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The question of resilient and effective ecosystem governance: a case study of the Abbotsford-Sumas Aquifer International Task Force

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The Question of Resilient and Effective Ecosystem Governance: A Case Study of The Abbotsford-Sumas Aquifer International Task Force

By

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Accepted in Partial Completion of the Requirements for the Degree Master of Science

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Stephanie L. Messa
November 18, 2014
THE QUESTION OF RESILIENT AND EFFECTIVE ECOSYSTEM GOVERNANCE: A CASE STUDY OF THE ABBOTSFORD-SUMAS AQUIFER INTERNATIONAL TASK FORCE

A Thesis
Presented to
The Faculty of
Western Washington University

In Partial Fulfillment
Of the Requirements for the Degree
Master of Science

by
Stephanie Messa
October 2014
Abstract

This paper examines the transition from government to governance in transboundary water resource management that is widely noted in the literature. As researchers and managers recognize the shortcomings of traditional management of natural resources, a shift away from the traditional, rules-based approach to an adaptive, iterative, and cross-scale form of management is occurring. This research focused on the Abbotsford-Sumas Aquifer International Task Force as a possible example of this paradigm shift. Semi-structured interviews and surveys were used to collect background information and history, current status and efforts, and future directions of the Task Force. The results of the research show that adaptive management is not occurring and therefore the Task Force is not an example of active adaptive governance. Although the Task Force has been successful in providing a means for information sharing and collaboration very little has been done in terms of action items leading to the reduction of nitrate contamination in the aquifer. Although largely ineffective in accomplishing its mission, stakeholders still value small, working groups and continue to show interest in participating.
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1.0 Introduction

1.1 Project Description

Traditional methods of water governance follow a top-down or state-centric approach, also known as topocratic (Akamani and Wilson, 2011). This traditional method usually falls under the modern paradigm or worldview in which the fundamental assumption is that the world is knowable and predictable (Plummer & Armitage, 2007). This form of management attempts to control natural systems through a reductionist approach in an effort to make change or disturbances, such as droughts, minimal and anticipated. This modernist paradigm views the world as a machine, which can be controlled via the scientific method (Plummer & Armitage, 2007). However, this form of management is often reactive and too rigid to deal with the many variables encountered in complex social and ecological systems, consequently leading to a plethora of problems (Plummer & Armitage, 2007). Scholars are recognizing that in an increasingly global world, social-ecological systems are far more complex than previously thought (Homer-Dixon, 2011). In light of this knowledge the need for a new management approach which allows flexibility and takes a proactive approach becomes apparent.

Increasingly, the scientific community is acknowledging that a cross-scale, cross-border approach, where managers and decision-makers link global, transnational, and local scales, is vital in the quest to manage resources sustainably (Cash and Moser, 2000). Recently, scholars and government agencies have recognized a trend of increasing local actor involvement in water management initiatives in Canada and the United States (Norman and Bakker, 2009; International Joint Commission 2009). According to Norman and Bakker (2009), “this trend parallels the
devolution of environmental governance to the sub-national level. In Canada and the U.S., devolution has led to an increased role of citizen participation in environmental governance, particularly for water resources” (p.8).

Since 1998, the International Joint Commission, at the request of the governments of Canada and the U.S., has been working to create an integrated, participatory, ecosystem approach to transboundary water issues. This approach, known as the International Watersheds Initiative, is based on the idea that local people and institutions are often the most appropriate level at which to mitigate and prevent water resource problems (International Joint Commission, 2009). This new perspective on transboundary water governance allows the opportunity to examine the creation of, and interconnection between, new scales of water governance, including the local, bioregional, and cross-border scale. Devolution of governance to the watershed or local level is becoming increasingly common throughout North America; “this trend is apparent along the Canada-U.S. border as the International Joint Commission [IJC], which has historically addressed disputes in a formal nation-to-nation setting, moves towards adopting a watershed approach via watershed commissions” (Norman and Bakker, 2009, p.11).

Although a shift from government to governance is occurring, where non-governmental, and local community actors in particular, play an integral role in environmental management (Karkkainen, 2006; Akamani and Wilson, 2011; Norman et al., 2012), scholars are recognizing that this collective action across scale is not enough to ensure the sustainability of transboundary water resources (Akamani and Wilson, 2011). One challenge facing decision-makers is the lack of a systematic way to incorporate science and policy across multiple scales. The management of transboundary water bodies is further complicated because water, as a flow resource, naturally defies man-made borders. An additional problem is the need for political commitment on both
sides of the border. Finally, the resilience of the institutions and management strategies is key to creating a lasting and effective management system (Giordano et al., 2005).

A new paradigm, resilience-building management, is emerging. It focuses not only on collaboration, but also supports the complex systems theory that views the world as continuously adapting and changing in response to environmental feedback (Plummer & Armitage, 2007). Resilience-building management, or adaptive management, has been introduced as a way to view and manage social-ecological systems as one continuous and inter-linked system. This type of management employs flexibility and openness to learning in order to sustain social-ecological systems in the face of unpredictability and complexity (Folke et al., 2002).

Folke et al. (2002) describe resilience as “1) the magnitude of shock that the system can absorb and remain within a given state; 2) the degree to which the system is capable of self-organization; and 3) the degree to which the system can build capacity for learning and adaptation” (p.438). By setting a sustainability goal, or stating what condition managers would like the aquifer to end up in, decision-makers can develop policies by backcasting from this goal and determining what actions would most likely lead to the desired outcome (Gleeson et al., 2012). This structured decision-making processes can allow managers the opportunity to build resilience in the system. In essence, management of resources can build or destroy resilience based on the systems anticipation of and reaction to disturbances in the natural or social system. Plummer and Armitage (2007) suggest, this new worldview serves as a bridge between natural and social sciences and has contributed to the development of the social-ecological systems approach in which human and natural systems are interlinked and viewed holistically. The concepts of social-ecological resilience and complex systems theory will be discussed in greater detail in the following sections.

The management of the Abbotsford-Sumas aquifer is a possible example of this paradigm
shift from a rules-based, top-down system to a cross-scale, adaptive approach that incorporates local involvement into a potentially more resilient framework. Several groups have tried to manage the aquifer collaboratively across the border, but no management strategy has been fully successful in reducing nitrate contamination overall. A full list of these groups can be found in Appendix A. One of these groups is the Abbotsford-Sumas Aquifer International Task Force (“Task Force”). One subgroup of aquifer users has externalized the costs by polluting a commons. The Task Force was established as a means to protect this resource and those affected by the degraded water quality. The Task Force has existed for over twenty years and has successfully provided a means for cross-scale and cross-border information sharing and collaboration amongst stakeholders. Adaptive governance is a proactive approach to management, which stands in contrast to traditional management that is largely focused on efficiency and is often a reactive approach. While nitrate contamination of the aquifer is well known, no serious health impacts have been reported, making it plausible that managers are attempting to solve an environmental issue before it enters crisis-mode.

Although the group has been in existence for over two decades there are definite limitations to the Task Force’s successful governance of an international aquifer. While it can be assumed that social capital, the creation of social bonds and norms through the development of trust (Pretty, 2003), has been created, the overall resilience and effectiveness of this Task Force comes into question. Interest and participation of historically involved stakeholders can begin to dwindle if the effectiveness and accountability of the Task Force decrease. If long-term member disengagement becomes the norm for these informal working groups, their relevance into the future seems bleak. A more in depth discussion of the Task Force will be given in the following sections.

The goal of this study is to see if the Task Force serves as a model of active adaptive governance and to analyze how stakeholders perceive the effectiveness and resilience of the Task
Force. Further, this thesis examined what the barriers are to the Task Force’s success. With this information we can draw conclusions about the importance of these types of informal working groups in the future.

### 1.2 Research Questions

Generally, the study focuses on background information and history, current status and efforts, and future directions of the Task Force. My specific research questions which guided this study are:

- Has the Task Force been effective in managing the aquifer?
- Do stakeholders believe that the current method of water governance used by the Abbotsford-Sumas Aquifer International Task Force fosters social-ecological resilience?
- What information does the Task Force provide about whether informal, ad-hoc governance structures can be as productive and successful as more formal institutions?
- Is recursive, iterative, and adaptive management of the aquifer occurring from the efforts of the Task Force?

A mixed methods approach was used to complete this research. A combination of qualitative and quantitative data were collected via semi-structured interviews and surveys. After background knowledge was attained through the interviews and secondary research, all currently involved stakeholders (according to an email list from 2013 meetings) were invited to complete a survey. This survey contained both qualitative and quantitative questions. The qualitative questions were largely used to assess stakeholders’ perception of the Task Force’s mission statement and future direction; additionally each quantitative question had a comments section to allow for further explanation of answers. The quantitative section of the survey asked participants to rank statements about the Task Force on a scale of 1-5, with 5 being highest or strongly agree.
The survey focused on three areas aimed at measuring whether or not the Task Force exhibited characteristics that would result in resilient and effective ecosystem governance. These areas included: extent and type of involvement of stakeholders in the Task Force, increased and consistent communication (both amongst Task Force members and in regards to any public outreach programs), and future directions.

Analysis of interview and survey responses revealed that, although stakeholders value the information sharing and collaboration associated with the Task Force, they do not believe it is effective in executing its mission, nor is it resilient. Further, the Task Force does not manage in an adaptive or iterative way. Ultimately, stakeholders believe that the current governance efforts of the Task Force will not be enough to sustainably manage the aquifer into the future.

1.3 Background

A brief background will be provided here to familiarize the reader with the frameworks and concepts that shaped this research. A more in depth discussion of these concepts will be covered in the following chapter.

1.3.1. Abbotsford-Sumas Aquifer International Task Force

The Abbotsford-Sumas aquifer, located along the border of southwestern British Columbia and northwestern Washington, was used by over 100,000 people in 2005 (USGS, 1999; Mitchell et al., 2005). This aquifer has been plagued with nitrate contamination well above the safe drinking water standards on both sides of the border for over two decades (Norman and Melious, 2004; Carey and Cummings, 2012). Studies have proven that a reduction in nitrate leaching is necessary to improve the health of the aquifer.
The Abbotsford-Sumas Aquifer International Task Force, a subcommittee of the British Columbia-Washington Environmental Cooperation Council [ECC], has been tasked with reducing nitrate in the aquifer. The Task Force was initiated as part of an agreement in 1992 after the ECC declared the aquifer one of the five highest environmental priorities (Norman and Melious, 2004). The ECC created the Task Force to coordinate groundwater protection efforts in the aquifer as part of the larger goal of resolving transboundary hydrologic issues. Specifically, the Task Force is required to make recommendations on both water quality and water resource management issues on both sides of the border (Abbotsford-Sumas Aquifer International Task Force, 1993). As stated in the original mission statement, the Task Force was responsible for “coordinating efforts directed towards protecting the aquifer across the common border between Canada and the United States” (Abbotsford-Sumas Aquifer International Task Force, 1993, p.48) The Task Force is an international organization which draws its members from State/Provincial and local governments with some influence from Federal, Tribal/Aboriginal governments, and little representation of Non-Governmental Organizations.

The Task Force has not been successful in reducing nitrate overall; the levels remain above the acceptable 10 mg/L and are increasing in some areas (Carey and Cummings, 2012; Graham, 2012). As Redding et al. state (2011), “A 2003-2005 study of 35 local private domestic wells shows that nitrate-N concentrations exceeded (did not meet) the 10 mg/L drinking water standard during at least one sampling event in over 70% of samples wells. A total of 26% of the wells consistently exceeded the drinking water standard and 31% of the wells displayed an increasing nitrate trend. One well had nitrate concentrations as high as 43.1 mg/L.” Although these facts are explicitly for the Sumas-Blaine portions of the aquifer, a report prepared by Environment Canada in 2012 suggests a similar situation in which nitrate levels have steadily remained above 10 mg/L on the Canadian side.
of the aquifer as well (Graham, 2012).

Further, the Task Force was on a hiatus from 2007-2012 with no formal meetings occurring during this time. The Task Force reconvened in 2013 and held two formal meetings during the year (January and June 2013); to date the Task Force has not held any meetings since. In May of 2014 the co-chairs sent email correspondence to stakeholders indicating that inadequate resources prevented them from participating at the level needed to meet the organization’s objectives. It was suggested that a letter be written to the ECC to confirm that the effort to reduce nitrate in the aquifer was still of high importance to British Columbia and Washington State. The letter was to be drafted and submitted to the ECC in the summer of 2014, but confirmation that this has taken place has yet to be released.

Despite the inconsistent nature of the Task Force, the organization has continued to exist (at least on paper) for over twenty years. Regardless of the ebb and flow of the Task Force as an active group, member organizations continue to work on monitoring and managing the aquifer within their respective fields. For example, the Whatcom County Health Department continues to monitor public wells and Whatcom County Conservation District continues to work with farmers to come up with farm management plans to mitigate nutrient loading into water bodies.

1.3.2. Complex Systems Theory & Social-Ecological Resilience

Transboundary water resources are complex social-ecological systems that are sometimes referred to as common-pool resources because they are resources that are available to all users without restriction and as such, one user, or a group of users, can degrade the resource for all. In order to ensure the sustainability of such complex systems a shift in governance is needed, not only to include actors across boundaries and scale, but also to account for uncertainties in the human
and natural systems in which they exist (Akamani and Wilson, 2011). Uncertainties in the human system include changes such as fluctuation in funding or administration of governance institutions; changes in the natural system include droughts and the introduction of new species into the ecosystem.

Resilience thinking offers an alternative to traditional management practice. Traditional management follows a top-down, topocratic approach in which laws are made at the federal or state level and passed down. Traditionally, management of resources has attempted to control natural systems for human benefit. Alternatively, resilience theory offers the opportunity to work across scale and boundary in order to incorporate all levels of knowledge. As Cosens (2010) states, “when applied to the coupled human-ecological system, it [resilience] provides an umbrella theory for integration of concepts of natural resource management with ecological response to achieve sustainability” (p.230).

Addressing transboundary water management through the lens of resilience theory coupled with the adoption of adaptive governance as an organizing framework would foster the sustainability of the resource and thus resilience. The concept of resilience was introduced by C.S. Holling in 1973 in the study of ecological systems. “Resilience is the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks...” (Cosens, 2010, p.231).

By viewing water resources as part of a complex system one can begin to understand why a traditional management approach, which is largely focused on “controlling” the resource, is not resilient. Simply controlling the resource for social or economic gain is not sustainable; incorporation of the ecological component is necessary. While aspects of a topocratic approach can
provide much-needed structure and leadership to any governance institution, the recognition and inclusion of both social and ecological factors is necessary for the system to be resilient. Decision-makers now understand and appreciate the complexity of natural systems and a transition to a more collaborative approach to governance has been occurring over the last two decades (Akamani and Wilson, 2011). However, promotion of collaborative governance is not enough to ensure sustainability because cross-scale institutions are not necessarily equipped to deal with natural or anthropogenic drivers of change. A push toward multilevel collaboration is a step in the right direction, but institutional arrangements also need to account for uncertainties and changes in the system (Akamani and Wilson, 2011). Instead Akamani and Wilson (2011) recommend institutional frameworks that explicitly address “complexity, fluidity of scale, flexibility of rules, and the use of multiple systems of knowledge in the governance of transboundary water resources” (p.411). Such a system would proactively seek to enhance system resilience (Akamani and Wilson, 2011) by structured decision-making and evaluation.

