INSTITUTIONAL REQUIREMENTS FOR WATERSHED CUMULATIVE EFFECTS ASSESSMENT IN THE SOUTH SASKATCHEWAN WATERSHED

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By

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ABSTRACT

Watersheds in Canada are under increasing threats due to the cumulative environmental effects from natural and anthropogenic sources. Cumulative effect assessment (CEA), however, if done at all is typically done on a project-by-project basis. This project-based approach to CEA is not sufficient to address the cumulative effects of multiple stressors in a watershed or a region. As a result, there is now a general consensus that CEA must extend from the project to the more regional scale. The problem, however, is that while the science of how to do watershed CEA (W-CEA) is progressing, the appropriate institutional arrangements to sustain W-CEA have not been addressed. Based on a case study of the South Saskatchewan Watershed (SSW), this research is aimed to identify the institutional requirements necessary to support and sustain W-CEA.

The research methods include document reviews and semi-structured interviews with regulators, administrators, watershed coordinators, practitioners, and academics knowledgeable on cumulative effect assessment and project-based environmental assessments (EAs). The findings from this research are presented thematically. First, participants' perspectives on cumulative effects, the current state of CEA practice, and general challenges to project-based approaches to CEA are presented. The concept of W-CEA is then examined, with a discussion on the need for linking project-based CEA and W-CEA. This is followed by the institutional requirements for W-CEA. The Chapter concludes with foreseeable challenges to implementing W-CEA, as identified by research participants

The key findings include that cumulative effect assessments under project-based EAs are rarely undertaken in the SSW, and the project-based EA approach is faced with considerable challenges. The project-based EA challenges suggested by interview participants are similar to the ones discussed in the literature, and are primarily related to the lack of guidance to proponents regarding boundaries of assessments and thresholds, the lack of data from other project EAs, and the lack of capacity of both proponents and regulators to achieve a good CEA under project EA. These challenges could be addressed by establishing regional objectives at a broader scale, which could provide better context to project-based approaches. Further, interview results revealed several opportunities for the government to take the lead in implementing and sustaining W-CEA, but a multi-stakeholder approach is essential to W-CEA success. The results also suggest that the establishments of thresholds and data management are necessary components of W-CEA, but that the need for legislation concerning such thresholds and W-CEA initiatives is not agreed upon. At the same time, research results emphasize that the coordination and education among various stakeholders will be difficult to achieve. The lack of financial commitment, political will, and difficulties in establishing cause-effect relationships currently impede the implementation of W-CEA.

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This work is dedicated to the memory of my father

Chikkanna Gowda Sheelanere

1947–2007

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AB	Alberta
AEPEA	Alberta Environmental Protection and Enhancement Act
CEA	Cumulative Effect Assessment
CEAA	Canadian Environmental Assessment Act
EA	Environmental Assessment
ENGOs	Environmental Organizations
EUB	Energy and Utility Board
NRCB	National Resources Conservation Board
SEAA	Saskatchewan Environmental Assessment Act
SK	Saskatchewan
SSW	South Saskatchewan Watershed
VECs	Valued Ecosystem Components
W-CEA	Watershed Cumulative Effect Assessment

CHAPTER 1

INTRODUCTION

1.1 Introduction

A watershed is a topographically delineated total land area within which all waters drain into a single river system (Heathcote, 2009; Brooks et al. 2003). Watersheds are the primary source of freshwater supply for important human activities such as agricultural production, industry and domestic water supply. Safeguarding the quality and quantity of freshwater resources is at the top of the world's environmental agenda for the next decade (Gleick et al. 2007). However, the effects of increasing water withdrawals and alterations to aquatic biota, combined with human development activity on the landscape and increased runoff, are resulting in adverse effects on the sustainability of freshwater resources across the globe (see Gleick et al. 2007; Gleick, 2003; Schindler, 2001; Gleick, 2000).

Canada is considered to be a freshwater-rich country with a total freshwater area of 891,163 km^2, which is approximately 8.9 % of the total land area (Environment Canada). But, Canada's watersheds, particularly in the western Prairie provinces (Manitoba, Saskatchewan and Alberta), are under increasing threats due to the cumulative environmental effects of both natural change and anthropogenic activities (Schindler and Donahue, 2006). Climate change, landscape disturbances and the large-scale development of water resource infrastructure such as dams, aqueducts, pipelines, and complex centralized water treatment units to support growing populations, expanding irrigation, and industries, have resulted in both deteriorated water quality and enormous withdrawals of freshwater resources (Gleick, 2003; Gleick, 2000). As early as 1987, the

Canadian Environmental Assessment Research Council (CEARC) observed that cumulative effects are having an increasingly significant impact on the quality of natural and social environments in Canada (Sonntag et al. 1987). However, Schindler and Donahue (2006) and Schindler (2001) observe that the cumulative effects of natural and anthropogenic stress on Canada's watersheds have seldom, if ever, been considered by land managers and policy makers.

1.2 Cumulative environmental effects

Cumulative environmental effects are changes to the environment that are caused by an action in combination with other past, present and future actions. In a watershed context, cumulative effects include "any changes that involve watershed processes and are influenced by multiple land-use activities" (Reid, 1993: vii). Cumulative Effects Assessment (CEA) is a systematic process of assessing cumulative environmental effects and the human actions that cause them (Spaling and Smit, 1993). CEA is done to ensure that the incremental effects resulting from the combined influences of various human activities on the environment are assessed when making decisions about development such that watershed ecological processes are conserved. Combined, these incremental effects may be significant to a particular Valued Ecosystem Component (VEC), such as water quality or water quantity, even though the effects of each individual action, when independently assessed, may be considered insignificant (Hegmann et al. 1999).

