, following Brunsson and Jacobsson's (2000) discussion of different regulatory modes. Interestingly, certain features of RIDAS have also been incorporated into the inspection authorities monitoring of the dam owners, thus clearly blurring regulator-regulatee relationships (Sahlin-Andersson, 2004).

The most striking example of voluntary participation was, however, the Maritime Administration's continuous shore observation, which was not recorded in any formal documentation. Yet during the interviews it became apparent that this informal commitment was an integral part of the landslide prevention regime.

Responsibility and accountability

Interpretations of responsibility and accountability emerge as a strong theme in all the regimes, often as a result of vague and ambiguous regulatory frameworks that research has found to be a general characteristic of climate adaptation (c.f. Naess et al, 2005). None of the regimes had clear instructions on how to implement preventive measures based on existing regulation. While some cases were clearly hampered by the lack of guidance others appeared to benefit of flexible interpretations.

The division of responsibility is particularly accentuated in the landslide prevention case. Similar to the other cases, there are notably no clear national policies stating how the municipalities should act in stability issues, which has led to different interpretations of the municipalities' responsibility. Unclear distribution of roles and responsibility has been found to be a key obstacle to the implementation of preventive measures (Naess et al, 2005, Neuval & van der Brink, 2009, Storbjörck, 2007), which the problems associated with the initial stability analysis clearly demonstrates.

In Göta Älv, dam safety inspection is the sole responsibility of the County Boards, even if the municipalities are also formally responsible for the inspection of dams classified as hazardous facilities. In a community of practice, actors negotiate boundaries of accountability and informal responsibility may therefore differ from those formally stated (Wegner, 1998). The division of inspection responsibilities between the municipalities and the County Board may be perceived in this way; the County Board taking the main responsibility and the municipalities knows that the dams are inspected, which is what matters in practice.

Information

In the landslide and dam preventive regimes officials find it difficult to inform the public about the risk issues. This may be understood if using Suchman (2000) concept 'orders of stabilisations' that refer to different understandings of an issue. Using the case of bridge building she demonstrates that expert engineers' sense-making emerge in a professional setting where understandings of technical artefacts and organisational functions are communally negotiated and agreed upon. In contrast, residents developed an understanding of bridge building comprised of familiar artefacts and points of references in their daily lives. The experts and the residents 'orders of stabilisation' were hence not aligned as experts negotiated an understanding of the issue from their professional sphere which differed from residents who placed bridge building within their domestic sphere. The concept of 'order of stabilisation' can be applied upon the landslide and dam cases where officials from authorities and property owners feared that public perceptions of the risks would differ remarkably from the official view thus rendering communication problematic. This became salient in the landslide case where officials and property owners understanding of the stability issue are clearly not aligned. Property owners will foremost (as perceived by the officials) be concerned about values related to their home, thus using different points of departure for the evaluation of the stability issue. Officials on the other hand, will daily encounter the risk of landslide in their professional lives, when discussing with colleges and when preparing planning documents.

Expert management

Throughout the risk governance regimes the presence of experts was a striking theme and is concurrent with previous research of Swedish risk management (Löfstedt, 2005). The fragmented risk governance regime of Göta Älv may be perceived as a network of experts that through negotiations and deliberations establish practices that are possible to implement. The River Council, which proved to be important for flood as well as landslide prevention, is a forum composed of experts stretching over several key actors. Networks appear to have bridged institutional boundaries in several instances in the Göta Älv river valley. However, all actors are not included in the expert network that characterizes Göta Älv. Indeed, the municipalities' ability to influence decisions appears to be limited except in the landslide case. According to Kelman (1981) Swedish regulation is characterized by a tradition of deferent values to elites or experts. This notion may be applied on the Göta Älv case, where municipalities despite their limited influence on the regime expressed 'accommodationist' and accepting views towards expert policy outcomes.

Dam risk management is particularly characterised by expert management, nationally as well as in the local context of Göta Älv. The competence gap between the public authorities and the dam industry may, however, be seen as a result of the partition between the Swedish state and one of its previous functions. Since

Vattenfall used to be public, some of the interviewees ascribe a certain moral imperative to the company, which may explain why Vattenfall is allowed to largely determine dam safety directions without interference. The Maritime Administration is also included in the dam safety regime, which shares historical ties to Vattenfall. The two actors exemplify a community of practice: even if they no longer formally have joint managerial duties, the established practise still remains intact and is reinforced by mutual engagement in common projects (Wegner, 1998, Wegner et al, 2002).