Resilience thinking offers a way “to understand complexity in an ecological system and a framework to develop governance in a way that enhances resilience and thus sustainability of the social-ecological system” (Cosens, 2010, p.237). This framework is known as adaptive governance in resilience literature. Adaptive governance includes a polycentric institutional framework in which “institutions are hierarchically nested multilevel institutions with some degree of diversity and autonomy at each level, and are alternatives to the top-down approach” (Akamani and Wilson, 2011, p.412). This framework allows institutions fair and equitable participation in the policy-making process by providing the opportunity for cross-scale communication. Adaptive governance recognizes the inseparable connection of multi-level governance of natural resources with the implementation of policies. This broader understanding and inclusion of social factors make
adaptive governance an appropriate approach to address the complexity of transboundary water management.

1.3.3. Adaptive Management

Allen et al. (2011) describe adaptive management as, “… an approach to resource management that emphasizes learning through management based on the philosophy that knowledge is incomplete and much of what we think we know is actually wrong, but despite uncertainty managers and policy makers must act” (p.1339). According to Allen, adaptive management has been viewed as a way to stop the trial and error process that plagues resource management traditionally. Allen defines trial and error as implementing one strategy at a time that incorporates little knowledge into the management approach. Adaptive management, in contrast to trial in error, is a structured process that employs multiple, experimental management strategies and is continually monitoring these actions providing a positive feedback loop (Allen et al., 2011). “However, unlike a traditional trial and error approach, adaptive management has explicit structure, including careful elucidation of goals, identification of alternative management objectives and hypotheses of causation, and procedures for the collection of data followed by evaluation and reiteration” (Allen et al., 2011, p. 1339) Adaptive management offers a process that is continually attaining knowledge and allows flexibility to incorporate that new knowledge, ultimately increasing adaptability; the process is iterative and recursive. “Adaptive decision making can be distinguished from a trial and error approach of “try something and if it doesn’t work try something else,” involving an ad hoc revision of strategy through time when it is seen as failing. Adaptive management differs from trial and error by the structure used in adaptive decision making, involving articulation of objectives, identification of management alternatives, predictions of management consequences, recognition of key uncertainties, and monitoring” (Williams, 2011, p.1347). Allen et
al. (2011) describe adaptive management as “management based on learning and subsequent adaptation of management based on that learning. The process is iterative, and serves to reduce uncertainty, build knowledge and improve management over time in a goal-oriented and structured process” (p.1339).

1.4 Utility of Research

This research will contribute to knowledge about the policy and governance elements of a complex, international system. This knowledge is needed to better understand the uncertainties of managing transboundary resources, such as an aquifer, and developing policies accordingly to ensure social-ecological resilience and therefore sustainability of the resource. Further, if this research reveals that the Task Force has created a collaborative relationship in which an ecosystem can be governed effectively and resiliently, it can serve as a model for future cross-border working group initiatives. If however, the research reveals that the current set up of the Task Force does not lead to effective governance of the aquifer, we should be able to identify lessons that could provide insight to other transboundary groups. Finally, this research will be informative in understanding what role informal governance structures play, and could play in the future, in the larger picture of Salish Sea ecosystem governance.

1.5 Organization of Thesis

This thesis is divided into five chapters. The first chapter identifies the research questions and goals for the project. The second chapter includes background information and a literature review of pertinent concepts including, social-ecological resilience and adaptive management. The third chapter outlines the research framework and methods used to complete the thesis research as
well as data analysis of information collected. The fourth chapter will discuss the results of the research. The fifth and final chapter will draw conclusions from the project, discuss possibilities for further research and limitations of this thesis.
2.0 Literature Review and Background Information

2.1 Literature Review

2.1.1. Background of Abbotsford-Sumas Aquifer

The Abbotsford-Sumas aquifer is located in northwestern Washington State and southwestern British Columbia. The aquifer covers approximately 100 square miles and provided water for over 100,000 people in 2005 (USGS, 1999; Mitchell et al., 2005). The aquifer first gained public attention in the mid-1980s, when widespread nitrate contamination caused concern about agricultural practices and increased pressures for urban development above the aquifer (Gleeson et al., 2012). The shallow aquifer is particularly susceptible to nitrate contamination due to its largely unconfined nature, consisting of loose sands and gravel. At the center of the aquifer, the water table is no more than 100 feet below the surface; in some parts near the edge of the aquifer the water table is just 15 feet (Norman and Melious, 2004). High levels of annual precipitation in the region add to the problem.

It is largely believed that agricultural sources are to blame for the elevated levels in nitrate contamination (Norman and Melious, 2004). In 1992, best management practices (BMPs) were implemented to mitigate nitrate leaching due to poor agricultural practices (Gleeson et al., 2012). In particular, the best management practices sought to reduce the amount of manure contained in the region and switch to using a synthetic fertilizer. At the time it was believed that synthetic fertilizers would not cause nitrate contamination as long as application rates were controlled (Gleeson et al., 2012). More recently it has been discovered that in fact inorganic fertilizers do contribute to nitrate contamination. Although more than 90% of farms complied with these BMPs, manure levels increased as farming continued to grow in the region and thus nitrate contamination persisted in
the aquifer (Gleeson et al., 2012). To date the nitrate levels in the aquifer remain above 10 mg/L, the drinking water standard on both sides of the border (Environmental Protection Division, 2001; Washington State Department of Health, 2012).

In some of the deepest portions of the aquifer, it can take decades to see any effect of management practices. This feature is unique to aquifers as underground resources and adds complexity to monitoring and management efforts. According to Gleeson et al., (2012) “… any actions taken now will likely take two or more decades to see any significant effect on drinking water quality. The complexities of monitoring a large, heterogeneous aquifer and the evolving scientific understanding (i.e. synthetic fertilizers were not thought to cause nitrate contamination in the early 1990s) demand an adaptive approach for water and nutrient management (p.23).”

Figure 1: Map of the Abbotsford-Sumas Aquifer, Stefan Freelan, WWU, 2005
2.1.2. Rescaling of Governance

The Local Trap

In recent years water governance literature has been increasingly focused on the local, or more specifically, the watershed level (Norman and Bakker, 2009; Cohen and Davidson, 2011). This rescaling of governance reflects the idea of the “local trap” brought up by Brown and Purcell (2005). The “local trap” criticizes the assumptions of managers and decision-makers that it is inherently better to operate on a local level and necessary to include local actors in management; therefore, “increasing empowerment, accountability, and/or cost efficiency” (Norman and Bakker, 2009, p.3).

There are many problems associated with the assumption that any one scale, and particularly the local scale, is inherently better than others. The first problem stems from the general assumption that scales are natural and are therefore the best way to address water quality issues. As stated by Brown and Purcell (2005), there is “nothing inherent about scale” (p.608). Scale is, in fact, a socially-constructed concept that can be molded, shaped, and changed by ones experiences. As Cash and Moser (2000) point out, there is rarely a widely accepted definition of ‘local,’ but rather that people supply a definition for a particular issue and purpose. Given the fluid nature of the definition of scale it becomes apparent that we must work across and within multiple scales to efficiently govern resources.

Without a doubt, in both the United States and Canada devolution of governance has occurred and caused an increase in local actor involvement and citizen engagement (Norman and Bakker, 2009). However, according to Norman and Bakker (2009), local-level governance often goes un-critiqued because of the assumption of positive benefits from local or watershed level governance, without the evaluation of the costs. These negative implications of rescaling levels of governance are not widely noted in the literature. Further, this assumptive attitude implies that all
stakeholders will be included equally. However, this devolution from the nation-state or provincial level has included a scaling down to sub-state levels and simultaneously a scaling-up to supranational levels. This shift in governance may increase responsibilities for local entities, but limits the capacity of these institutions to better govern water resources. For example, although substantial rescaling of water governance has occurred in the US and Canada, higher levels of government have not loosened their grip on their decision-making power or reallocated funds to support these initiatives. Therefore, devolution of governance does not necessarily lead to empowerment of local entities. As Cochrane (1986) states, “governments seem to use community as if it were an aerosol can, to be sprayed on any social program, giving it a more progressive and sympathetic cachet” (51). In the case of the Abbotsford-Sumas aquifer, the existence alone of the Task Force has not led to empowerment of local entities and reduction in nitrate contamination.

Watershed level governance is further complicated by the question of accountability. Due to the implicit nature of watersheds to cross political boundaries, the question of who is responsible to take action when problems arise within the watershed remains unanswered. This issue is further complicated by the previously stated challenge of responsibility being passed down without the reallocation of resources. While local actors may have a genuine interest in improving water management, they may not be provided with the means to do so (Norman and Bakker, 2009). In transboundary water issues the concept of accountability is particularly pertinent, especially in circumstances of scale mismatch. In cases where one side of the border is governing at a national level and the other is governing at a watershed level the priorities of each may not match, thus compounding the issue of accountability. In the case of the Abbotsford-Sumas aquifer, the obligations that fall under the Department of Ecology’s responsibilities on the U.S. side may not match what is required by their Canadian counterpart, the Ministry of the Environment. Not only
does this scale mismatch complicate accountability, but likewise how each country prioritizes a particular issue will affect allocation of resources and ultimately the extent of management efforts.

Another challenge associated with the watershed approach to governance is boundary choice. Although watersheds may seem straightforward and are based in hydrologic data, the definition is open to interpretation and at times can include an area as big at the Great Lakes or as small as a puddle on the sidewalk (Cohen and Davidson, 2011). As technology improves and increases our capacity to understand and accurately map our surroundings, these boundary lines can change, which makes the decision of selecting which boundary to use both a social and natural one.

One of the commonly cited reasons for devolving to a watershed-level of governance is the benefits of integrated social, political, and natural systems in policy decisions and the engagement of local actors from all sectors. However, an asymmetry between watersheds and ‘problem-sheds’ exists. According to Cohen and Davidson (2011), a ‘problem-shed’ is the geographic area that encompasses all of the issues, but is small enough to deal with them. Watersheds do not encompass all of the factors, both physical and social, that affect the waters within them, nor the factors upon which the watershed has an affect. Managing groundwater based on the boundaries of the aquifer ignores all the land use and surface water issues surrounding it that affect its waters as well as disregarding the aquifer’s impact on the larger Salish Sea ecosystem. Due to this scale mismatch, policies made outside the scope of the watershed can have adverse impacts on the problems occurring within the watershed; since not all policy is made at a watershed level, the probability of gaps or overlap in policy seems likely.
The challenges associated with watershed level governance are significant and continue to inhibit the efficiency of water management, making it necessary for decision-makers and managers to once again consider another alternative to governance. It is becoming increasingly more apparent in the scientific community that a cross-scale approach, where managers and decision-makers link global and local scales, is vital in the quest to sustainably develop resources. Cash and Moser (2000) describe this management approach in detail, and their work will be discussed in the following paragraphs.

Challenges for Cross-Scale Management: Scale Mismatch

The challenge in implementing cross-scale management comes from the lack of a systematic way to incorporate science and policy across multiple scales. For example, in regards to climate change, the situation is one where policy makers want to make local policies based on global climate change impact, and conversely, local data is necessary to increase the accuracy of global climate models. This exemplifies the challenges faced in water governance, and environmental governance, more broadly. Three main examples of scale mismatch affect water governance: 1) when decision-makers lack the ability to match the scale of a natural system (i.e. a watershed) to the scale of management (i.e. a political jurisdiction), 2) data collection often does not take place at the scale where policies or decisions are being made, and 3) a general misunderstanding of the interconnection between scales exists, thus leading to poor communication and lack of information during the decision-making process.

What is obvious to decision-makers at all levels is the fact that policies created and implemented at any stage have repercussions for all scales, and this interconnection can constrain
or provide opportunities among scales. While it is obvious that scale is not the only problem in water governance, or in environmental governance more broadly, it is apparent that until cross-scale obstacles can be overcome, inefficiency in the form of gaps and overlap will continue to cripple governance efforts.

One recurring challenge is the mismatch between scales of management and environment. Rarely does a political or governing body have the authority to manage an environmental phenomenon in its entirety. This mismatch leads decision-makers to produce policies separately for human and natural systems instead of viewing them as whole, inclusive systems. Typically this method of management leads to unsustainable development of resources, which has been echoed by the serious degradation of many natural resources in the Salish Sea ecosystem and others. Some researchers believe that in the case of common-pool resources, such as transboundary water, the solution comes in the form of a centralized, governing body— a higher scale of governance. For transboundary water in the U.S. and Canada, this belief has been successfully executed by the creation of the International Joint Commission, which has developed a set of rules and regulations it continues to enforce today. At the request of both governments the IJC will investigate environmental issues of mutual concern, but to date has not been involved in management of the Abbotsford-Sumas aquifer (Norman and Melious, 2004).

Another challenge for cross-scale management is the asymmetry between assessment and management. The level at which scientific data is collected and analyzed and the scale at which policies and decisions are made many times do not correspond. Often, decision-makers require the scaling up or down of data in order to make informed decisions relevant to the scale at which they operate. For example, if water data are collected and analyzed for all groundwater sources in Washington State, it makes it more difficult for managers at the local level to make decisions
pertinent to their resources and community. This mismatch in assessment and management leads to a slew of problems. The first problem is the lack of credibility for policies made around seemingly irrelevant data. If nitrate contamination is happening at a higher rate for one or two aquifers, those numbers can alter the results when statewide groundwater resources are looked at as a whole, making clean aquifers look more contaminated. Inversely, the cleaner groundwater may make the situation for aquifers with severe nitrate contamination appear to be in better condition than they truly are. In line with this notion, without local specificity, an issue lacks importance to the community, preventing managers from fully understanding the issue and enacting scale-appropriate responses. Perhaps worse than the stand-still of not enacting local adaptive responses to environmental changes is the opportunity to enable policies that cause further degradation. While managers wait for assessment to be salient to the local level, thus gaining community support, they may be forced to allow outdated policies to continue. In the Abbotsford-Sumas aquifer, the issue of nitrate contamination is well known, but a lack of consensus on what to do about it and whose responsibility it is has led to a period of little action.