In order to ensure that the cumulative environmental effects of development activities in Canada's watersheds are assessed, there exists a requirement under the *Canadian Environment Assessment Act* (CEAA, 1992) that every project assessed under

the Act must consider cumulative environmental effects. The problem, however, is that the requirement for CEA under the Act is limited to the individual development project. Project-based assessment is not alone sufficient to address the potential cumulative effects of multiple developments and other human-induced stresses that occur within a watershed, many of which are beyond the scale and scope of the individual development proponent and project impact assessment (see Harriman and Noble, 2008; Dubé et al. 2006; Duinker and Greig, 2006;). As Duinker and Greig (2006) suggest, CEA under project-based Environmental Assessment (EA) is a "bad conceptual fit."

There is now a general consensus that CEA must focus beyond the project level, to encompass broader regional-scale considerations of the sources of cumulative environmental change (e.g. Harriman and Noble, 2008; Dubé et al. 2006; Duinker and Greig, 2006; Dubé 2003). This regional scale is defined by ecologically significant boundaries, such as watersheds or eco regions, and not ones necessarily defined in terms of project or administrative boundaries (Duinker and Greig, 2006; Dubé, 2003). In order for CEA to advance to this scale, however, there is a need to examine, not only the science of cumulative effects beyond the individual development project, but also the institutional arrangements necessary to implement and sustain a more spatially relevant approach to CEA and management.

1.3 Institutional arrangements for CEA

Cumulative effects assessment has two important components, each of which yields a particular contribution to the identification, assessment and management of cumulative effects (see Dixon and Montz, 1995; Peterson et al. 1989), namely:

i. *scientific input*, which provides the necessary research and technical aspects to do CEA; and

ii. *institutional arrangements*, which provide the management framework for the implementation of CEA.

In order for CEA to be successful, equal contributions from the above two components are necessary. However, the majority of progress that has been made in assessing cumulative effects has been in the *science* of how to do broader regional or watershed-scale CEA (e.g. Noble, 2008; Dubé et al. 2007; Dubé et al. 2006; Culp et al. 2000). The *institutional* requirements to support regional or watershed scale CEA, in contrast, have not been adequately addressed (Harriman and Noble, 2008; Duinker and Greig, 2006). Institutional arrangements are equally important to the scientific and technical components of CEA, as institutional arrangements ensure necessary actions to manage cumulative effects. The challenge is that existing institutional arrangements for CEA and the institutional requirements necessary to support regional or watershed scale CEA in Canada are largely unknown (Duinker and Greig, 2006). As such, this research will serve to advance the current understanding of the institutional requirements necessary to implement and sustain CEA at the watershed scale.

Institutional arrangements for CEA involve administrative, legislative, economic and socio-political influences concerning the identification, assessment, and management of cumulative effects (see Imperial, 1999; Watson, 1996; Peterson, 1989). If the scientific evidence suggests the need for watershed scale CEA, then institutional arrangements are necessary to see that the action is taken to appropriately assess and manage cumulative effects at that scale. Dixon and Montz (1995) note that the implementation of CEA

depends largely on the processes within and between agencies, organizational structures, disciplinary boundaries, allocation of functions and coordination between agencies, developers and other interested parties. This institutional dimension is critical for the effective implementation and application of relevant methods in support of CEA beyond the project scale, and evolving CEA practice requires further investigation into the institutional aspects of, and the requisites for effective CEA and management.

1.4 Research purpose and objectives

The overall purpose of the research is to advance the current understanding of necessary institutional requirements to support a more watershed-based approach to CEA. The specific objectives of this research are:

1. To examine the nature and current state of CEA under existing environmental assessment frameworks; and
2. To identify the institutional requirements useful for a watershed-based approach to CEA.

These objectives are pursued within the context of environmental assessment in the South Saskatchewan Watershed – a watershed spanning the Saskatchewan-Alberta border, and subject to environmental assessment laws and regulations under the governments of Saskatchewan, Alberta, and Canada (see Chapter 3).

1.5 Thesis organization

The thesis is presented in five chapters, including the Introduction. Chapter 2 provides a general overview of environmental assessment and CEA in Canada, and addresses the need for a more 'regionally-relevant' approach to CEA. The research methods and study area are explained in Chapter 3. Chapter 4 presents the research results. Conclusions on the findings and directions for further research are discussed in Chapter 5.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The accumulation of natural and anthropogenic stressors over space and time has resulted in the rapid degradation of Canada's watersheds. Schindler (2001) argues that human activities on the landscape, when viewed individually, may not seem all that harmful, but the overall effects of such activities can act synergistically, resulting in significant environmental effects to Canadian freshwater systems (Schindler, 2001; Schindler, 1998). To ensure that human development activities on the landscape do not cause significant adverse environmental effects, project developments are subject to assessment under federal and various provincial EA processes so as to contribute to informed decision making in support of sustainable development (see Orrega, 2007; Gibson, 2002). In practice, however, the assessment of the potential environmental effects of individual project developments has been largely ineffective in managing cumulative environmental change (see Harriman and Noble, 2008; Dubé, 2003). The sections that follow present an overview of the nature of cumulative environmental effects, with a focus on watershed cumulative effects, and the EA procedures in place to assess and manage cumulative effects. The case is then made for a more regional and integrated approach to CEA that is sensitive to the scope and scale of the watershed.

2.2 Cumulative environmental effects

Generally speaking, cumulative environmental effects are effects that accumulate over time and space in an additive or interactive manner (Spaling and Smit, 1993).

Perhaps the most widely adopted definition of cumulative environmental effects, or cumulative impacts, is that provided by the US National Environmental Policy Act (NEPA) of 1969 (US CEQ Guidelines, 40 CFR 1508.7, issued 23 April 1971)

> 'Cumulative impact' is the impact on the environment, which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non- Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

In practice, however, there are various ways of defining cumulative effects, and thus different understandings of what constitutes a cumulative effect.