Experience

Practical experience may be regarded as highly important to the network of key actors. Experience of slopes and dam material can be seen as prerequisite for the trust the actors place in each other's expert competence. Boholm (2009b) found that practical experience of previous events determines outcomes of organisational action to delimit risk in railway planning. Previous experience functions as a catalogue of references to which experts continuously compare new situations, experience based knowledge is furthermore seldom contested. The use of experience in risk management is particularly manifested in the landslide and dam risk preventive regime but may also be related to the expert network comprising the River Council. Key officials with expert competence derived from experience may thus have facilitated decision-making.

In Göta Älv, the themes of voluntary participation, divisions of responsibility and expert knowledge are closely correlated. Due to vague or flexible regulations, divisions of responsibility and accountability are negotiated to facilitate agreements.

8. Discussion

While Hood et al (2001) argues that risk governance regimes must be disaggregated to be understood, the findings of this study points towards the need for greater aggregation in order to 'get the whole picture'. The relationships between the actors and the strong linkages between the risk governance regimes in Göta Älv would have been hard to detect if the point of the departure had been a particular risk issue, such as the potential for dam failure. In addition, risk governance, as a process-based model advocated by Renn (2008), beginning with identifying and setting risk acceptability appear as ill-suited to practical risk management, since the risk problem is already embedded in an existing regulatory framework, framed by organisational functions and working arrangement having a long history. By recommending a standard set of procedures for a certain category of risk (Renn, 2008), informal practices crucial for risk management, threatens to be ignored. A too narrow focus on isolated regimes and specific policies thus serves to decontextualizes risk governance practices. The interconnectedness of the risk governance regimes in Göta Älv makes it pertinent to question whether

the regimes are interlinked or in fact nested within an overarching governance network, forming through historical interdependences and continuous practice regarding physical objects that need to be managed.

Therefore it is essential to address current practices in addition to formal policy requirements. Practices provide the linkages between regimes and may enable governance regimes to cohere and consequently bridge administrative and organisational boundaries, despite fragmented regulation and unclear divisions of responsibility, challenges which have been emphasized as particular important in regards to climate change (Betsill and Bulkeley 2007, Naess et al, 2005, Neuval & van der Brink, 2009, Storbjörck, 2007). Climate adaptation is moreover likely to be based upon already existing risk governance structures. The results in this study therefore support the advice by Burton (1997) and Naess et al (2005); an enhanced understandings of risk management is needed in order to successfully implement adaptive measures rather than to adopt generic risk managerial tools or models (EUCOM, 2007; 2009, Renn, 2008) that may dismantle functioning practices.

References

Alén, C. Bengtsson, P-E, Bergren, B.Johansson, L. Johansson, Å, 2000 *Skredriskanalys I Göta Älvdalen- Metodbeskrivning.* Rapport 58. SGI Linköping

Ahrne,G. Brunsson, J. 2004. Soft Regulation from and Organizational Perspective. In Mört,U (ed) 2004. *Soft law in Governance and Regulation*. Cheltenham.

Betsill, M.,Bulkeley, H. 2007. Looking Back and Thinking Ahead: A Decade of Cities and Climate Change Research. *Local Environment* vol 12 No 5 pp 447-456

Berntsson,S.2001. *Dam safety and Risk Management: Risk analysis of spillway gate function*. Licentiate thesis. Royal Institute of Technology. Stockholm.

Brickman, R.,Jasanoff, S., Ilgen, T.1985. *Controlling Chemicals. The Politics of Regulation in Europe and the United States.* Cornell University Press

Brunsson, N and Jacobsson (2000). *A World of Standards.* OUP, Oxford.