In addition to these challenges, and perhaps most important, is the inability of managers to see the connection between scales and to create integrated policies and decisions based on these connections. While managers acknowledge the existence of environmental problems across multiple scales, the focus of management is often within the context of a single scale. “...it can be argued that a focus on a single scale tends to emphasize processes operating at that scale, information collected at that scale, and parties influential at that scale – raising the possibility of misunderstanding cause and effect by missing the relevance of processes that operate at a different scale” (Cash and Moser, 2000, p.113).
Cross-Scale Management: Integration and Communication of Knowledge

Instead of a single-scale focus, Cash and Moser (2000) suggest an approach that allows decision-makers to examine the associations between social and geophysical systems. In essence, this method enables a phenomenon to be viewed from a certain scale with reference and integration of all other scales. It allows managers the opportunity to explore the speed at which change or adaptive processes can be enacted at the local level and the constraints in place at the next higher scale due to the larger and slower system dynamics at play.

In water management, for example, it is crucial to understand how slow and arduous the process of passing legislation at the state and federal levels can be; simultaneously, it is equally important to realize how water is used at the local level and how quickly communities can adapt to changes in their immediate environment. Through the understanding of these cross-scale dynamics decision-makers can begin to integrate the knowledge of each; formulating policy that pulls on commonality in priorities, rather than differences, creating a succinct and efficient model.

Another important factor, in addition to integration of knowledge across scales, is the manner in which knowledge is communicated to various scales. In a typical top-down management system a “pipeline model” is employed, where scientists release policy briefs at the highest level and decisions at lower scales are made accordingly. However, this funneling of information from one level to the next dismisses the opportunity for legitimatizing one others’ work through the interactions between actors at different scales. For example, in the case of the Abbotsford-Sumas aquifer, the water quality standard for Washington State is made at the state level, while local managers and the public may not perceive violation of this standard as a real problem. This exemplifies the failure to communicate the risk of high nitrate levels across scales and to the public.
Figure 2: Cash and Moser's (2000) Assessment and Management Heuristic. The arrows indicate bi-directional pathways of information sharing amongst stakeholders while the circles represent positions that individuals or organizations can hold in assessment and management systems. These positions are socially-constructed and can shift in location and responsibilities. The Task Force could serve as a medium for this cross-scale collaboration by bringing several organizations together and encouraging cross-scale collaboration.

Instead of funneling information from the top down, as in the “pipeline model”, one solution is to create a system where multi-directional communication is possible and encouraged. Figure 2 shows various pathways of cross-scale and science-policy collaboration and communication. In this type of communication system decision-makers and scientists work together creating and maintaining a relationship. This cross, and multi, scale communication allows stakeholders to break through the science-policy boundary, where information flows from all levels and persons, from the
local to the global and the decision-maker to the scientist. This relationship in turn will create a more accurate picture of the environmental condition.

**Cross-Scale Management: Utilizing Scale-Dependent Comparative Advantages**

Cross-scale management is no easy feat, especially in the complicated case of transboundary water. It is possible, however, by the diligence and commitment of actors at all scales to accomplish cross-scale management and reap the benefits of efficient governance. Instead of a one-directional governance model where knowledge is created at the top, passed down level by level, and regurgitated without thought or consideration of the scale-appropriate factors at play, managers can employ a model where scale-dependent comparative advantages are utilized. Cash and Moser state, “These comparative advantages can be thought of as unique knowledge, technical capacity, or functional specialization characteristic of a specific scale” (p.116).

The technical capacity of an institution is particularly relevant in the case of water resources. Data collection and monitoring can be costly and time consuming, thus making it imperative for managers to select the appropriate scale at which to do monitoring. While larger governing bodies are able to give a bigger picture or an overview of a larger problem, the smaller forms of governance are able to “ground-truth” these larger scale problems. The Task Force knows nitrate contamination above 10 mg/L is the general situation in the aquifer, however in order to address the sources of contamination they need to know the specific hot spots.

Cross-scale management is an effective alternative to watershed- or local- governance because of its ability to incorporate the benefits of local governance while overcoming the obstacles of such small scale management. The move toward devolution or decentralization of environmental governance reflects the desire for greater community involvement in resource management and for
policies that are conducive to the needs and conditions at the local level. In recognizing these benefits, it is equally important to note where certain governance activities are most appropriately executed. Monitoring and educational programs may be better suited to the local level, while legislation and funding may come from a higher level. The enablement of policies created at higher levels can provide opportunities for local decision-making. A national program may be established and funds may be divided out to states to enact a program according to the overarching national goals. In essence, rather than competing for power and place across scales, it is important that managers recognize each scales’ strengths and weaknesses and act accordingly for the sake of efficient resource management. The ability to utilize each scale’s comparative advantages is directly correlated with the elimination of other scale discordance problems. Through the integration of both the natural and human systems at all scales, a larger, more complex and holistic picture is painted, enabling decision-makers to work together to create credible, reliable, and salient policies at all scales.

The Abbotsford-Sumas Aquifer International Task Force is a possible example of a cross-scale management system. The Task Force ideally could provide a platform for organizations (local through federal) to exchange information, communicate across scale, and coordinate management efforts. The Environmental Cooperation Council is the governing body which oversees the Task Force and helps to pass down funding and resources which allows the organizations within the Task Force to enact and enforce management strategies to reduce nitrate contamination in the aquifer. As stated by Karkkainen (2006),

“...the role of the “center” is not that of an authoritative commander in a top-down decision-making process, but rather that of a central information hub, absorbing, integrating, and redistributing information from all the specialized components of the larger arrangement. The center can also play a coordinating role to see that all the parts cohere into some unified whole, articulating systemwide “big picture” goals, and assessing progress toward those goals. (p. 232)”
In essence, the higher level of governance supports the lower levels by passing down resources and funding in order to allow proper monitoring, education and outreach, and management.

**Achieving Cross-Scale Management: Building Flexibility through an Adaptive Approach**

Cross-scale management is an effective governance system as long as it remains a robust yet flexible system. Since environmental and human systems will change over the course of time, an efficient governance model must be flexible enough to account for these changes. Consequently, the ability of management to be adaptive to change is imperative to the long-term relevance of any governance system. One process that leads to adaptation is policy experimentation. Policies are developed as a way to test hypotheses in practical application (Karkkainen, 2006). Managers monitor and evaluate the results of multiple management decisions and incorporate this new knowledge back into the management system. This process could provide an opportunity for multi-stakeholder involvement and grant further insight into the interaction of human and natural systems across scales. In addition, as the breadth of our understanding of local impacts increases, managers would continually incorporate information from different scales. This cross-scale interaction would further build on the relationships established between managers, foster respect and trust across scales, and allow for increased feedback and effective policies. However, policy experimentation is associated with high risks, and the current system of governance is often unwilling to accommodate these risks. The need for a resilient and adaptive assessment and management system is strong. The literature has proposed that the best way only way to achieve such a system is through the integration of actors across scales by empowering unique scale advantages, enabling policy, and working cooperatively rather than competitively.

In contrast to a widely held belief, water scarce regions may have more resilient systems in place than their water abundant counterparts. As Giordano et al. (2005) states, “Arid areas, where
the historic experience with water scarcity is longest and the benefits from resilient management structures are greatest, may be more prepared to cope with water pressures than better-watered areas” (53). Although the Pacific Northwest is historically a well-watered region, the changing environment as well as increased pressure from development, population growth, and agricultural expansion will put stress on water resource systems in the near future. As noted in the 2010 State of the Watershed Report some water resources in Whatcom County have already been closed to new water uses due to shortages of freshwater in the region. The need for efficient management strategies that are able to adapt to changing social and ecological systems will only compound over time.

It is vital for the sustainable future of water resource management that all scales of governance be included in the decision-making process. As stated earlier, it is clear that operating solely at the local level does not necessarily result in effective water governance. Therefore, recognizing and enacting comparative advantages at all levels is advantageous for meaningful engagement of institutions and the building of resilient management systems, creating cohesion across scales. The development of a resilient, adaptive, cross-scale management system might be the missing link in environmental governance that could usher in a more flexible system allowing for, and adapting to, changes in the human and natural systems.

2.1.3. Social-Ecological Resilience

Building Resilience in Complex Systems

The recent recognition of two fundamental errors in previous natural resource management has led to a change in thinking and practice of environmental management (Folke et al., 2002). The first error is the assumption that natural systems will respond to human use linearly, making them
predictable and controllable. The second error is the assumption that social and ecological systems are separate and can be managed independently. As Homer-Dixon (2011) points out, managers believed the world could be analyzed into parts and thus controlled. Doing so made us believe that we understood the relations between the systems and consequently could predict and precisely manage the behavior of a system. A new understanding of the interconnectedness and complexity of social-ecological systems has brought about a new way of managing them. Humans rely on ecosystems to deliver goods such as food and clean water; simultaneously human action can impact ecosystems changing them into a more or less desirable state (Folke et al., 2002). Negative impact on ecosystems can reduce their ability to provide the goods and services we rely on; such a negative shift represents a loss of resilience.

Over the next ten years, several factors could rapidly trigger such negative shifts in international watersheds (Cosens and Williams, 2012). These factors include a deteriorating ecosystem, population growth, climate change, and aging infrastructure. Accordingly, all of these factors will “place greater demands on competing water interests and increase the need for cooperation across jurisdictional boundaries” (p.1), the uncertainty associated with these factors further challenges traditional approaches to management of transboundary water resources. Cosens and Williams (2012) note that the review of the Columbia River Treaty provided an opportunity to connect local restoration efforts to international operations. Likewise, the current review of the mission and relevance of the Task Force provides an opportunity for greater transparency and public input in management decisions.

“Transboundary water resources can be conceptualized as complex systems comprised of dynamic social and ecological elements and institutional arrangements in a dynamic of interconnected reliance across multiple spatial and temporal scales” (Akamani and Wilson, 2011,
New theories are stressing the importance of assessing and actively managing resilience in complex systems that have a degree of uncertainty (Akamani and Wilson, 2011; Cosens and Williams, 2012). Resilience in social-ecological systems is measured by their ability to cope, adapt, and/or reorganize and maintain essential function without sacrificing the delivery of ecosystem services, slowly degrading, or slipping into a less desirable state (Folke et al., 2002; Folke et al., 2005; Cosens and Williams, 2012). “Resilient systems are able to adapt and adjust to unforeseen events, to absorb change, and to learn from adversity” (Homer-Dixon, 2011, p.9). Complex systems are dynamic in nature and are therefore constantly undergoing change. The traditional topocratic approach to water resource management viewed the state as the appropriate geographical scale of analysis, but Akamani and Wilson (2011) argue “the new emphasis on resilience building implies that traditional approaches to decision making and implementation, characterized by top-down and with a heavy reliance on scientific expertise, are poorly suited for complex systems” (p. 411). In the case of the Abbotsford-Sumas aquifer, one example is a recent switch in the types of agricultural crops being grown in the region. An increase in berry production, particularly blueberry and raspberry crops, has changed the economic structure and the farming practices taking place on the land. As new knowledge is acquired about the impacts of these changes, management strategies must remain flexible in order to adapt to information as it becomes available. According to Folke et al (2002), “… management that uses rigid control mechanisms to harden the condition of social-ecological systems can erode resilience and promote collapse… Similarly, governance can disrupt social memory or remove mechanisms for creative, adaptive response by people, in ways that lead to breakdown of social-ecological systems.”

In contrast, resilience building management anticipates change, surprise, and uncertainty and thus remains flexible and open to learning in order to adapt to the unpredictability inherent in
the system. Cosens (2010) states, “research to translate resilience theory into specific administrative actions may provide a road map to improving our ability to foster sustainability in our response to change in transboundary river basins” (p.230). This research could also be beneficial for transboundary aquifers, which face similar issues of uncertainty in drivers of change and fragmentation of jurisdictions. According to Gleeson et al., (2012) “Adaptive management to changing conditions e.g., population growth, cultural or climate change, better theory or understanding, new measurements) allows for more resilient long-term management and potentially provides a bridge within and across generations for addressing the longer term issues of groundwater sustainability” (p. 22). In order to achieve this type of management an understanding of the ecosystem that can only be attained through the incorporation of knowledge from local users is necessary (Folke et al., 2002). Further, remaining ignorant about the ecological system (and its interconnectedness with the social system) undermines resilience. One might argue that by continuing to view the human system as separate from, and in control of, the ecological system only adds to society’s vulnerability. While a deeper understanding of the Abbotsford-Sumas aquifer would prove helpful, a lack of political will to act on knowledge about the ecosystem has degraded resilience.

Tools for Achieving Resilience in Social-Ecological Systems

Two tools have been suggested for resilience-building in social-ecological systems. These include structured scenarios and active adaptive management (Folke et al., 2002; Cosens and Williams, 2012). Structured scenarios involve envisioning several different alternative futures and the steps necessary to avoid or attain those outcomes. The Puget Sound Nearshore Ecosystem Restoration Project produced a report that did just this. The report predicted what the future of Puget Sound would look like under three different scenarios, status quo, managed growth, and
unconstrained growth (Bolte and Vache, 2010). From these predictions the report offered recommendations in order to achieve (or avoid) the situations.

The second tool, active adaptive management, is the process by which policy is viewed as a set of experiments that determine what management actions build or sustain resilience (Folke et al., 2002). This implementation of adaptive management has a social context; institutions remain open and flexible and the multi-level governance system fosters an environment for learning, thus increasing the adaptive capacity of the system and in doing so prevents closing off any possible future development. In essence, the multi-level governance system provides an opportunity for cross-scale communication and collaboration as well as a feedback loop for learning (i.e. the local level can relay upward what management strategies are or are not working and vice versa). For scholars working on resilience theory, the failure of current management strategies to retain a full range of ecosystem services is the key reason a new approach to management must be investigated (Cosens and Williams, 2012).
2.1.4. Adaptive Management & Governance

Defining Adaptive Management & Governance

Many advocates of managing resources for resilience support the use of adaptive management to allow modifications in management decisions in light of new knowledge (Holling, 1978; Lee, 1999; Folke et. al., 2002; Folke et al., 2005; Cosens and Williams, 2012). “Adaptive management emphasizes learning and subsequent adaptation of management based on that learning. The process is iterative [recursive], and serves to reduce uncertainty, build knowledge and improve management over time in a goal-oriented and structured process” (Allen et al., 2011, p.1339) (Fig. 3).

Figure 3: Adaptive Management achieves management objectives through a formal recursive, iterative and structured feedback process (Allen et al., 2011)
Figure 4: The process of active adaptive management significantly increases the opportunity for learning and inference in comparison to the trial and error approach which relies on the success or failure of a single management option (Allen et al., 2011).

Adaptive decision-making is different than a trial and error approach, which implements a single management action at any given time followed by an ad hoc revision strategy when that management decision is seen as failing (Williams, 2011) (Fig. 4). “Adaptive management differs from trial and error by the structure used in adaptive decision making, involving the articulation of objectives, identification of management alternatives, predictions of management consequences, recognition of key uncertainties, and monitoring” (Williams, 2011, p.1347). A key defining feature of adaptive management is the feedback between learning and decision-making. The learning involved in adaptive management helps to inform decision-making and reduces the risk of management strategies failing and the eventual breakdown of the ecosystem. Thus, “management can contribute to learning through interventions that are useful for investigating resource processes and impacts” (Williams, 2011, p.1347).
Implementation of adaptive management happens through a two-phase process (Fig. 5). The first of these is the setup phase in which the resource problem is framed in terms of stakeholders, objectives, management alternatives, models, and monitoring protocols. The second portion of the implementation involves an iterative phase where these elements go through an ongoing cycle of learning about the system and readjusting management based on this learning.