Cumulative effects are sometimes defined based on the broad temporal and spatial dimensions in which the *sources* of cumulative impacts accumulate in a region and over time, either in an additive or interactive manner (Spaling and Smit, 1993). These sources of cumulative effects are due to single or multiple types of disturbances (see Cocklin et al. 1992). In this context, cumulative effects are understood to be accumulated "environmental stressors". Cumulative effects occur specifically due to a proposed project (i.e. single source) and refer to the direct and incremental effects of that project within the project's activity area, in combination with other projects and sources of stress. The proposed project serves as the focus of assessment in a single source disturbance, and emphasis is often on mitigating the cumulative contribution of the project's additive stress. Alternatively, cumulative effects can be viewed from the perspective of the environmental response of a single receptor to a variety of stressors in a region. In this context, the focus is on the ways in which the environmental component responds to the

various contributions and withdrawals of human actions (i.e. stressors), rather than the stressors per se (Cocklin et al. 1992; Sonntag et al. 1987).

Many authors have acknowledged that a single definition in all cumulative effect circumstances may not be possible (e.g. Hegmann et al. 1999; Spaling and Smit 1993; Cocklin et al. 1992; Peterson et al. 1989; Sonntag et al. 1987); and, hence, each attempt to define cumulative effects in the literature has a particular relevance to the context in which it was established (Sonntag et al. 1987). However, a more holistic view of cumulative effects, despite it being defined in various ways, encompasses both environmental stressors and environmental response relationships (Noble, 2010).

2.2.1 Sources and pathways of cumulative effects

Cumulative effects acting on an environmental receptor can be characterized based on the sources and pathways that lead to those effects. Cumulative effects may originate from either an individual project, or from the combined actions of anthropogenic disturbances that reappear over time and space, and have the potential to alter the state of the valued ecosystem components (VECs) of a region. Valued ecosystem components are the various aspects of the environment that are considered to be important, either from a public or ecological perspective, and often the focus of impact assessment. Based on the source of effects, cumulative effects can be broadly classified into four types, as outlined by Noble (2005):

i. *Linear additive effects:* Incremental additions or deletion from a fixed large storage where each addition has the same individual effect.

ii. *Amplifying or exponential effects:* Incremental additions are made to, or deletions form an apparently limitless resource base where each incremental or deletion has a larger effect than the one preceding.

iii. *Discontinuous effects:* Incremental additions that have no apparent effect until a threshold is reached, at which a time components change rapidly with very different types of behavior and responses.

iv. *Structural surprises:* Changes that occur due to multiple activities within a region. These are often the least understood and more difficult to assess.

Examples of sources of cumulative effects include alteration in catchments of a watershed due to climate warming; removal of natural vegetation due to agricultural activities, encroachment, or timber harvesting; and combined reductions in flow volumes within a particular river resulting from irrigation, municipal and industrial water withdrawals (Ramachandra et al. 2006; Noble, 2005)

Cumulative environmental effects may also progress through different pathways or processes of change. These pathways vary by nature, time, and space, and are dependent on the particular source of change (Spaling and Smit, 1993). Generally, four pathways can be differentiated by source of change (individual or combined actions) and process of accumulation (Peterson et al. 1989), namely:

i. *Pathway 1:* An individual action that steadily adds or removes materials within an environmental system without any interactive relationships. For example, the slow but steady contamination of an aquifer by deep bedrock nuclear waste disposal.

ii. *Pathway 2:* An individual action that steadily adds or removes materials which involves interactive relationships. For example, biomagnification of pesticides through food chain.

iii. *Pathway 3:* Two actions that induce environmental change in an additive but non-synergistic manner. For example, copper and nickel toxicity to aquatic organisms are strictly additive.

iv. *Pathway 4:* Multiple actions with synergistic interaction. Synergism occurs when the total effect of an interaction between two or more processes is greater than the sum of the effects of each individual process. For example, photochemical smog.

The magnitude of the combined effects along any single pathway can be equal to the sum of the individual effects (i.e., additive effect), greater than the sum of individual effects (i.e. synergistic effect), or less than the sum of individual effects (i.e. antagonistic effect). The primary focus of assessing cumulative effects has often been to delineate these "pathways" and to determine the relationship between a cause and an effect or particular VEC response.

2.2.2 Cumulative watershed effects

Cumulative effects in a watershed can be defined as environmental changes that are caused by more than one land-use activity and that are influenced by processes involving the generation or transport of water (Reid, 1998). Almost all land use activities directly alter environmental parameters (e.g. soil properties, topography, vegetation, and fauna) and these parameters, in turn, modify transport of watershed products (e.g. sediment,

organic matter, chemicals, heat). Therefore, according to Reid (1998), cumulative watershed effects can be generated either at the site of land use disturbance (on-site) or away from the site of the land-use activity (off-site or downstream); the impact triggering agent may be transported by water or sediment and thus almost all land-use activities and their impacts in the watershed can be evaluated as cumulative watershed effects (Reid 1998; Reid, 1993).

In this regard, Reid (1993) points out two attributes to the definition of cumulative watershed effects. First, the term 'cumulative watershed effects' includes those changes occurring to resources influenced directly or indirectly by watershed processes, so processes of water and sediment transport are functionally responsible for the expression of cumulative impacts. Second, cumulative watershed effects could be simply interpreted as changes/impacts that take place in the drainage area and not necessarily due to watershed processes. In this second case, the watershed is simply a location and does not play a role in the expression of impacts. As Reid goes on to explain, for example, watershed processes do not directly affect some wildlife species; assessment for those species may extend beyond watershed boundaries. Core to understanding cumulative watershed effects are to identify whether watershed processes influence the issue of concern.