Boholm. M. 2009. Risk and Causality in newspaper reporting. *Risk Analysis*, Vol 29. No, 11. 2009

Boholm,Å.2003 The cultural nature of risk: Can there be an anthropology of uncertainty? *Ethnos,*Volume 68, Number 2, June 2003 , pp. 159-178(20)

Boholm,Å. 2009a.Speaking of Risk: Matters of context. *Environmental Communication.* Vol 3, No 3, 2009, pp. 335-354

Boholm, Å. 2009b, (submitted) On the organizational practice of expert-based risk management: A case of railway planning". Submitted to *Risk Management. An International Journal.*

Elforsk, 2006, *Dammsäkerhet, beredskapsplanering för dammbrott- ett pilotprojekt I Ljusnan* Elforsk rapport 05:38

European Commission, 2007. *Adaptation to climate change in Europe- options for EU action*. Green paper. COM(2007)354. Brussels

European Commission,2009. *Adapting to climate change-towards a European framework for action*. White paper. COM (2009) 147 Brussels

Granberg, M, Elander.2007. Local Governance and Climate Change: Reflections on the Swedish Experience. *Local Environment* Vol. 12 No. 5 pp.537-548

Gunningham N,.Grabosky,P.,Sinclair,D.1998.Smart Regulation: An Institutional Perspective. *Law and Policy,* vol 19 no 4 pp363-414.

Gustavsson,E.,Elander,I.,Lundmark, M. 2009. Multilevel governance, networking cities, and the geography of climate-change mitigation: two Swedish examples. *Environment and Planning C: Government and Policy.* Vol. 27.pp 59-74

Hammarström, T.2008. Vänern får inte sänkas i panik. *Expressen,* 2008-03-17

Hartford, D., Baecher, G.2004. *Risk and Uncertainty in Dam Safety.* Thomas telford, Ltd. London

Hutter,B. 2001. *Regulation and risk: occupational health and safety on the railways*. Oxford: Oxford University Press.

Hutter, B. 2005. 'Ways of seeing': understandings of risk in organizational settings. In Hutter B & Power M (eds).2005. *Organizational Encounters with Risk.* Cambridge. CUP

Hood, C., Rothstein, H. and Baldwin, R. 2001. *Government of Risk*, Oxford, OUP

Kelman. S. 1981. *Regulating America, Regulating Sweden*. MIT Press

Langlais. R. Hedin, S.,Francke. P. 2007. *Early warning, floods and climate change.* Civil Protection Network. Working paper 2007:4. Nordregio

Lindström, B.1992. *Trollhätte kanals historia.* Trollhättan. Statens vattenfallsverk.

Lundqvist, L.1980. *The Hare and the Tortoise: Clean Air Policy in the United States and Sweden,* The University of Michigan Press.

Löfstedt, R, 1996, Risk communication-The Barsebäck nuclear plant case, *Energy policy* vol. 24, no8, pp. 689-696

Löfstedt, R. 2005. *Risk Management in Post-Trust Societies.* Macmillan Palgrave

MSB. 2009. www.msbmyndighten.se

Mört,U (ed) 2004. *Soft law in Governance and Regulation*. Edward Elgar. Cheltenham.

Naess, L-O, Bang, G., Eriksen, S,.Vevatne, J. 2005. Institutional adaptation to climate change: Flood responses at the municipal level in Norway. *Global Environmental Change.* Vol 15. pp. 125-138.

National Audit Society (Riksrevisonen,)2007, *Säkerheten vid vattenkraftdammar* RiR 2007:

Neuvel, J, van der Brink, A. 2009. Flood risk management in Dutch local spatial planning practices. *Journal of Environmental Planning and Management.*Vol. 52. No 7 pp.865-880

Purvis,T, 2002. Regulation, Governance and the State. In Mac Neil, M, Sargent, N, Swan, P (eds) *Law, Regulation and Governance*. Oxford University Press.

Renn O. 2008. *Risk Governance*. Earthscan, London

RIDAS. 2004. Kraftföretagens riktlinjer för damsäkerhet. Swedenergy

Sahlin-Andersson, K. 2004. Emergent Cross-Sectional Soft Regulations. In Mört,U (ed) 2004. *Soft law in Governance and Regulation*. Edward Elgar. Cheltenham.

SGI. 2006a. *På säker grund för hållbar utveckling*. Rapport.

SGI.2006b. Geotechnical conditions for increased drainage from Lake Vänern to River Göta. SGI Varia 565

SGI, 2009. Information om myndighetsfunktion. www.swedgeo.se (accessed 2009-06-14)

Sjöfartsverket, 2009. Information om Sjöfartsverket./ Om oss. www.sjofartsverket.se (accessed 2009-07-14).