Environmental governance institutions throughout North America have begun using adaptive management as a framework for managing resources. Puget Sound Partnership’s Strategic Science Plan is an example of active adaptive management in the Salish Sea region. Puget Sound Partnership serves as the coordinating body for salmon recovery in the Puget Sound region, helping
to unite organizations and encourage collective action. The strategic plan encourages two-way engagement between science and policy stakeholders across scales within an adaptive management framework (Puget Sound Partnership, 2010). Puget Sound Partnership provides the vision while watershed chapter areas strive to implement three year work programs.

To be clear in this thesis the use of ‘adaptive management’ refers specifically to monitoring and action that takes place, which is necessary to inform decisions regarding our water resources. The term ‘adaptive governance’ refers to the broader, social context in which this management takes place. Adaptive governance is the social process of learning and responding to information provided by managing agencies (Cosens and Williams, 2012). Adaptive governance is achieved “through collaboration and cooperation across different levels of government, non-governmental, and individual actions and among agencies within the same level of government with overlapping authority” (Folke et al., 2005; Cosens and Williams, 2012). Boyle et al. (2001) summarize the differences in these concepts: “governance is the process of resolving trade-offs and of providing a vision and direction for sustainability, management is the operationalization of this vision...” (p.122). Put more simply, “governance creates a vision and management actualizes the vision” (Allen et al., 2011, p.1343).

**Adaptive Governance as a Means to Managing Holistically**

Cosens and Williams (2012) argue that adaptive governance, as defined by Boyle et al., naturally will involve trade-offs and thus may not lead to a perfect ecological system. However, in order to manage the social-ecological system fully and holistically, there must be consideration of the social elements in all management decisions; otherwise adaptive management would be flawed in the same way that traditional management is – “by optimizing for a subset of the system”(Cosens and Williams, 2012, p.2). Huitema et al. (2009) established four criteria for adaptive governance:
polycentricity, public participation, an experimental approach to resource management, and management at the bioregional scale. These components are necessary and indicative of good water governance.

Instead of focusing on efficiency and a lack of overlap, which often leads to gaps, adaptive governance focuses on diversity and multiple levels of management (Cosens and Williams, 2012). This type of governance works to connect organizations and individuals at multiple scales for the purposes of environmental management (Folke et al., 2005). The connectivity of diverse nested levels of management can overcome issues of scale mismatch and lead to cohesive, collaborative management of a shared resource (Cash and Moser, 2000; Allen et al., 2011). While the Task Force has been successful at providing a platform for connecting organizations at multiple scales, ultimately little has been done in terms of actual management. Clearly, providing a means for cross-scale, cross-border interaction is not enough to reduce nitrate in the Abbotsford-Sumas aquifer.

**Reducing Uncertainty, Building Resilience**

This unique cross-scale approach to resource management makes adaptive governance especially suitable to resolve issues of uncertainty within social-ecological systems. According to Williams (2011), there are at least four different types of uncertainty that can influence the management of natural resources; these include environmental variation, partial observability, partial controllability, and structural or process uncertainty. All of these factors limit a decision maker’s ability to make an informed management decision. Environmental variation consists largely of changes in the environment that are outside of the control of humans, such as levels of precipitation. Partial observability is particularly pertinent in the management of a transboundary aquifer. Not only does sampling variation contribute to uncertainty about the status of the resource, but also mismatch in methods and standards between countries. Partial controllability speaks to the
mismatch between the actions desired by decision makers and those that are actually implemented. A misinterpretation of a regulation can lead to an entirely different action being implemented or the action we thought would resolve an issue does not actually lead to the desired outcome. Lastly, structural or process uncertainty refers to the “lack of understanding, or lack of agreement, about the structure of biological and ecological relationships that drive resource dynamics” (Williams, 2011, p.1348).

The process of adaptive governance continually attains new knowledge that becomes incorporated into decisions and therefore reduces these uncertainties. Many scholars believe adaptive governance can be a successful management approach that reduces uncertainty and sustainably manages social-ecological systems. Akamani and Wilson (2011) state, “grounded in resilience thinking and common pool resources theory, adaptive governance offers promise to (1) build the adaptive capacity of existing social-ecological systems, (2) build the capacity of such systems for learning and adaptation, and (3) transform them into different social-ecological systems when the existing state becomes undesirable” (p.414).

2.1.5. Problems with Adaptive Governance

Changing Perspective and Behavior

A management approach focused on ecosystem resilience will require a new perspective and a change in human behavior. Society will have to shift from an “aspiration to control change in systems, assumed to be stable, to sustain and generate desirable pathways for societal development in the face of increased frequency of abrupt change” (Folke et al., 2005, p.443). However, as indicated by many known human-caused environmental issues, changing human behavior does not happen overnight. “Human behavior does not shift in perspective simply because science indicates
it is the right thing to do” (Cosens and Williams, 2012, p.3). Some researchers believe that the use of incentives will be required in order to make the transition from a command and control system to adaptive governance. “More recently the use of economic incentives, locally evolved social norms, and voluntary approaches to rule compliance are being explored” (Akamani and Wilson, 2011, p.414). This stands in contrast to the traditional approach of “command and control” environmental regulation for rule compliance (Akamani and Wilson, 2011).

**Legitimacy**

One of the big concerns facing adaptive management is the issue of legitimacy. Cosens and Williams (2012) define legitimacy as “a qualitative term used to describe the basis for a governmental action. It is a fundamental premise of political theory that people seek legitimacy in the actions of those who govern them...Thus, to be legitimate, a governmental assertion of authority must be justified and perceived to be justified” (p.3). Put simply, legitimacy is public acceptance of governmental action. Cosens and Williams (2012) argue that simply monitoring and adjusting management in favor of the best possible ecological outcome is not enough. Full integration of the social component, including public input, on what to monitor and how to make changes, must be done in a transparent way that fosters legitimacy (Cosens, 2010; Cosens and Williams, 2012). Bridging the gap between what science indicates is the best management strategy for the ecosystem and what society feels is the best decision for the social system is the all too common problem facing researchers that work at the science-policy nexus. Public participation in the management of the Abbotsford-Sumas aquifer is particularly interesting. Since land use practices in the area are largely agriculture, the majority of residents are rooted in farming culture, making it in their best interest that nitrate contamination remains unenforced.
Closing the Gap Between Theory and Application

Resilience scientists currently face a gap between theory and application of adaptive management practices (Cosens and Williams, 2012). For example, according to Allen et al. (2011) there are five issues which challenge the implementation of adaptive management: “1) a lack of clarity in definition and approach, 2) a paucity of success stories on which to build, 3) management, policy, and funding paradigms that favor reactive rather than proactive approaches to natural resource management, 4) failure to recognize the potential for shifting objectives, and 5) failure to acknowledge the social source of uncertainty and hence increased risk of surprise” (p.1341-1342).

Another large hurdle for the adaptive management approach to overcome is the framework under which laws and policies are made. As Allen et al. (2011) state, “legal certainty does not mesh well with environmental unpredictability. The certainty of law and institutional rigidity often limit the experimentation that is necessary for adaptive management” (p.1343). Some scholars argue that environmental governance of the commons will only succeed if rules evolve with the system. In this instance informal groups, such as the Task Force, may have a better chance at implementing adaptive management than any single agency, especially since the Task Force is a combination of many organizations working collaboratively on a single issue- water quality in the Abbotsford-Sumas aquifer. The agencies within the Task Force can simultaneously implement management and outreach actions that are advantageous to the level or scale at which they work (i.e. outreach is best done at the local scale while legislation is usually passed at the higher level). Any single agency within the Task Force can only work within the confines of their mission, but collaboratively they may be able to efficiently and adaptively manage the aquifer.

The following section discusses the Task Force in greater detail. Specifically, the discussion evaluates whether the Task Force utilizes active adaptive management, closing the gap between
theory and application of this governance approach. Further, it examines what role, if any, the existence of a supranational institution, such as the ECC, play in the success of the Task Force. Is it possible for ad-hoc working groups, such as the Task Force, to function effectively and resiliently without the structure of a regulatory body?

2.2 Background Information

2.2.1. Abbotsford-Sumas Aquifer International Task Force

As mentioned in the first chapter of this thesis, the Abbotsford-Sumas Aquifer International Task Force was formed by the 1992 Environmental Cooperation Agreement between British Columbia and Washington State. The purpose of the agreement was to create a process for information sharing and coordinated action on environmental matters of mutual concern (“Abbotsford-Sumas Aquifer International Task Force”, 1993). The agreement created the BC/WA Environmental Cooperation Council, which established priorities and an action plan. Management of the ground water in the Abbotsford-Sumas aquifer was deemed a high priority issue and thus the Task Force was created.

Representation from federal, state/provincial, local, tribal/aboriginal governments, and non-governmental organizations (NGO) were present in the original membership of the Task Force. It should be noted that although significant variation in the membership list hasn’t occurred, there was a lack of NGO participation in 2013 meetings. Further, the tables below represent membership as reported on the Ministry of the Environment’s Water Stewardship webpage. However, this list is not all inclusive of participants in 2013 meetings. The roster of attendees for 2013 meetings was the basis for which stakeholders were invited to participate in this study; therefore the term(s) member(s) and stakeholder(s) are used interchangeably throughout this thesis.
Table 1: Original members of the Task Force (Abbotsford-Sumas Aquifer International Task Force, 1993)

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<thead>
<tr>
<th>WASHINGTON</th>
<th>BRITISH COLUMBIA</th>
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<td>State &amp; Federal Agencies</td>
<td>Provincial &amp; Federal Agencies</td>
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<td>U.S. Environmental Protection Agency</td>
<td>Environment Canada</td>
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<td>U.S. Soil Conservation Service</td>
<td>Agriculture Canada</td>
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<td>U.S. Geologic Survey</td>
<td>Health &amp; Welfare Canada</td>
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<td>WA Department of Agriculture</td>
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<td>City of Sumas (BLENS)</td>
<td>District of Abbotsford</td>
</tr>
<tr>
<td>Whatcom County Health Department</td>
<td>District Matsqui</td>
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<tr>
<td></td>
<td>Central Fraser Valley Regional District</td>
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<tr>
<td><strong>Tribal Governments</strong></td>
<td><strong>Aboriginal</strong></td>
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<td>Nooksack Indian Nation</td>
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<td>Lummi Indian Nation</td>
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<tr>
<td><strong>Non-Governmental</strong></td>
<td><strong>Non-Governmental</strong></td>
</tr>
<tr>
<td>WSU Cooperative Extension Service</td>
<td>Project Enviro-Health</td>
</tr>
</tbody>
</table>
Table 2: Current members of the Task Force (Ministry of the Environment, 2013)

<table>
<thead>
<tr>
<th>WASHINGTON</th>
<th>BRITISH COLUMBIA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>State and Federal Agencies</strong></td>
<td><strong>Provincial and Federal Agencies</strong></td>
</tr>
<tr>
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<td>Agriculture and Agri-Food Canada</td>
</tr>
<tr>
<td>U.S. Natural Resources Conservation Service</td>
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</tr>
<tr>
<td>U.S. Geological Survey</td>
<td>Health Canada</td>
</tr>
<tr>
<td>WA Department of Agriculture</td>
<td>Ministry of Agriculture and Lands</td>
</tr>
<tr>
<td>WA Department of Ecology</td>
<td>Ministry of Environment</td>
</tr>
<tr>
<td>WA Department of Health</td>
<td>Ministry of Health Living and Sports</td>
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<tr>
<td>WSU Extension</td>
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<tr>
<th><strong>Tribal Governments</strong></th>
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<tr>
<td>Nooksack Indian Nation</td>
<td>Sto:Lo Nation</td>
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<td>Lummi Indian Nation</td>
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<th><strong>Local Government Agencies</strong></th>
<th><strong>Local Government Agencies</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>City of Sumas</td>
<td>City of Abbotsford</td>
</tr>
<tr>
<td>Whatcom County</td>
<td>Central Fraser Valley Regional District</td>
</tr>
</tbody>
</table>

| **Non-Governmental Organizations** | Project Enviro-Health |

According to the original mission statement, the Task Force was responsible for “coordinating efforts directed towards protecting the aquifer across the common border between Canada and the United States” (Abbotsford-Sumas Aquifer International Task Force, 1993, p.48). These efforts would establish a managerial approach, develop and exchange information, develop aquifer management strategies, and educate and engage the public (Abbotsford-Sumas Aquifer International Task Force, 1993). Moreover, the vision statement of the Task Force states “The Abbotsford-Sumas Aquifer is viewed as a shared resource and is being cooperatively managed and protected, insuring water resources of high quality and in sufficient quantity for the future and current needs of the citizens and the environments of British Columbia and Washington State” (Abbotsford-Sumas Aquifer International Task Force, 1993, p.49). The Task Force is responsible for
submitting an annual report to the ECC indicating problems and issues within the aquifer, recommendations for actions and strategies, and summarizing the activities and accomplishments of the Task Force. From this report the ECC will endorse the activities and recommendations for future management; therefore authority to direct implementation efforts resides with the ECC (Abbotsford-Sumas Aquifer International Task Force, 1993, p.52). The implementing regulations for the Task Force established that the ECC would act as the overseeing body for the Abbotsford-Sumas Aquifer International Task Force and other subcommittees created by the 1992 Environmental Cooperation Agreement.

For the purposes of this thesis, the Abbotsford-Sumas Aquifer International Task Force, and the other four Task Forces that came out of the 1992 agreement, are considered informal working groups. Unlike the International Joint Commission, the Task Force does not have a permanent staff working on management issues in the aquifer. Further, membership to the Task Force is largely voluntary. While involvement in the Task Force is in the job description of the co-chairs, Washington State Department of Ecology and British Columbia Ministry of Environment, it is just one of many issues that they are required to deal with. Lastly, due to the large period of no formal meetings, administrative turnover, and recent reorganization of the group, the actual structure and mission statement is under question and is still currently being defined by the members of the Task Force.

The Task Force implemented several outreach programs over the duration of its existence. However, none of these programs has been sustained, and therefore it would seem that the Task Force is currently at a standstill. From 2007-2012, the Task Force did not hold any formal meetings. Members reconvened in 2013 for two semiannual meetings taking place in January and June. No formal meetings have occurred as of yet in 2014, with a large portion of members reporting that resources, both funding and staff, have not been allocated to allow them to be actively involved in
the Task Force. The Task Force is currently working to draft a letter to the ECC requesting confirmation that addressing the issue of high levels of nitrate in the aquifer still remains a high priority for both British Columbia and Washington State.