It is widely recognized in the literature, particularly in the watershed management literature, that watershed processes influence a large range of variables and their interrelationships in a watershed (Heathcote, 2009; Mitchell, 2005; Reimold, 1998). Further, the watershed is regarded as a geographic unit that holds relevance for off-site impacts that influence biological, socio-economic resources and values (Reid et al. 1994).

Overall, the message is that watershed cumulative effects on VECs must be evaluated in the context of all potential land-uses in the watershed that influence them. Hence, the concept of cumulative watershed effects assists to identify an approach to the evaluation and mitigation of effects to freshwater systems that recognizes multiple influences, including sources and pathways of cumulative effects (see Reid 1993).

2.2.3 Sources and pathways of cumulative watershed effects

From the discussions above, it is clear that almost all impacts generated in a given watershed that affect watershed processes could be regarded as cumulative effects. Watershed cumulative effects can be further classified into four major types based on the interactions or mechanisms that trigger them (see Reid, 1993).

i. *Same influence effect*: This type of watershed cumulative effect is generated as a result of repeatedly occurring single activity at a site or over a progressively larger area or multiple land-use activities contributing to the same environmental change. For example, logging, road use and grazing cause on-site cumulative soil compaction in the watershed.

ii. *Complementary effect*: Complementary effects can occur when different activities affect the same resource by different mechanisms but contribute to the same response. For example, decreased salmon population due to increased water pollution and fishing pressure. So the overall fish population decrease is a cumulative result of two activities through different mechanisms

iii. *Cascading effects:* Watershed cumulative effects can be generated by cascading influences, where one type of use influences a second to provoke a cumulative impact. Example: urbanization is accompanied by increased recreational demands

and leads to increased recreational impact. In this case, urbanization influences the recreational demand to cause recreational impacts and therefore recreational impact does not necessarily appear unless urbanization occurs.

iv. *Interdependent effects:* Interdependent effects result from interactions between different environmental changes, and influences are interdependent in causing the impact. Example: activities like industrialization and mining may release two different chemicals which may then combine to form a toxic chemical mixture that affects aquatic biota.

A simplified framework for understanding cumulative watershed effects, as described by Reid (1993), is presented in Figure 2.1 and summarized as follows. In a watershed, land-use activities can influence on-site environmental parameters (e.g. vegetation, soil characteristics, topography, chemicals, pathogens and fauna) (path **A**). Changes in these environmental parameters can induce compensatory changes among themselves (path **B**), and also can influence watershed processes (path **C**). Watershed processes arise from an area's role as a concentrator of runoff, and include production and transport of runoff, sediment, chemicals, organic material, and heat. These processes can further influence environmental parameters (path **D**), and they can also interact among themselves (path **E**). Changes in either environmental parameters or watershed processes can generate on-site cumulative watershed effects (paths **F** and **G**), but, as Reid explains, only changes in watershed processes can produce off-site cumulative watershed effects (paths **H** and **I**)."

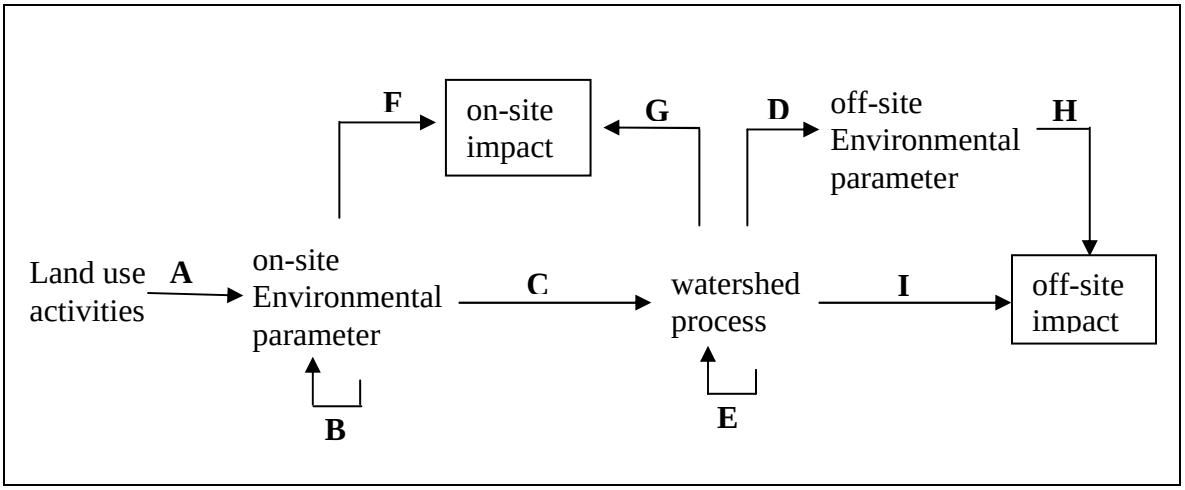

Figure 2.1: Pathways that generate on-site and off-site cumulative effects in a watershed. Source: Reid, 1993

2.3 Cumulative effects assessment (CEA)

Cumulative effects assessment (CEA) is generally understood to be the systematic process of assessing the total or cumulative environmental effects on VECs, and the human actions that cause those effects (Smit and Spaling, 1995). However, there are two approaches by which this can occur: (i) project-based EA, occurring under the requirements of formal, project-based impact assessment; and (ii) regional-based CEA, occurring external to the EA process, often under informal regional environmental studies (see Harriman and Noble, 2008; Dubé, 2003). Assessing cumulative effects under project-based EA approaches typically focus on identifying and mitigating the incremental contributions or stressors of a single proposed project, whereas regional CEAs examine how environmental receptors respond to a whole variety of cumulative stressors, regardless of the individual source (Harriman and Noble 2008; Creasy and Ross, 2005 Dubé, 2003) (Table 2.1).