Storbjörck, S. 2007. Governing Climate Adaptation in the Local Arena: Challenges of Risk Management and Planning in Sweden. *Local Environment.* Vol 12. No 5 457-469

Statens Offentliga Utredningar SOU. (The Swedish Government's Public Inquiries):

- SOU:1995:40 Älvsäkerhet. Stockholm
- SOU 2006:196 Översvämningshot Risker och åtgärder för Mälaren, Hjälmaren och Vänern. Delbetänkande av klimat-och sårbarhetsutredningen-
- SOU 2007:60 Sverige inför klimatförändringarna- hot och möjligheter.

Sorensen, E, Torfting, J. 2005. The Democratic Anchorage of Governance Networks. *Scandinavian Political Studies*. Vol 28 No 3.

Star, S. and Griesemer, J. (1989):' Institutional Ecology, 'Translations' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology'. *In Social Studies of Science,* 19 pp. 387-420

Svenska Kraftnät.2001. *Analys av översvämningarna under sommaren och hösten 2000 samt vintern 2001*. Nr 1:2001, BE 90

Svenska Kraftnät, 2007. Dammsäkerhet- egenkontroll och tillsyn. Svenska Kraftnät, Stockholm.

Svenska Kraftnät 2009- *Dammsäkerhet utvärdering av försöksperiod* " Särskild granskning" 2006-2008 – En sammanställning av erfarenheter och lärdomar PM accessible at http://www.svk.se/Om-oss/Varverksamhet/Dammsakerhet/Dammsakerhetsradet-

Tranberg, K. 2002. *Vänerns höga vattenstånd och dess omfattning* 1807-2000. Serie B nr 311. Institutionen för Geovetenskap, Göteborgs Universitet

Turner B., Pidgeon N. 1997. *Man-Made Diasasters,* 2nd edition. Biddles Ltd, Guildford

Vattenfall,2009. Koncernens Historia. www.vattenfall.se (accessed 2009-07-14)

Vogel, D. 1986. *National Styles of Regulation: Environmental Policy in Great Britain and the United States*. Ithaca, NY: Cornell University Press

Vänersborgs tingsrätt,2009. Court Order, Nr M 2290-07.2009-05-08

Västra Götaland County Board. 2008. Överenskommelse 2008-04-14. En ändrad tappningsstrategi för Vänern.

Länsstyrelsen Västra Götaland, 2009, Överenskommelse mellan Länstyrelsen Västra Götalands län och Vattenfall AB.

Webb, K. 2002. Government, Private Regulation, and the Role of the Market. in Mac Neil, M, Sargent, N, Swan, P (eds) .2002. *Law, Regulation and Governance.* Oxford University Press.

Wegner, E.1998. *Communities of Practice; learning, meaning and identity.* Cambridge University Press

Wegner,E, McDermott, R.Snyder, W. 2002. *Cultivating communities of practice.* Harvard Business School Press.

Weir. D. 1996. Risk and Disaster: the role of communications breakdown in plane crashes and business failure. In *Accident and Design.* 1996. Hood. C & Jones D (eds) UCL Press

White, G.F. 1942/1945. *Human Adjustment to Floods: A Geographical Approach to the Flood Problem in the United States.* Doctoral dissertation at the University of Chicago, Department of Geography (1942) republished as Research Paper No. 29 (1945), University of Chicago, Department of Geography, Chicago, USA.

Regulations

SFS 1987:10 The Planning and Construction Act (Plan och bygglagen)

SFS 1998:808 The Environmental Code (Miljöbalken)

SFS 2003:778 The Civil Protection Act (Lag om skydd för olyckor)

SFS 2006:942 Ordinance of Emergency Preparedness (Förordning om krisberedskap)

Appendix

List over respondents

S1- SGI
M1- Ale municipality
M2- Ale municipality
M3- Trollhättan Municipality
M4- Lilla Edet Municipality
C1- Västra Götaland County Board
C2- Västra Götaland County Board
C3- Västra Götaland County Board
MA1- The Swedish Maritime Administration
MA2- The Swedish Maritime Administration
SK1 - Svenska Kraftnät
SK2- Svenska Kraftnät
V1- Vattenfall
V2- Vattenfall