3.0 Methods

A mixed methods approach was used to answer the following research questions:

- Has the Task Force been effective in managing the aquifer?
- Do stakeholders believe that the current method of water governance used by the Abbotsford-Sumas Aquifer International Task Force fosters social-ecological resilience?
- What information does the Task Force provide about whether informal, ad-hoc governance structures can be as productive and successful as more formal institutions?
- Is recursive, iterative, and adaptive management of the aquifer occurring from the efforts of the Task Force?

A mixed methods approach includes the collection of qualitative and quantitative data. The research for this thesis included semi-structured interviews followed by a survey. The semi-structured interviews were used to obtain background information and assess the current status of the Task Force. Additionally, I attended two Task Force meetings, during these meetings, and in outside communication, informants provided me with further background information through informal conversations.

The survey was a combination of qualitative and quantitative questions. The first part of the questionnaire gathered background information about the participant and their involvement in the Task Force. This was accomplished largely through open-ended questions with a few background questions (i.e. citizenship). The second section of the questionnaire included eleven Likert scale (or ranked) questions. Participants were asked to answer a series of questions on a scale
of 1 to 5 with one being lowest or strongly disagree and five being highest or strongly agree. These questions were aimed at assessing how participants perceived the Task Force’s resilience and effectiveness. The framework surrounding these questions will be discussed in greater detail in the sections below. The last portion of the survey included a combination of ranked and open-ended questions. These four questions were used to evaluate the future direction of the Task Force.

The intention of using this mixed methods approach was to collect background information and context from informants through qualitative means. These conversations would be followed by a survey consisting largely of quantitative questions that could accurately measure the effectiveness and resilience of the Task Force, report on its current status, and make predictions about its existence and importance in the future. The original objective of the quantitative data was to compare the results of subgroups within the Task Force. Specifically, the hope was to compare local versus state/provincial and Canadian versus American results. Unfortunately, a low level of responses (eight in total) meant that although data could be subdivided, no statistical significance could be ascribed to most results.

A Human Subject Review Board (HRB) Exemption was submitted on January 23rd, 2014; upon approval, research began shortly thereafter. Two American stakeholders participated in semi-structured interviews. Two Canadian counterparts were contacted, but never responded to participation requests. The original intent was to interview equal Canadian and Americans (4 in total), preferably with similar backgrounds and/or involvement in the Task Force (two long standing members and two with leadership positions or heavy involvement). The major purpose of these interviews was to gain background and historical knowledge regarding the Task Force, the current status, as well as a deeper understanding of the barriers facing the group. The interviews were structured around the following questions:
• How long have you been involved in the Task Force?
• Why did the Task Force stop meeting for the years 2007 through 2012
• Why did the Task Force recently reconvene?
• What factors are contributing to nitrate contamination in the aquifer?
• What potential solutions exist for solving the nitrate contamination issue?
• What is preventing these solutions from being implemented?

As previously mentioned, informal conversations began in January of 2013 at the Task Force meeting in Abbotsford, British Columbia. The interviews took place in February of 2014.

A 24 question survey was developed after the interviews concluded. The first section consisted of preliminary background questions, including citizenship and level of government at which they work. Following these questions were six questions that addressed the length and extent of their involvement in the Task Force and their perception of the Task Force’s mission and current status. The second portion of the questionnaire consisted of eleven Likert scale, or ranked, questions. Participants were asked to rank a statement on a scale of 1-5 with 5 being highest or strongly agree and 1 being lowest or strongly disagree.

The ranked questions in the survey were based on a framework developed by Bradley Karkkainen (2006). Karkkainen asserts that a shift from rules to governance is taking place in environmental policy and natural resources management. He outlines a shift from an issue-by-issue, hierarchical, rule based approach to a new model of integrated, “place-based”, and “networked” governance of ecosystems. Successful institutional arrangements for integrated and adaptive ecosystem governance would incorporate ten necessary characteristics. These characteristics shaped the Likert scale questions of the survey. In his research Karkkainen focuses on the Great
Lakes, I applied his framework to a much smaller scale and used it to identify which of these key features and behaviors stakeholders felt the Task Force demonstrates. Additionally, a comments section was provided for each question to allow participants to further explain their answers and add to the breadth of the information being obtained.

Table 3: Characteristic from Karkkainen’s (2006) framework and corresponding question in research survey

<table>
<thead>
<tr>
<th>Corresponding Question</th>
<th>Characteristic</th>
</tr>
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<tbody>
<tr>
<td>Q11</td>
<td>Information pooling, collaboration, and coordination</td>
</tr>
<tr>
<td>Q12</td>
<td>Integrated databases, common monitoring protocols, and joint ecosystem modeling</td>
</tr>
<tr>
<td>Q15</td>
<td>Peak coordinating body</td>
</tr>
<tr>
<td>Q16</td>
<td>Central staff support</td>
</tr>
<tr>
<td>Q17</td>
<td>Coordinated program of communications, public education, and outreach</td>
</tr>
<tr>
<td>Q18</td>
<td>Specific goals, targets, and timetables at all levels</td>
</tr>
<tr>
<td>Q19</td>
<td>An iterative and adaptive management approach</td>
</tr>
<tr>
<td>Q20</td>
<td>Genuine integration across issue areas and mission-specific agency responsibilities.</td>
</tr>
</tbody>
</table>

It should be noted that two of the ten characteristics were not included on the questionnaire. These included: functionally defined committees and nested scales of governance. I considered the Task Force a subcommittee or working group of the Environmental Cooperation Council. Out of the original Environmental Cooperation Agreement between British Columbia and Washington State a total of five subcommittees were created. According to Karkkainen (2006), “typically, most of the real work of collaborative interaction, information-pooling, analysis, coordination, and operational decision-making occur at the committee, subcommittee, and working group level” (p. 233).

Ultimately, I felt this characteristic had been fulfilled. Lastly, I did not ask about nested scales of governance because I know organizations from the local level through the federal level are involved, to some extent, in the Task Force. Therefore, I concluded that this condition was also fulfilled.
As Karkkainen (2006) states, “A large, complex ecosystem usually exhibits characteristic system-wide properties and processes, requiring that its parts be understood in relation to the whole. On the other hand, the biotic components, physical and chemical properties, and ecological processes that comprise the larger system are typically not distributed uniformly and homogeneously across the entire system; the larger system has spatially distinct subsystems. Consequently, while one set of basin-wide governance institutions may be needed to address system-wide problems and processes, and to coordinate the efforts of spatially differentiated parts, another level of more localized institutional arrangements may be necessary to address locally varying conditions” (p. 235).

Questions 10, 13, and 14 asked about the effectiveness of the Task Force in regards to its ability to accomplish its goals and improve transboundary management.

The last section of the questionnaire focused on future directions of the Task Force and the impact of smaller working groups within the larger context of Salish Sea or regional governance. These questions asked respondents to reflect on whether they felt the Task Force was resilient and how relevant small working groups will be in the future.

Stakeholders were invited to participate in the study via email in March and April of 2014. Emails of members were procured from a list of meeting attendees from the January and June 2013 meetings. Meeting notes and a list of attendees were provided from the American co-chair of the Task Force, Doug Allen, manager of the Department of Ecology Bellingham field office. Of the 41 stakeholders invited to participate, only 12 responded. Ultimately, 8 surveys were completed; although two additional stakeholders (one Canadian and one American) expressed interest they never sent back a completed survey or responded to further correspondence. Two additional stakeholders responded and declined interest in participating in the survey (one Canadian and one American both working at the state/provincial level). Seven responses were completed via email and one survey was completed over the phone. In total, 5 Americans and 3 Canadians completed the survey. A copy of the survey is below.
Background

1.) What is your country of residence?

2.) Is your country of residence the same as your citizenship?

3.) What level would you say you work at?
   A) Local
   B) State/Provincial
   C) Federal
   D) Other ________________

4.) How long have you been involved in the Sumas-Abbotsford Aquifer International Task Force?

5.) Could you briefly describe the extent of your involvement?

   1 2 3 4 5
   Very Little Involved 3 4 Very Involved

6.) In your opinion, what is the mission of the Task Force?

7.) Although the Task Force was not formally meeting between 2007-2013 was the organization still active? For example, did the Task Force provide structure for productive activity amongst members or was activity performed in an ad hoc fashion?

8.) In your opinion what initiated the re-forming and formal meetings of the Task Force beginning in 2013?

9.) Are you or your organization involved in (Please circle all that apply)
   A) Restoration efforts
   B) Policy and/or regulation
   C) Education and Outreach
   D) Research and data gathering
   E) Program development and management*
   F) Other ________________

   *Please briefly describe the programs and/or management efforts that you participated in:
Likert Questions

On a scale of 1-5, 5 being highest or strongly agree, rate each statement based on your opinion and involvement with the Sumas-Abbotsford Aquifer International Task Force.

10.) According to the Task Force website, the purpose of the Task Force is to coordinate efforts directed towards protecting the aquifer across the common border between Canada and the United States. How effective do you feel the Task Force is?

1 2 3 4 5 Unable to answer

11.) Would you agree that your involvement in the Task Force has led to increased information sharing and collaboration amongst organizations (yours or others you work with) operating at any level (local, federal, etc.) involved in the Sumas-Abbotsford Aquifer International Task Force?

1 2 3 4 5 Unable to answer

Comments:

12.) Member organizations of the Task Force share:
   A) Integrated databases
   B) Common monitoring protocols
   C) Joint ecosystem modeling

Comments:

13.) The existence of the Task Force has improved transboundary management of the aquifer.

1 2 3 4 5 Unable to answer

Comments:

14.) The Task Force has created a more holistic picture of the ecosystem, which transcends international borders, for the public and decision makers to understand.

1 2 3 4 5 Unable to answer

Comments:

15.) The Environmental Cooperation Council is the peak coordinating body overseeing the Sumas-Abbotsford Aquifer to whom which the Task Force reports.

1 2 3 4 5 Unable to answer

Comments:
16.) WA Dept. of Ecology and BC Ministry of Environment jointly serve as the coordinating staff that is responsible for organizing Task Force meetings, keeping records, providing information to participants and the public, and acting as a central information repository.

   1  2  3  4  5  Unable to answer

   Comments:

17.) There are organized, consistent, ecosystem-wide programs for communication, public education, and outreach.

   1  2  3  4  5  Unable to answer

   Comments:

18.) Task Force member organizations, operating at any level (local through federal), work in unison to manage the Sumas-Abbotsford aquifer ecosystem.

   1  2  3  4  5  Unable to answer

   Comments:

19.) The Sumas-Abbotsford Aquifer ecosystem is managed in an adaptive way—which means monitoring and re-evaluation of management decisions happen continuously, building institutional learning capacity into the management system.

   1  2  3  4  5  Unable to answer

   Comments:

20.) Short term solutions are integrated into the long term recovery and management goals of the Task Force.

   1  2  3  4  5  Unable to answer

   Comments:

   **Future Directions**

21.) In your opinion, how resilient is the Task Force? Resilient meaning the organization can withstand unpredictable disturbances, such as changes in funding or administration, and continue to pursue its mission.

   1  2  3  4  5  Unable to answer

   Explain:
22.) In your opinion how important is continuing the activities of small working groups, such as the Task Force, in reaching the overall transboundary governance goals in the Salish Sea Ecosystem?

1  2  3  4  5  Unable to answer

Will they become more or less important over time?

23.) To what degree would a cross border database create a unified picture of the aquifer and therefore make governance efforts more effective and less fragmented by the border?

24.) Going forward do you feel current management efforts are effective for present and evolving issues in the aquifer ecosystem?

4.0 Results and Discussion

The overarching goal of the research was to analyze stakeholders’ perceptions of Task Force efficacy and resilience and determine if the Task Force served as a model of applied adaptive governance. The intention had been to compare Canadian versus American and local versus state respondents in order to determine if there were any differences in perception amongst sub-populations. Specifically, did one group feel the Task Force had been more effective over the years? Did one sub-population feel the Task Force was resilient? The goal of the survey was to show whether or not the group held consistent beliefs about the mission of, effectiveness, resilience, and future direction of the Task Force. If there were any significant divides amongst sub-populations it could point to barriers to success either as an institution or in accomplishing their goals. For example, if a large portion of the stakeholders feel the mission of the Task Force is to mitigate nitrate contamination in the aquifer and another portion feels it is solely a mechanism for exchanging information then there will be an obvious difference of opinions in terms of measuring success. The findings may not be statistically significant, but the responses provide useful information about participants’ views of the Task Force and its effectiveness. The fact that responses were anonymous allowed respondents to state these views frankly, which has value.
4.1. Semi-Structured Interviews

Two American stakeholders participated in semi-structured interviews. Two Canadian counterparts were contacted and invited to participated, but did not respond to correspondence.

Interview Question 1: How long have you been involved in the Task Force?

Of the two participants interviewed, the first has been involved in the Task Force for 19 years and the second has only been involved for two.

Interview Question 2: Why did the Task Force stop meeting for the years 2007 through 2012

Both interviewees were unsure why the Task Force stopped meeting from 2007-2012, but they believe that meetings just “trickled out” possibly due to higher priority issues or a lack of funding.

Interview Question 3: Why did the Task Force recently reconvene?

When asked why the Task Force reconvened, the first interviewee was unsure. The second interviewee believes it is because the ECC reconvened in 2012 and re-evaluated the status of the aquifer and the Task Force. The ECC placed a reinvigorated emphasis on the Task Force and mandated that it be re-established. The informant also thinks the contamination of the aquifer continues to be a high priority issue because several water systems on the U.S. side of the border rely on the aquifer for drinking water. Many agencies are working to find a solution because they know that treating the water after it is contaminated is very costly.

Interview Question 4: What factors are contributing to nitrate contamination in the aquifer?

Interestingly, the two responses were starkly different. The first interviewee, who had not been actively involved in the Task Force in recent years, was not sure of the factors that were currently
contributing to nitrate contamination in the aquifer as he/she had been less involved in the Task Force in recent years. However, having participated in the Task Force for 19 years, this respondent believed that agriculture received most of the blame for nitrate contamination while other sources or potential contributors were largely overlooked. The second interviewee did not mention any other potential contributors other than agriculture. The respondent did note that the recent shift from poultry to berry production should, in theory, lessen the extent of nitrate contamination. The respondent pointed out that, once berries start to grow, farmers can no longer spray manure on the plants and manually applying manure is too complex. In the case of raspberries, plants are usually replaced every 7-8 years, at this time manure may be applied. However, in the case of blueberries, the crop is typically never replaced. The respondent also stated that, by looking at a map (Appendix B) of the hot spots for nitrate contamination, one might conclude that infiltration of nitrate is not just happening in the northern part of the aquifer and flowing south as was originally hypothesized, but is also being introduced into the aquifer on the U.S. side of the border.