Table 2.1 Characteristics of project-based and regional-based approaches to CEA

Aspect	Project-based approach	Regional-based approach
Typical proponent	Single proponent	Regional planning or administrative authority of governing body
Trigger	EIA legislation	Cumulative environmental change or land use planning initiatives
Scope	Restrictive inward-focused, limited to stressors and impacts from a single project	Ambitious, outward- focused, consideration of combined influences of stressors effects on the landscape
Temporal	Project life cycle and considering also past environment conditions	Past, present and future environments and economies
Spatial bounds	Site specific, focused on direct on-site and off-site project impacts with continuous dispersion over space	Regional, ecosystem, watershed or as defined by regional authority-possibly multi-jurisdictional
Sources and pathways of effects	Individual, predicted project actions combined with past and future environmental change	Activities of multiple sectors, often diverse and interacting with other regional activities plans, policies or developments
Typical CEA questions	What are the likely additive or incremental impacts of the proposed activity? What are the key stressors?	What are the preferred regional environmental conditions or objectives? What are the potential cumulative effects of each regional alternative? What are the opportunities and constraints to current and future developments

Source: Harriman and Noble, 2008

2.3.1 Project-based CEA

The current approach to CEA in Canada is chiefly project-based environment assessments - also known as stressor-based CEA (see Dubé, 2003), carried out under the *Canadian Environmental Assessment Act* (the Act). The Act was introduced in 1992 as

Bill C-13, coming into force in 1995 and updated in 2003 (Noble, 2005). The preamble to the Act emphasizes the expectation that EA process will foster sustainable development by assessing, among other things, the cumulative effects of development. Section 16(1) (a) of the Act requires consideration of cumulative effects under project–based EA, stating

> **16(1) (a)**: Every screening or comprehensive study shall include a consideration of any cumulative environmental effects that are likely to result from the project in combination with other projects or activities that have been or will be carried out.

The focus of the project-based approach under the Act is to predict the cumulative effects that are associated with the addition of a new project or development (Dubé, 2003). The responsible party to carryout project-based CEA is the project proponent. The assessment usually involves a detailed description of the project baseline environment on which to build predictive models and to determine whether project activities will contribute to significant, adverse effects including cumulative effects (Harriman and Noble, 2008).

The problem, however, is that the project-based approach to CEA is inherently inward-focused; predictions are usually based on information about the project actions of the individual project, i.e. project stressors, and potential interactions with other projects within the project region (Harriman and Noble, 2008; Therivel and Ross, 2007). The project-based approach does not provide sufficient information to understand the pathways of land use changes and human development activities influencing a region, but rather is specific to a proposed development (Quinn et al. 2004). An approach that effectively captures, assesses and manages the cumulative effects that occur due to multiple disturbances and processes in a given region would be more beneficial.

To address this deficiency in project-based EA, in part, the Canadian Environmental Assessment Agency, between 2000 and 2003, identified "regional frameworks" as a priority for EA research and development in Canada, noting: "working at the regional scale can provide proponents, government decision makers and affected publics with a better understanding of cumulative effects" (CEAA 2000 – 2003). The importance of a regional approach to CEA was further manifest via recent revisions to the *Canadian Environmental Assessment Act*. Section 16.2 of the Act makes reference to the use of regional studies as a means to support project-based EA and decision-making, and in particular to assist in the consideration of cumulative environmental effects:

> **S.16(2).** The results of a study of the environmental effects of possible future projects in a region, in which a federal authority participates, outside the scope of this Act, with other jurisdictions referred to in paragraph 12(5)(*a*), (*c*) or (*d*), may be taken into account in conducting an environmental assessment of a project in the region, particularly in considering any cumulative environmental effects that are likely to result from the project in combination with other projects or activities that have been or will be carried out. (2003, c. 9, s. 8.)

2.3.2 Regional-based CEA

A regional-based approach to CEA focuses on a wider range of impacts resulting from multiple project developments, including other non-point sources of cumulative effects, and environmental component interactions within a spatially defined area (Noble, 2005). Regional-based approaches have largely developed outside the formal EA process. The emphasis of regional CEA is typically on the characterization of environmental responses to multiple stressors, and therefore often termed as effects-based CEA (see Dubé, 2003).

Regional or effects-based CEAs generally encompass a broader range of biophysical, economic and socio-cultural issues than stressor-based EA, and often explicitly focuses on ensuring the sustainability of potentially affected VECs (Dowlatabadi et al. 2005). In addition, regional CEA provides the opportunity to examine the effects that may occur over a longer period of time, both into the past and into the future, within a large spatial boundary (Hegmann et al. 1999). As such, regional approaches are viewed as having the potential to enable more effective and systematic assessments of cumulative environmental effects by reducing the duplication of effort and increasing efficiency in project-based EAs; providing consistent requirements and direction for industry planning and development; providing a framework for administrative and policy coordination; and capturing nibbling effects not normally subject to formal EA (Grzybowski & Associates, 2001).

A number of regional scale (e.g. watershed, eco region) CEA studies have been undertaken across Canada (Table 2.2). These regional CEA studies are carried out by academic institutions or public agencies. The concern with such regional CEA studies, however, is that the agencies or study groups rarely have the authority to implement their recommendations and action plans to manage cumulative effects (Spaling et al. 2000). Implementation challenges are further exacerbated by constraints such as data acquisition, unclear responsibilities to undertake CEA, and the complexities and limitations of financial and human resources (see Creasey and Ross, 2005; Baxter et al. 2001; Culp et al. 2000; Sadar, 1996). As a result, to date, regional-scale CEAs have experienced limited success as an ongoing process for assessing and managing

cumulative effects and remain disconnected from development decision-making and have little influence on EA activities (Noble, 2010; Harriman and Noble, 2008).

Table 2.2: Examples of regional CEAs in Canada

Regional CEAs	**Assessment boundaries**	**Focus**	**Assessment Agency**
Northern River Basin Study	Watershed	To assess cumulative effects of industrial, agricultural, municipal and other development in the Peace, Athabasca and Slave River basins	Board members representing education institutions, private companies, government agencies and independent scientists
Banff Bow Valley Study	Watershed	To assess cumulative effects of recreation, transportation and urban activities in Banff National Park on Bow River Watershed	BBVS task force comprises of experts from sciences, tourism, and policy and management sectors
Great Sand Hills Regional Environment Study	Ecological (grasslands and dunes) and Social (regional municipalities)	To assess Cumulative effects of human activities on ecosystem components	An independent scientific advisory committee
The Hudson Bay Bioregion	Bioregion	To assess cumulative effects of human activities on the marine and freshwater ecosystem of the Hudson Bay Bioregion	Canadian Arctic Resources Committee, Environmental Committee of Sanikiluaq, and Rawson Academy of Aquatic Science

Source: Noble, 2008; Spaling et al. 2000; BBVS, 1996; NRBS, 1996; CARC 1992

2.4 Toward a more integrated approach to CEA in Canada's watersheds

The assessment of cumulative watershed effects is complicated due to the complexities in watershed processes that often obscure the relationship between cause

and effect. These watershed processes are responsible for i) cumulative effects expressed long after the triggering activity has occurred; ii) cumulative effects that occur far away from the original land-use disturbance; and iii) local conditions that often modify the form of an impact. Added to these complexities is that some cumulative effects may not be evident until they reach certain, often unknown thresholds (Reid, 1993). To better address these complex cause and effect relationships in a watershed a more integrated approach is required - that uses the information from the different scales of assessment, the project and the region.

Project-based CEA can help provide the specific stressor information in relation to the project spatial scale, whereas regional based CEA may be useful to measure the overall condition of a VEC due to the variety of stressors acting on it (Dubé, 2003). CEA conducted at the project scale alone may often miss important interrelationships that can only be revealed at broader scales; at the same time, a regional CEA perspective alone may miss important stressor information that can be seen only at finer scale and is important to managing individual project effects (Magee and Carroll, 2006). In other words, CEA plays a different role at each level of assessment, with each level addressing different types of cumulative effects questions and thus generating different types of assessment outputs (Harriman and Noble, 2008).

An example provided by Reid et al. (1994) emphasizes this concept. They explain that a regional approach to CEA is capable of determining the sites susceptible to land sliding in a larger area of assessment, and this information aids project-based CEAs in evaluating stability conditions at the project site. Further, regional CEA requires project-based stressor information in order to better describe and assess cumulative effects in a

region. For example, in order to understand the cumulative effects of sediment loading acting on a stream channel and to restore that stream channel, it is important to characterize the individual stressors originating from single projects that contribute to the overall effect of sediment loading (Reid, 1993). Therefore, effective assessment and management of cumulative effects is possible only with the integrated descriptions of the influences of environmental parameters and land use stressors (Magee and Carroll, 2006; Cooper and Sheate, 2004; Dubé and Munkittrick, 2001; Reid, 1998; Reid et al. 1994). It is clear then, that an integrated approach of project-based (i.e. stressor-based) and regional-based (i.e. effects-based) CEA is needed to assess cumulative effects in a watershed. Such an integrated process assists broader, regional scale CEAs to inform CEA and decision-making at the project scale, and project-based development can feedback monitoring data into larger-scale CEA and management frameworks.

While this relationship seems almost intuitive, in practice project-based EA remains largely divorced from regional based CEAs (Harriman and Noble 2008). Duinker and Grieg (2006), for example, in reviewing the state of CEA in Canada, concluded that the current types and qualities of CEA practices are doing more harm than good. Assessing cumulative effects at a watershed scale is challenging - not only scientifically, but also institutionally. Scaling up from the individual project to the region typically exposes institutional constraints to CEA that impede translation into action (see IAIA, 2008). Currently, in Canada, there is research unfolding with a focus on the science of how to do watershed (i.e. regional) CEA (e.g. the Canadian Water Network funded project at the University of Saskatchewan – Dubé et al. 2007), but the necessary institutional arrangements to support and sustain watershed based CEA remains unaddressed (e.g.

Duinker and Grieg, 2006; Mitchell, 2005).

2.4.1 Institutional arrangements

Institutional arrangements refer to the structure of the relationships between the institutions (e.g. government authorities, proponents of developmental projects, watershed agencies, organizations - public/private) involved in some type of common endeavor (e.g. assessment of cumulative effects) (Imperial 1999). As such, institutional arrangements are a prominent concern in the field of CEA and water resource management (e.g. Mitchell, 2005; Watson, 1996; Dixon and Montz, 1995). Based on experiences with floodplain restoration in the UK, for example, Adams et al. (2005) and Hughes et al. (2001) reporting that a major challenge in scaling-up from the project to the region lies not solely in understanding ecological interactions, but also in the additional institutional complexity that is involved in broader scale, watershed-based planning and management processes and structures.

Institutional arrangements greatly influence the prospects for a scientific and a planning approach to CEA, by facilitating appropriate co-operation between them (Spaling and Smit, 1993). In this regard, some of the key institutional variables that may be of concern to advancing CEA from the individual project to the broader, watershed scale may include (see Dixon and Montz, 1995; Mitchell, 1989; Mitchell, 1975): enabling legislation and regulation for CEA; policies and guidelines concerning how cumulative environmental effects should be considered in EA; administrative structures for promoting co-operation between federal – provincial powers, and for determining appropriate policies and responsibilities for land and water resources and for CEA and

management; financial arrangements and the resources required to support CEA at the watershed scale; customs and values in conducting EA, and the strong body of public opinion in favor of effective government action to protect the environment; and key stakeholders who define the roles and stakes involved in supporting the implementation of activities and programs for watershed CEA.