Discussion

Although a shift from poultry to berries may be occurring in Whatcom County, dairies are still largely the main contributor to nitrate contamination on the U.S. side of the aquifer. “Dairies are the predominant source of nitrogen to the land surface, contributing over 60% of the annual average load to the aquifer. Other sources include irrigated agriculture and on-site sewage systems” (Redding et al., 2011). Redding et al. (2011) point out that over 70% of wells tested between 2003 and 2005 exceeded the standard drinking water standards and that the aquifer is the only source of drinking water available to the majority of area residents.
Interview Question 5: What potential solutions exist for solving the nitrate contamination issue?

The first respondent was not able to say what potential solutions exist now, but mentioned that a few outreach programs in the past had gotten farmers on board with appropriately storing and disposing of excess manure. Ultimately, those programs were not sustained as an on-going outreach program provided by the Task Force. The second interviewee mentioned that a Ground Water Management Area would have the most powerful impact by allowing stricter regulation. This idea was also brought up at Task Force meetings in 2013.

What was most interesting to note from the response to this question was that a gap analysis was going to be performed by the Task Force to identify gaps and overlaps within the agencies participating in the Task Force. This analysis had not been completed at the time of the interview. The interviewee wondered further if the organizations involved in the Task Force had proper funding and resources could they collectively reduce nitrate in the aquifer. Finally, the obvious solution that was mentioned was that “the long term fix is to stop putting so much manure into the groundwater.”

Discussion

Below is an excerpt from the interim status report outlining the importance of proactive education and awareness.

“A proactive program of public education and awareness for a continual exchange of information pertaining to the Abbotsford-Sumas Aquifer and the International Task Force is needed. The public education and awareness requires full involvement of stakeholders to maximize its efforts, and to promote best aquifer management practices.

The Task Force recognizes that the Abbotsford-Sumas Aquifer requires joint management via a proactive approach to identifying problems and recommending long term strategies for aquifer management. Changes in traditional farming practices, and other land use activates such as septic
fields, industrial and municipal sources which contribute to the nitrate loading on the aquifer are needed. In addition, the detection of extremely low levels of pesticides in wells on both sides of the border, and the presence of non-agricultural chemicals from industrial activities indicate the vulnerability of the aquifer. Public health concerns stem from elevated nitrate levels, and the detection of other chemicals indicate a proactive approach to the prevention of further contamination is needed.

The public education and awareness requires full involvement of stakeholders to maximize its efforts, and to promote best aquifer management practices. A communication program aimed initially at the farming community regarding pesticide persistence, leachability, application practices that may increase the probability of leaching and sound pest control practices is needed. Industrial and municipal sources are the next set of stakeholders who need to be involved in the communication efforts.

Management and protection of the Abbotsford-Sumas Aquifer is a high priority issue if this source of high quality groundwater is to be maintained for future users. The Task Force is the obvious vehicle for ensuring transboundary cooperation, coordination and enhancement of this resource is continued" (Abbotsford-Sumas Aquifer International Task Force, 1993, p.6)

While some outreach programs continue to exist, they typically occur outside and independent of the Task Force. The Whatcom County Conservation District continues to provide farms with assistance in planning and proper manure storage and disposal, but these programs are an initiative taken on by the conservation district and are not related to their involvement in the Task Force. Further, as noted in the Task Force’s Interim Status Report (1993), the Whatcom County Health Department offered free nitrate testing to Whatcom County residents in July of 1993; however, “there are currently no programs in place to systematically test private domestic wells for nitrate contamination” (Redding et al., 2011).

In the 1990s, the Task Force provided financial assistance to farmers to help construct acceptable storage facilities to eliminate over-winter field storage of manure (Abbotsford-Sumas Aquifer International Task Force, 1993). The Task Force provides no such program today.
Some solutions that have been suggested include:

- “Where nitrate-N concentrations in groundwater exceed 10 mg/L, stringent nitrogen management techniques and programs should be used to protect groundwater quality and reduce nitrogen loading.
- Wastewater and manure should only be applied at agronomic rates sufficient to maintain a viable crop with minimal leaching below the root zone. Winter storage of wastewater and manure should be used during the non-growing season.
- Management efforts should be enhanced and focus on mitigating nitrogen loading from those dairies where the estimated nitrogen application rate exceeds crop needs.
- Public education and outreach should be enhanced.
- Residents should be encouraged to have their drinking water tested.
- Interested parties should be encouraged to work cooperatively to monitor conditions and reduce nitrate contamination” (Redding et al., 2011).

**Interview Question 6: What is preventing these solutions from being implemented?**

The general consensus from the interviews and informal conversations at Task Force meetings is that there is a lack of funds and resources to implement any solutions. The responsibility of taking care of the issue has been passed on from the state/provincial level, but funding and resources to the Task Force have not followed suit. This situation is not unique to the Task Force, but is often an issue when problems are passed down to be dealt with at the local level. This frustrating scenario can lead to a lack of empowerment for stakeholders (Norman & Bakker, 2009; Cohen and Davidson, 2011).

Both interviewees agreed that farms lack the money to deal with the problem and it is not economically feasible for them. Government agencies also lack funds to implement mitigation or outreach programs. Lastly, due to the complex nature of the problem, both in terms of being an underground resource as well as a transboundary one, the question of who is responsible for addressing nitrate contamination remains unanswered.
4.2 Surveys

4.2.1. Background Information

Eight stakeholders participated in the survey. A breakdown of the survey participants is given in the table below. Seven of eight participants completed the survey via email; one participant completed the survey over the telephone. In total, 41 participants were invited to participate giving a total participation rate of 19.5%. It should be noted that survey questions are paraphrased or omitted altogether for brevity purposes. A full version of the survey is provided in chapter 3 of this thesis. Also note that some grammatical and spelling errors may be present when quoting respondents. On the charts provided for the ranked questions, if there is no response indicated, the respondent reported “unable to answer”.

Questions 1-5

Table 4: Breakdown of survey respondents

<table>
<thead>
<tr>
<th>Nationality</th>
<th>Level of Government</th>
</tr>
</thead>
<tbody>
<tr>
<td>American</td>
<td>Canadian Local State/Provincial Federal</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 5: Breakdown of non-responses

<table>
<thead>
<tr>
<th>Nationality</th>
<th>Level of Government</th>
</tr>
</thead>
<tbody>
<tr>
<td>American</td>
<td>Canadian Local State/Provincial Federal University Tribe/First Nations</td>
</tr>
<tr>
<td>19</td>
<td>12 8 17 3 2 1</td>
</tr>
</tbody>
</table>

For clarification, in the following tables participants A, B, C, D, and E are American and F, G, and H are Canadian. The tables are further broken down by length of involvement in the Task Force; from left being shortest amount of involvement to right being longest length of involvement (i.e. A-E
American respondents from 1 to 19 years and F-H Canadian respondents from 1 to 16 years involvement). Every respondent resided in their country of citizenship.

Involvement in the Task Force amongst participants ranged from 1 year to 19 years. The majority of participants viewed themselves as very involved in the Task Force, with only one response indicating little involvement. There did not appear to be significant trends between American and Canadian levels of involvement. One respondent was actively involved when a Ground Water Management Area might be established prior to the 2007 hiatus, but started to disengage upon realizing that this was not going to happen they.

“I asked the former Ecology co-chair when his agency would form a Ground Water Management Area to address the problem of high nitrates in groundwater. He answered that he would do it when his agency told him to and gave him the additional resources to do it. His agency wasn’t going to do it unless the politicians made it an issue. They were not going to do it unless their constituents made it an issue. So far they were not complaining. I stopped going to meetings after that because we are about solving problems, not talking about them. Shortly thereafter, there was a hiatus in meetings. It was recently reconvened. I am very involved though seem to be stuck again.”—Respondent D; American, 17 years of involvement

Respondent D’s sentiment speaks to the lack of political will to solve nitrate contamination in the aquifer. He/she also notes that until the public become involve in pressuring their representatives to make a change, little will be done to reduce nitrates in the aquifer. This level of public participation is unlikely due to the large influence of agriculture in the Abbotsford-Sumas area.
Question 6: What is the mission of the Task Force?

One respondent noted that the mission of the Task Force was to provide a means for information sharing and collaboration. Two respondents were very action oriented and stated simply “To reduce contamination of the aquifer” and “stewardship is the mission.” The remaining five respondents felt the mission was a combination of both information sharing and action. One respondent quoted directly from the 2012 ECC Work plan, stating “A) promote and coordinate mutual efforts to ensure protection, preservation, and enhancement of our shared groundwater resource. B) develop action plans to address water quality and water resource management issues affecting the A-S A.” Another respondent paraphrased these two points as well as adding “in other words, everyone use your authorities and resources to fix the problem not simply spend time analyzing it.”

Discussion

With differing opinions about what the mission of the Task Force is, there may be varying levels of perceived success, resilience, and effectiveness of the Task Force. For example, some
respondents viewed the Task Force as a means for sharing information and collaborating, this regard the Task Force has been historically successful. Further, the amount of effort a given individual or organization puts into the Task Force might vary according to what they think they are being asked to do by participating in the organization.

**Question 7: Activity level during the 2007-2012 Task Force hiatus**

One respondent was unable to state whether the Task Force was active during the years 2007-2012, while the other respondents concluded that, to their knowledge, the Task Force was essentially non-existent during this time. They added that any activity among members, such as discussions or outreach, was done in an ad-hoc fashion and that the relationships existed “before and independently of the Task Force.”

**Discussion**

Key relationships amongst stakeholders exist outside of the Task Force, and although they may have been strengthened by their involvement in the organization, they are not dependent on it for information sharing and collaboration purposes. Further any Task Force sponsored programs or activities were essentially non-existent during this time frame as well, which ultimately means that those programs were not sustainable or resilient outside the formal structure of the Task Force.

**Question 8: Why did the Task Force reconvene in 2013?**

“*Washington State-British Columbia 2012 Workplan on Environmental Cooperation. (Am guessing that key stakeholders pushed politicians to re-engage, resulting the 2012 Workplan.)*” – Respondent A, American, 1 year.

“*Recognition of the dramatic nitrate problem in groundwater on the US side of the aquifer and the lack of a plan in WA to deal with it.*” – Respondent B, American, 2 years.

“*The Environmental Cooperation Council agreed to do it in the 2012 Workplan.*” – Respondent C, American, 2 years.
“The fact that there was a citizen’s lawsuit in Yakima against dairies over high nitrates in groundwater which brought to prominence the failure of Ecology and EPA to effectively exercise their authorities to protect the health of citizens. It was anticipated that once that suit was resolved there would be another one in North Whatcom. The agencies didn’t want to be further embarrassed by ignoring the issue.” – Respondent D, American, 17 years.

“Ag-related groundwater-quality concerns in Whatcom County, Wa, which caused the WA State Dept of Agriculture to get interested in tackling the issue again.” – Respondent E, American, 19 years.

“From my understanding, they’re still concerned about a bunch of things including nitrates and what we’re going to do about them. What are we going to tell the public? I think there is still a lot of interest and concern, especially with the amount of agriculture going on.” – Respondent F, Canadian, 1 year.

“Doug Allen – The US CO-chair initiated contact with BC... new energy and interest” – Respondent G, Canadian, 8 years.

“I believe it came from the International Joint Commission mandate to report on transboundary water issues, the A-S-A being on the list.” – Respondent H, Canadian, 16 years.

Discussion

There was little consistency amongst respondents as to why the Task Force reconvened. Without a clear understanding of why it reconvened or what its mission is, it seems unlikely that they could be very effective at achieving their goals. Some respondents recognize that the ECC mandated that the Task Force reconvene in its 2012 workplan, while others believe a reinvigorated energy and interest in groundwater quality at the local level is responsible. Respondent D notes a citizen’s lawsuit in Yakima dairies that sparked new interest in groundwater quality in north Whatcom County. This response refers to a federal lawsuit filed by two environmental groups against four dairies in Yakima Valley in early 2013 (Flatt, 2013). The lawsuit was a result of high nitrate levels detected in residential wells by the Environmental Protection agency. A Lower Yakima Valley Groundwater Advisory Committee has been established and the Lower Yakima Valley has been protected as a Groundwater Management Area since 2011. Although the community still faces
issues with contamination, great strides have been made to mitigate nitrate contamination. This indicates that a more topocratic approach has been successful in this instance. In order to make this a plausible approach for the Abbotsford-Sumas aquifer a parallel action would need to take place on the B.C. side of the aquifer.

These responses indicate that some members participate in the Task Force because of their historic involvement in the Task Force, the recent mandate, because their job requires it, and/or a genuine desire to solve the nitrate problem and a vested interest in the information and relationships the Task Force provides. Some respondents were largely unaware of the 2012 workplan.

**Question 9: Individual or Organizational Activity**

Table 6: Breakdown of respondents’ activities

<table>
<thead>
<tr>
<th>Activity: Restoration Efforts</th>
<th>Policy and/or regulation</th>
<th>Education and Outreach</th>
<th>Research and Data Gathering</th>
<th>Program Development and Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Respondents involved:</td>
<td>1</td>
<td>8</td>
<td>7</td>
<td>6</td>
</tr>
</tbody>
</table>

Three respondents stated being involved in program development and management. Interestingly, all three respondents were American.

“Effort to assess and compile existing regulatory programs and identify gaps and needs.” – Respondent C, American, 2 years.

“Broadly speaking, agriculture non-point pollution prevention (nutrients, pathogens, sediment) and riparian/wetland restoration.” – Respondent D, American, 17 years.

“Public education programs (e.g., design, print, distribute “Aquifer Pledge” materials to households). Effort to discover noncompliant manure piles by overflying aquifer in helicopter.” – Respondent E, American, 19 years.
Discussion

Although there is only one individual or organization that participates in any type of restoration efforts in the aquifer ecosystem, all of the respondents report working or participating in policy and/or regulation efforts. If this is the case, it would seem that, within their respective jurisdictions, member organizations could have the power to regulate and enforce activities that cause nitrate contamination. Either the organizations lack the political will to do so or they lack the resources to enforce the regulations.

Respondent C reports an effort to put together a gap analysis, ultimately to make the efforts of the Task Force more succinct and effective. Since Respondent C has only been involved with the Task Force for 2 years, it can be concluded that this is a new effort, started after formal meetings began again in 2013. However, at the time of writing this thesis, the gap analysis has not been completed.

The aquifer pledge that is mentioned by Respondent E was a community action project designed to get citizens to “do their part for the environment”. The pledge asks citizens to adopt new “aquifer-friendly” practices in eight different categories, including: lawn care, weed and pests, septic systems, in the home, on the farm, on the road, rainwater or stormwater run-off and infiltration, streams and fish. The pledge was a collaborative effort between Canada and the U.S.

Interestingly, the aerial assessment of manure storage and application practices reported by Respondent E (American) was conducted by B.C. Ministry of the Environment from October 2000 to March 2001 throughout the Fraser Valley. During this time period, the agency found 34 violations via aircraft and 109 infractions from ground inspections (Rushworth et al., 2006). The ministry’s response included warning letters, directives and prosecutions.
The collaborative efforts of the Task Force were not sustained and no longer exist.

Further, nitrate contamination continues to be an issue for the aquifer, influenced by a variety of factors including, but not limited to, the expansion of the agricultural industry, the introduction of new types of agriculture, and the potential of non-compliance for proper manure storage and application.

4.2.2. Likert Questions

Question 10: According to the Task Force website the purpose of the Task Force is to coordinate efforts directed towards protecting the aquifer across the common border between Canada and the United States. How effective do you feel the Task Force is?

All but two of the respondents essentially felt that the Task Force was not effective in executing its mission statement. One respondent had not been involved long enough to respond. It is of interest to note the only response ranked above 3 was from the American respondent who has been involved in the Task Force the longest (19 years). This response indicates that over the long-term this member felt that the Task Force is effective. If it had been possible to receive results from original members of the Task Force this may have been a reoccurring theme.
Question 11: Would you agree that your involvement in the Task Force has led to increased information sharing and collaboration amongst organizations (yours or others you work with) operating at any level (local, federal, etc.) involved in the Sumas-Abbotsford Aquifer International Task Force

“This was always the strongest attribute or redeeming quality of the Task Force” – Respondent D, American, 17 years.

“When resourced and afforded the opportunity to give the task force priority over other activities within my responsibility.” – Respondent G, Canadian, 8 years.

Discussion

Information sharing and collaboration has always been one of the strongest features of the Task Force. Not surprisingly, all of the respondents agreed that their involvement has certainly strengthened their relationships with other agencies and increased communication. Although some of the respondents reported earlier that these relationships continue to exist regardless of the Task Force, they clearly value the opportunity provided by the Task Force to work and collaborate across the border.
**Question 12:** Member organizations of the Task Force share: A) Integrated Databases, B) Common monitoring protocols, C) Joint ecosystem modeling, D) Other

Table 7: Breakdown of responses to question 12

<table>
<thead>
<tr>
<th>Number of respondents:</th>
<th>Integrated Databases</th>
<th>Common monitoring protocols</th>
<th>Joint ecosystem modeling</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

“D) Other: Potential health impacts”
“D) Other: Education and Outreach info”
“D) Other: Regulatory activity for surface water”

“None of this occurred. It has always been about sharing information in a compartmentalized way. No integration. Further the Canadians have led in the quality and quantity of information. Very little investment has been made from the US.” – Respondent D, American, 17 years.

“C) Joint ecosystem modeling. Different PROTOCOLS are in place for monitoring N and S of the border, but identical lab test methodologies are used, for example.” – Respondent E, American, 19 years.

“There is a difference between sharing information and integration. Integration between two countries is a bad thing.” – Respondent F, Canadian, 1 year.

“Agree that the task force shares all of the above to varying degrees.” – Respondent G, Canadian, 8 Years.

**Discussion**

Three of the respondents felt that the Task Force shared none of these features, while others added in their own answers. Although the question was aimed at establishing whether efforts of member organizations worked in harmony or parallelism, an interesting response was given: “potential health impacts”. Further the idea of an integrated database or integration of any sort was met with opposition from some of the respondents. The idea of common monitoring practices and integrated databases is for accuracy of data and fluidity of information sharing. If all data about the aquifer could be housed in one location it would more readily provide the opportunity for ecosystem-wide analysis. However, ownership and maintenance of this information
could complicate this proposed idea and perhaps necessitate the existence of a formal, supranational institution.

**Question 13: The existence of the Task Force has improved transboundary management of the aquifer**

“Good start on information/science sharing and relationship building. Need political will and resources to stop unsustainable nitrate loading.” – Respondent A, American, 1 year.

“I don’t have any information on this as I am involved in the monitoring and science aspect it of the task force.” – Respondent B, American, 2 years.

“There has been some increase in cooperation of regulation of discharges of pollution into streams entering Whatcom County, but staff and resource limits on B.C. Env. Staff means this work is not sustainable.” – Respondent C, American, 2 years.

“I am sure that the information exchange aided the respective sides to some small modicum of improvement in the management of their respective activities. However, I am at a loss to identify or describe what “transboundary management” occurred.” – Respondent D, American, 17 years.

“yes when the task force is functional and no due to the inconsistent effort.” – Respondent G, Canadian, 8 years.

“has promoted the interest of many agencies: government, ngos, farming community, academic research.” – Respondent H, Canadian, 16 years.

**Discussion**
Five out of eight respondents marked this statement as 3 (neutral) or below with one other respondent unable to answer. The obvious outlier to this statement is the one ranking of 5, strongly agree and the answer from Respondent B “unable to answer”. The Canadian response is slightly higher than the American response with an average of 3.33 compared to 3.

While most of the respondents recognized that an increase in information sharing that resulted from being a member of the Task Force has improved management efforts, the respondents overall indicate that efforts are not sustainable due to a lack of resources and/or effort.

**Question 14:** The Task Force has created a more holistic picture of the ecosystem, which transcends international borders, for the public and decision makers to understand.

![Holistic picture of the ecosystem](image)

**Discussion**

The majority of respondents stated that the Task Force created a more holistic picture of the ecosystem. One respondent noted that this was true in the case of decision-makers, but that the existence of the Task Force did very little in terms of generating ecosystem wide knowledge for the general public. This statement acknowledges the lack of public input and involvement in the Task
All three Canadian respondents ranked this statement a 4 while the American responses were more sporadic and averaged a 3.5 ranking overall.

**Question 15:** The Environmental Cooperation Council is the peak coordinating body overseeing the Sumas-Abbotsford Aquifer to whom which the Task Force reports.

**Discussion**

One respondent was not sure who the ECC even was or what role it currently, or had ever played, in regards to the Task Force. Other responses indicated that they were aware that the ECC mandated the Task Force in 1992 and that it reconvene in 2012, but largely they felt it did little more than this.
The apparent lack of involvement of the ECC and obvious lack of funding for reducing nitrate loading brings up the issue of empowerment. The ECC has passed down the responsibility of managing this resource without providing any support.

Question 16: WA Dept. of Ecology and BC Ministry of Environment jointly serve as the coordinating staff that is responsible for organizing Task Force meetings, keeping records, providing information to participants and the public, and acting as a central information repository.

“These 2 groups have been doing these things.” Respondent B, American, 2 years.

“We had a good start, but it has been increasingly difficult to keep BC Env. engaged” – Respondent C, American, 2 years.

“Level of effort of both agencies has varied over the years due to varying levels support/resources and priority afforded to the task force efforts.” – Respondent G, Canadian, 8 years.

Discussion

Department of Ecology and BC Ministry of Environment have been actively involved in setting up and organizing the 2013 meetings and are clearly noted as the co-chairs of the organization. The responses of the participants largely reflect this involvement. Respondent C is the outlier with a
ranking of 2; in the comments section the respondent noted a disengagement of Canadian
stakeholders. However, Canadian Respondent G noted that a lack of support and resources has
affected the level of participation on both sides of the border. A shortage in funding has been an
ongoing issue for the Task Force. Richard Grout and Marc Zubel, the acting co-chairs of the Task
Force at the time, noted funding constraints as the primary reason for declining attendance of
member agencies in 2003. They also noted that, in addition to funding cuts, other priorities and
retirements (turnover in administration) affected the ability of subcommittees within the Task Force
to conduct activities (Grout and Zubel, 2003). At the time, Washington State was facing a 2.6 billion-
budget deficit, which resulted in less resources for aquifer protection activities (Grout and Zubel,
2003).

Question 17: There are organized, consistent, ecosystem-wide programs for communication,
public education, and outreach

Consistent communication, public
education, and outreach

USA
Canada

A B C D E F G H

1 2 3 4 5

“Not that I know of” – Respondent B, American, 2 years.

“By “ecosystem-wide” I assume you mean across the entire aquifer. This is not a comment on what
the Canadians have been doing within their country. I am unaware of a significant and sustained
effort state-side.” – Respondent D, American, 17 years.
“Really has been entities on either side of the border developing their own programs...” – Respondent E, American, 19 years.

Discussion

Although members felt very strongly about the ability of the Task Force to serve as a mechanism for information sharing and relationship building, it appears little is being done with this shared information. Only one respondent stated that consistent communication and outreach was occurring as a result of the Task Force. Although information is shared across scale, and border, the majority of responders indicated that true collaboration in terms of parallel programs and outreach is not occurring.

Question 18: Task Force member organizations, operating at any level (local through federal), work in unison to manage the Sumas-Abbotsford aquifer ecosystem.

“Not at all” – Respondent B, American, 2 years.

“There isn’t any management state-side” – Respondent D, American, 17 years.

“Agencies meet at the Task Force, but once away from the table, there are political, legal, and budgetary restraints affecting every entity. Thinks lurch along out of synch, as each entity pursues what it can, when it can.” – Respondent E, American, 19 years.
“this is not a lack of wanting to...it is my experience that it is the full intention of all members to fully cooperate – it is due to lack of resources and priority afforded to the task force.” –Respondent G, Canadian, 8 years.

Discussion

A significant difference between Canadian and American responses is noticeable with the average Canadian response a 3.33 and the average American response a 1.6. Generally, member organizations work within their own confines and do so without collaborating with other members of the Task Force. For example, monitoring of wells in Whatcom County occurs as part of regular public health requirements; it just happens to coincide with activities the Task Force should be doing. As reflected in the graph above, participants feel that organizations do not necessarily work in a planned, harmonious fashion to benefit the Task Force. When member organizations do work on aquifer-specific management efforts, they do so in an ad-hoc fashion with little to no collaboration with other stakeholders in the Task Force. As respondent E notes, without a central source of resources it is difficult to maintain programs.

Question 19: The Sumas-Abbotsford Aquifer ecosystem is managed in an adaptive way—which means monitoring and re-evaluation of management decisions happen continuously, building institutional learning capacity into the management system.
“Again, not at all” – Respondent B, American, 2 years.

“Adaptive management pre-supposes that there are activities taken which are monitored. This isn’t occurring state-side.” – Respondent D, American, 17 years.

“There are some attempts to develop an ever-more-accurate body of science (i.e., regarding nitrogen uptake by crops, effects of tilling, etc.) To some extent, the newer science ripples out into actual changes in farm practices. BUT, again, integrated binational management decisions aren’t really taking place in the first place. There is also continual staff turnover, which makes adaptive management difficult over time. There is also the inertia of the system itself—the effect of something done today is not visible for years to come.” – Respondent E, American, 19 years.

“varying lack of support for the task force means inconsistent use and awareness of the task force efforts” – Respondent G, Canadian, 8 years.

Discussion

At the heart of this thesis was the idea that perhaps given its longevity and relatively consistent member base, the Task Force could serve as model of adaptive management in action. However, it appears adaptive management is still a theory yet to come to fruition in the case of the Task Force. Respondents felt very strongly that an iterative and recursive process was not occurring. Some respondents stated that little or no management activity was even happening, which would make monitoring and evaluation of management efforts impossible. Further, according to
Respondent E the continual turnover in staff makes adaptive management difficult. This stands in contrast to the theoretical idea that adaptive management would help to sustain management efforts in light of disturbances, such as staff turnover.

This lack of action requires a re-evaluation of what the Task Force’s mission truly is. According to its mission statement, “the Mission of the Task Force is to coordinate efforts directed towards protecting the aquifer across the common border between Canada and the United States. These efforts will establish a managerial approach, develop aquifer management strategies and identify mechanisms to educate and involve the public in protecting the Aquifer’s water quality and water resource values” (Abbotsford-Sumas Aquifer International Task Force, 1993). According to this mission statement it would seem that coordinated management efforts and mitigation of nitrate contamination is in fact part of what the Task Force is called to do. Therefore, questioning the relevance, resilience, and effectiveness of the Task Force is valid.

**Question 20: Short term solutions are integrated into the long term recovery and management goals of the Task Force**

![Goal Cohesion](image)
“Not at all” – Respondent B, American, 2 years.

“No solutions are identified. There isn’t a plan for recovery...” – Respondent D, American, 17 years.

“In a sense, there ARE NO short term “solutions.” There is the need for sustained education and regulation/enforcement efforts extending over decades. Within that timeframe, there are programs and efforts that come into being for short periods.” – Respondent E, American, 19 years.

“There aren’t really any good solutions so far. We don’t really know where we’re going.” – Respondent F, Canadian, 1 year.

Discussion

The idea that short-term projects and solutions should fit cohesively with long term goals seems intuitive. However, in the case of the Task Force, stakeholders do not believe very strongly that this is happening. Many of the respondents indicate that there is not enough action to really state whether this is occurring. Further, some respondents noted that, without long term goals, it is impossible to accurately say whether short-term goals fit into the larger picture. There is also a noticeable difference in the American vs. Canadian responses. The average American response was 1.5 while the average Canadian response was 3.33.

4.2.3. Future Directions

Question 21: In your opinion, how resilient is the Task Force? Resilient meaning the organization can withstand unpredictable disturbances, such as changes in funding or administration, and continue to pursue its mission.
“It is important to maintain and build relationships even if political and financial resources are weak.”—Respondent A, American, 1 year.

“It’s not pursuing its mission to speak of now, much less if there are disturbances.”—Respondent B, American, 2 years.

“I believe it is non-functioning. Neither sponsor (Ecology and Ministry of Environment) are dedicating enough resources that demonstrate to the other stakeholders that the process is important enough for them to continue participation.”—Respondent D, American, 17 years.

“It is only resilient as the “champions” that exist within the two governments. Turnover at the level of the ECC and the level of the co-chairs and the level of the agency program managers is a constant threat. New environmental “crises” compete for scarce agency funds (e.g., new concern about oil train spills.)”—Respondent E, American, 19 years.

“On one hand they are resilient because they can stop and start again, but are not resilient because of the lack of continuity.”—Respondent F, Canadian, 1 year.

“resilient in that there continues to be the interest by a core group of people within the task force, but as those people leave (retire/move on) the resiliency will erode.”—Respondent G, Canadian, 8 years.

Discussion

Again, responses to this question were ranked relatively low. The Canadian responses were noticeably, and consistently, higher than American responses with an average response of 3 versus
1.6. The lull in activity from 2007-2012 may have played a significant role in shaping stakeholders' perception of resilience. However, in some instances participants indicated that the eventual revival of the Task Force spoke to its resilience, at least in terms of continued interest. On the other hand, they also acknowledged that existence alone does not mean that the Task Force bounced back from disturbances or improved functionality over time. Respondents noted that the typical disturbances to organizations like the Task Force, funding and staff turnover, continue to cripple the efforts and resilience of the Task Force.

**Question 22:** In your opinion how important is continuing the activities of small working groups, such as the Task Force, in reaching the overall transboundary governance goals in the Salish Sea Ecosystem?

![Importance of small working groups in the future](image)

“Unless policies and resources are in place to monitor water quality issues and address them, the Task Force’s importance will continue to grow.” –Respondent A, American, 1 year.

“Will they become more or less important over time? More important over time if they ever get going.” –Respondent B, American, 2 years.