The design of institutional arrangements is crucial in minimizing the problems that are anticipated in implementing any comprehensive (e.g. integrated, regional) project (Mitchell, 2005). It is therefore essential to understand institutional design and performances, as this assists in delivering appropriate guidelines and recommendations and significantly contributes toward sustainable resource and ecosystem management (Imperial, 1999). However, the importance of institutional arrangements has often received limited attention in many resource management based predictive models (Watson, 1996); understanding institutional arrangements is necessary to support an effective watershed-based CEA framework.

2.5 Summary

The need to better assess and manage cumulative environmental effects on Canada's watersheds is well argued (e.g. Dubé et al. 2006; Schindler and Donahue 2006; Dubé and Munkittrick, 2001; Culp et al. 2000); however, there are constant and consistent messages from the impact assessment community that CEA in its current form is simply not working (Harriman and Noble, 2008; Duinker and Greig 2006; Dubé 2003). The cumulative environmental effects of multiple stressors on Canada's watersheds have seldom, if ever, been considered by land use planners and policy makers (see Dubé et al.

2006; Schindler, 2001). To date, the cumulative effects of development activities are typically considered within the context of project-based EA with little regard for the effects that may result in combination with other past, present, and reasonably foreseeable planning and development actions (Schindler and Donahue, 2006). As a result, the scope of CEA is narrow and not well equipped to deal with cumulative effects at a broader watershed scale.

There is now a collective understanding in both the scientific and management literature that CEA must go beyond the evaluation of project specific impacts to encompass broader regional understandings and considerations of the sources of cumulative effects (e.g. Harriman and Noble 2008; Dubé et al. 2007; Duinker and Greig 2006). In doing so, regional CEA must, however, also incorporate cumulative effect information from project-based EA and provide a better context to conduct future assessments of projects. The implementation of an integrated approach (combined project-based and regional-based CEA) requires a strong understanding of both scientific and institutional aspects. The challenge is that the science of how to do watershed-based CEA is progressing, but there remains limited understanding of the institutional requirements to sustain it. Institutional aspects are prominent concern in the field of water resource management, and improper institutional structures often pose the most significant barriers to environmental management and cumulative effects management (IAIA 2008; Imperial, 1999; Watson, 1996; Dixon and Montz, 1995). Thus, the overall goal of this research is to advance current understanding of the institutional requirements to support a watershed-based approach to CEA.

CHAPTER 3

RESEARCH METHODS

3.1 Introduction

The purpose of this research is to identify the institutional requirements that are necessary to support watershed scale CEA practice. To realize this purpose, this research was intended to first understand the nature and status of CEA practice under EA frameworks and then to identify necessary institutional requirements for W-CEA with a focus on the South Saskatchewan Watershed (SSW). In this context, the research adopts a qualitative research approach. This chapter begins with a description of the study area, followed by a discussion of the research methods used to collect and analyze the data.

3.2 Study area

The South Saskatchewan Watershed (SSW)[1] extends across southern parts of Saskatchewan and Alberta (Figure 3.1), and is selected as the focus of this research for two primary reasons: i) the SSW is identified as one of Canada's western watersheds that is under increasing threats from the cumulative effects of human development (see Schindler and Donahue, 2006; Environment Canada, 2004; Bedford, 1999); and ii) EA in the SSW falls under the jurisdiction of three different administrative authorities (two provinces and the federal government), each of which have different requirements for the assessment and management of cumulative effects.

[1] It is generally referred as the South Saskatchewan River Basin (SSRB).