“More important. It has become more apparent, however, that the B.C. side of the aquifer is not causing most of the nitrate contamination in WA groundwater, and the water all flows NE to SW.” –Respondent C, American, 2 years.
“The “small working groups” that exist are not formed out of the Task Force. Recognize that Task Force members come to the table because of the commonality of the issue and their respective missions... The consequence of not having a single over-arching entity that lives up to its mandate, is the lack of authority and resources to address all the potential significant contributors to the problem. Without a comprehensive program, the problem will persist as we have witnessed it over the past 20 plus years.” –Respondent D, American, 17 years.

“Will they become more or less important over time? Hard to say. They are all that exist now, so they are very important. If a largely binational environmental-management effort were to be enacted, such an effort could subsume the effects of the smaller task forces.” –Respondent E, American, 19 years.

“Should they become more important? Yes because we have a whole bunch of environmental issues on the table, but will they? Probably not. But importance has to do with how government’s allocate funding, and in Canadian government they are cutting anything to do with environmental protection. The environment isn’t something the federal government really cares about, I wouldn’t say it’s even second to the economy.” –Respondent F, Canadian, 1 year.

“Will they become more or less important over time? Essential – small groups are essential to getting work done. Large committees are less effective and less productive.” –Respondent G, Canadian, 8 years.

“More important over time; health of people and ecosystem is extremely important to the public.” –Respondent H, Canadian, 16 years.

Discussion

Even though respondents tended to state that, overall, the Task Force was not effective in accomplishing its mission, they felt very strongly about the continued importance of small working groups in transboundary water governance. Respondent A shared an interesting insight, noting that unless resources are allocated to address water quality issues, the importance of the Task Force would continue to grow. This stands in contrast to the reoccurring theme throughout the responses to questions emphasizing that in fact the Task Force is also inadequately equipped to deal with water quality issues in the aquifer without the reallocation of funds. Perhaps it is the relationships and connections formed and strengthened through these organizations along with the shared information and increased communication that make them an invaluable resource for stakeholders.
Respondents noted that, with the plethora of environmental issues on the docket today, the importance of small working groups could only grow. Respondent G noted that smaller groups are more productive and effective than larger committees.

However, the lack of action in recent years makes it difficult to measure whether small groups are more productive than larger committees. Further, the Task Force only reconvened after the intervention of the ECC; it would seem that larger, more formal organizations are integral components to effective water governance.

**Question 23: To what degree would a cross border database create a unified picture of the aquifer and therefore make governance efforts more effective and less fragmented by the border?**

“Would be very helpful. Data is good, but setting performance goals and using data to evaluate and improve performance is much better!” –Respondent A, American, 1 year.

“It would be very helpful to have a cross-border database for groundwater data, including water level and water quality data, land use, etc.” –Respondent B, American, 2 years.

“I’m not sure that’s the biggest issue at this point – its resources and staff time to coordinate this work.” –Respondent C, American, 2 years.

“It is a piece of the puzzle. It alone will not make governance efforts more effective as the lapse in efficacy is due to the lack of political will including the commitment of resource adequate to the challenge. It is a waste of time and effort to pursue in a vacuum of leadership.” –Respondent D, American, 17 years.

“Don’t think this really is the issue. We collectively know what the contamination looks like, even if the info is present in a couple of databases. Governance efforts would be more coordinated only through some new determination (or mandated structure) that caused responsible entities on either side of the border to undertake efforts in parallel.” –Respondent E, American, 19 years.

“It’s probably necessary, but not sufficient. We need to know what’s going on on both sides, but I wouldn’t say that would necessarily lead to positive action.” –Respondent F, Canadian, 1 year.

“It would help—maintenance of the database is a question? Custody of the data?” –Respondent G, Canadian, 8 years.

“It would certainly add to a better and more accurate view of what is going on over both sides of the border.” –Respondent H, Canadian, 16 years.
Discussion

Some respondents believed that this effort could add to a comprehensive understanding of the aquifer; however, most of them noted that this effort alone would not necessarily improve management efforts. Additionally, the issue of custody and maintenance of such a database was brought up in responses. Ultimately, although shared data could help to understand the issue its entirety, without clear performance goals little will change in terms of nitrate mitigation.

Question 24: Going forward do you feel current management efforts are effective for present and evolving issues in the aquifer ecosystem?

“No.” – Respondent A, American, 1 year.

“No, not much is going on, because there is not enough incentive to make things better. We seem to meet, talk, exchange some info maybe once or twice per year, and that’s it. I don’t know about the Canadian governments, but the US governments aren’t that concerned about fixing the groundwater contamination.” – Respondent B, American, 2 years.

“No” – Respondent C, American, 2 years.


“Not effective enough. With 20 years of effort, we seem to have succeeded in lessening the rate of decline in water quality. But we have not reversed things and caused actual IMPROVEMENT in water quality. And all of that effort has essentially been targeted at one locus of threat – agricultural. Not much attention being paid to evolving threats…” – Respondent E, American, 19 years.

“I think it’s important that we’re monitoring things and we’ve changed some things in agricultural practice.” – Respondent F, Canadian, 1 year.

“Unfortunately no solely due to the lack of priority given to the task force work compared to the many other competing work activities within the province.” – Respondent G, Canadian, 8 years.

“Not completely. Elevated Nitrate level trends have remained relatively unchanged for the past two decades, even after all efforts to mitigate nutrient loadings over the aquifer. However, this may be positive, in that the Nitrate level trend has not increase.” – Respondent H, Canadian, 16 years.

Discussion
Overwhelmingly, respondents stated that the current level of effort would not suffice to appropriately manage the aquifer into the future. This response was interesting in comparison to their high value of small working groups into the future. Again, although they value the relationships and information that comes with being involved in the Task Force, participants recognize that these relationships can, and often do, exist outside of the organization. Overall, respondents are not impressed with the current efforts of the Task Force.

In 2003, an original member of the Task Force stated that the Task Force was worth the effort and was successful in not letting things get worse and for promoting positive multi-agency involvement (Grout and Zubel, 2003). However, we now know that nitrate contamination is getting worse in parts of the aquifer. As noted by Redding et al. (2011) 31% of wells tested in a 2003-2005 study showed increasing nitrate trends. These results indicate that current management efforts are not enough to reduce nitrate overall.

5.0 Findings

The Abbotsford-Sumas Aquifer International Task Force provides the opportunity to examine the resilience and effectiveness of a cross-border collaborative group. The Task Force has existed since 1992 with spikes in activity as well as lulls. The objective of this research was to investigate the following questions:

- Do stakeholders feel the current management efforts have been effective?
- Do stakeholders feel the current method of water governance used by the Abbotsford-Sumas Aquifer International Task Force fosters social-ecological resilience?
- Can informal, ad-hoc governance structures be as productive and successful as more formal institutions?
- Is recursive, iterative, and adaptive management of the aquifer occurring from the efforts of the Task Force?
Overall, the respondents believed that the Task Force was successful at providing a means for information sharing and collaboration as well as creating a holistic picture of the ecosystem. Respondents also recognized that the Washington State Department of Ecology and B.C. Ministry of Environment served as the coordinating staff for the Task Force. Further, every respondent agreed or strongly agreed that the importance of small, informal working groups in the future would increase. The high valuation of information sharing and collaboration as well as the importance of these small groups may explain how this particular group has been able to endure for so long. Further, given adequate resources the Task Force could prove to be resilient, which may be another reason stakeholders continue to express interest in participating in small working groups.

However, stakeholders did not believe the Task Force was effective at executing its mission as stated on the Task Force webpage. Further, the Task Force has not improved transboundary management of the aquifer or created a means for consistent public outreach and education. Organizations do not work in unison, adaptive management is not occurring, and goal cohesion amongst organizations does not exist. Ultimately, respondents ranked the Task Force as not resilient. Of all the respondents, the Canadian stakeholder represented by the letter H was the most positive and optimistic about the group overall, ranking every question a 3 or above.

While stakeholders recognized that the Task Force is resilient in terms of continuing to exist, even after periods of inaction, they also believe that there is not enough action occurring to determine whether or not the Task Force is fostering social-ecological resilience or if it is as productive and successful as more formal institutions. Given that nitrate contamination is above the allowable amount and trends are increasing in some areas, it is fair to say the ecosystem has degraded over time, thus making it less resilient. The resilience of the social system is also questionable as the current status of the Task Force is up in the air. Although the organization has
continued to exist in spite of a lack of funding and changes in administration, the effectiveness has certainly been impacted by these uncertainties.

Further, members have an inconsistent idea of what the mission of the Task Force actually is. The majority of members feel that the mission is to provide a means for information sharing as well as collaborative, parallel action, while others feel that the only role of the Task Force is to provide a platform for information sharing. Although a portion of respondents were not aware of the role of the Environmental Cooperation Council most of them recognized that the recent reconvening of the council and subsequent 2012 workplan was the catalyst for renewing interest in the aquifer and engaging the Task Force. Considering this involvement of the ECC it would appear that formal institutions are necessary to provide structure and act as a peak coordinating or regulatory, body. Without the involvement of the ECC the Task Force may never have reconvened. Further, without the continued interest of the ECC, and reallocation of resources, it would appear the Task Force may cease to exist as they have not had any meetings since June 2013. One solution for the Task Force may be the evolution to a largely digital organization. Perhaps online meetings and records could help keep costs down as members would not need to travel across the border to participate. The obvious solution is the reallocation of funds and priority to this issue in order to fully support the Task Force.

Ultimately, iterative, recursive management of the aquifer is not occurring due to the Task Force. Therefore, the organization cannot serve as a model of active adaptive management for other cross-border groups. This is due to the fact that parallel action, or action of any sort, is not occurring according to respondents, therefore making it impossible to monitor, evaluate, and learn from management practices. Contrary to much of the literature that proposes adaptive governance as a preferable alternative to traditional management, adaptive governance may be poorly suited
for transboundary water governance. Due to the ongoing monitoring and evaluation processes, high levels of resources, and therefore funding, are required in order to make adaptive governance possible. Clearly, a lack of resources is an issue for this transboundary group. One may conclude that this may be the case for most transboundary groups as participation in transboundary management efforts is largely done above and beyond most managers’ job descriptions. This work also takes place outside of any political jurisdiction, compounding the funding issue.

Moreover, although public input and NGO participation were part of the original vision for the Task Force, it has largely become an organization made up of government agencies. Without public participation the Task Force may not even be an example of rescaling governance. Public participation and transparency of government actions is necessary for adaptive governance to be possible.

5.1 Limitations of Study

An obvious limitation of this research was the limited response rate to both interviews and the questionnaire. Although I interviewed two American stakeholders, I was not able to procure an interview with a Canadian counterpart. Further, only 8 of 41 stakeholders participated in the survey. While two other stakeholders expressed interest, they never returned a completed questionnaire, and two respondents declined participation. This lack of interest and response in the survey may be a reflection of the deteriorating involvement of members in the Task Force. Having the survey prepared in time for the June 2013 meeting, and perhaps landing a spot on the meeting’s agenda, may have resulted in greater response rates. Due to the fact that I received such a limited response I was not able to perform statistical analysis on my results. Therefore I am unable to state whether the responses I received are truly representative of the group as a whole.
Another limitation of the study is the inconsistent nature of the Task Force. Given the lull in activity from 2007-2012 and the turnover in members, some stakeholders were not able to answer some of the questions because of their limited and short involvement in the Task Force. In retrospect it would have been helpful to get the perspective of prior members who are no longer involved in the Task Force.

5.2 Future Research

In addition to procuring a larger number of respondents, other areas for future research exist. First, having a larger group of respondents would offer the opportunity to perform statistical analysis and identify perceptions among sub-groups including local vs. state/provincial and Canadian vs. American. Additionally, following up on the Task Force’s proposed letter to the ECC and subsequent continuation (or discontinuation) of the group could provide greater details of the resilience of the group. Although I contacted the co-chairs to see if this letter was ever sent and what the results were, I received no response to my correspondence.

Expanding the vision of the research to encompass all five of the subcommittees that came out of the 1992 Environmental Cooperation Agreement would shed light on how resilient and effective the groups are as a whole. This expansion of the research could also more accurately predict how important these types of working groups are in the future of transboundary governance.

Further, researching a group that is knowingly using adaptive governance as a framework could shed light on how the process works, or doesn’t, and how we can apply that knowledge to other environmental governance groups. The Puget Sound Partnership provides an opportunity to
study this approach in action, however it lacks the transboundary element, which eliminates many of the uncertainties and complexities faced by the Task Force.

5.3 Conclusions

The goal of this study was to see if the Task Force served as a model of active adaptive governance. The findings of this study indicated that the Task Force does not serve as a model of adaptive governance. In conclusion, stakeholders do not feel that current approach of transboundary governance taken by the Task Force fosters social-ecological resilience. Further, stakeholders do not perceive the Task Force as effective in pursuing its mission. The barriers to success, as expressed by respondents, included a lack of resources, both funding and staff, as well as a lack of political will to enforce regulations. Due to the fact that the Task Force is unable to maintain consistent meetings, membership, and programs, it would appear that informal groups may not be as effective as formal institutions. Further without the involvement of the ECC and the mandate that came out of the 2012 workplan the Task Force may never have re-convened on its own accord. Therefore, choosing between a rule-based or governance approach does not have to be an “either-or” choice, but rather that structured, formal groups can support the work of informal organizations (Karkkainen, 2006). Finally, stakeholders do not feel that adaptive management is occurring.

Moreover, due to the fact that the aquifer is part of a larger system including surface waters, economic and land use processes, the Task Force, alone, can not be expected to manage all of these factors – indeed other agencies and processes will necessarily be involved. The Task Force has limited ability to influence development and economic decisions. Further, to date, Task Force membership has been limited to largely governmental agencies with little or no representation from
the public or economic (farming industry) groups. Therefore the gap between theory and application of adaptive management leading to social-ecological resilience is still present in the case of the Abbotsford-Sumas aquifer.

As Karkkainen (2006) states, “This gap between the bright vision and failure of implementation is hugely significant, and perhaps emblematic of the current stance with respect to broader trends in environmental and natural resources policy... At one level, the participants understand the big picture. They clearly grasp that a fragmentary, piecemeal approach is insufficient, and that a holistic, integrated approach that addresses the synergies and interconnectedness of the many parts of, and stressors on, the system is needed... But the proof is in the pudding. Having the vision is simply not enough” (p.220).

In order to sustainably and resiliently manage our resources, we need to find a way to bridge the gap between science and policy, and to ensure that both ecological and social perspectives are being brought to the table.
Bibliography


Appendix A

- North American Free Trade Agreement: The Commission for Environmental Cooperation
- International Joint Commission
- British Columbia-Washington State Environmental Cooperation Council
- Abbotsford-Sumas Aquifer International Task Force
- The Abbotsford-Sumas Aquifer Stakeholders Group
- Industry Stewardship Groups
- Environmental Non-Governmental Organizations