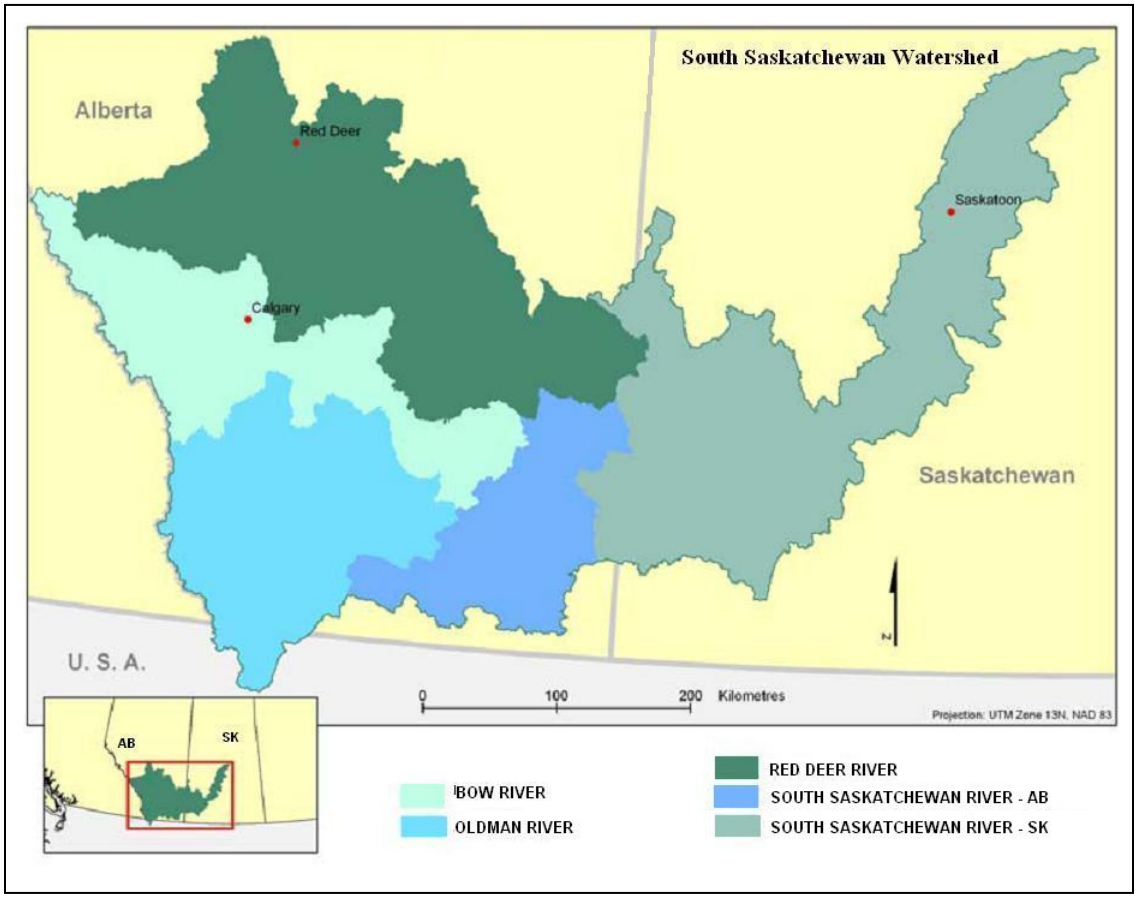

Figure 3.1 Map showing South Saskatchewan Watershed and its sub-watersheds
Source: Elise Pietroniro, GIS library Services, University of Saskatchewan

The South Saskatchewan Watershed (SSW) is a portion of the Saskatchewan-Nelson River watershed, with an area of about 150,000 square kilometers. The SSW is comprised of four sub-river basins or sub-watersheds, namely the Red Deer, Bow, and Oldman River and the South Saskatchewan - all originating from the Rocky Mountains in Alberta. The watershed consists of four eco-regions, namely mixed grassland, moist mixed grassland, aspen parkland and the boreal transition (Martz et al. 2007). The total human population in the watershed is about 2.2 million, of which approximately 80% live in cities and the remaining 20% in rural communities (Bruneau et al. 2009; Rothwell, 2007).

The primary land-use practice in the SSW is agriculture, with 90% of the land allocated to farming activities. Other land uses and sources of anthropogenic-induced stress include mining, oil and gas, urban development, and recreation (Table 3.1).

Table 3.1 Anthropogenic activities in the SSW

Anthropogenic activity	**Potential stressors or impacts**
Agriculture	Nutrient loading in surface water; increased water withdrawals and water runoff
Mining	Reduction in water supplies (e.g river, lake, aquifer); surface and ground water contaminations
Oil and Gas Industry	Water contamination due to organic contaminants (e.g. Polycyclic Aromatic Hydrocarbons – PAHs); water withdrawals
Urban development	Noise and air pollution due to increased transportation networks (e.g roads) and commercial and residential activities (e.g construction of buildings); increase in waste generation (e.g. waste water runoff); increased demand on resources and utilities (e.g forests, electricity)
Recreational developments	Habitat loss and fragmentation due to increased roads, highways, bridges, resorts etc around the forests areas.

Source: Martz et al. 2007; SWA 2006; Gibeau et al. 2002

3.2.1 Cumulative effects assessment in the South Saskatchewan Watershed

Cumulative effects in the SSW are assessed largely on a project-by-project basis. Generally, in a project-based CEA, certain individual developmental projects (as required by their respective EA legislation) are assessed to determine their potential cumulative effects, or stressors, in combination with other surrounding activities or projects (Hegmann et al. 1999). For example, a hydro-electric project may require the construction of a dam, access roads and, may results in increased number of vehicles, etc.

Then the assessment of cumulative effects of hydro electric project considers the effects of the project in combination with its associated activities (Sonntag et al. 1987).

In the SSW, project-based assessments fall under the regulatory requirements of either the province of Saskatchewan or Alberta, and often are subject to review also by the federal government.

At the federal level, as discussed in Chapter 2, the *Canadian Environment Assessment Act* (CEAA) provides the legislative basis for assessing the cumulative effects of certain developmental projects under section 16(1) (a) (see Table 3.2). The Act applies for projects in the SSW when a federal authority i) proposes as a project proponent; ii) grants financial assistance to the proponent; iii) grants land to enable a project to be carried out; or iv) exercises a regulatory duty in relation to the project (e.g. issuing permit, license). In the context of the Act, a federal authority refers to any federal body (department or agency) that may have expertise or a mandate relevant to a proposed project. The federal authority with such expertise or mandate becomes responsible authority to review for cumulative effects and to make decisions on the proposed project (CEAA, 2007).

In Alberta, the assessment of cumulative effects is required under the *Alberta Environmental Protection and Enhancement Act* (AEPEA), section 49 (d) (Table 3.2). The responsibility for reviewing EA is assigned to Alberta Environment (AENV), with an approval from the Alberta Energy Utility Board (EUB) and the Natural Resource Conservation Board (NRCB). The Alberta Environment Minister holds responsibility to ensure that all activities listed under the AEPEA are assessed and their potential cumulative effects identified (Griffiths et al. 1998). Proposed projects for certain energy

and natural resources are required to undergo a CEA as part of their EA, and the EA report needs to be submitted to all three authorities (AENV, EUB and NRCB), after which the EUB and NRCB review the EA report and provide recommendations to the Director of AENV. The assessment of cumulative effects under Alberta legislation is integrated with the approval processes of the EUB and the NRCB.

In Saskatchewan, the provincial legislation for EA – *The Saskatchewan Environmental Assessment Act* (SEAA) does not have a formal requirement for assessing potential cumulative effects. However, the guidelines drafted under SEAA, section 5, suggest that the Environment Impact Statement (EIS) should consider long-term cumulative impacts (Table 3.2). The Saskatchewan Ministry of the Environment is responsible for reviewing the EAs of developmental projects, and SEAA does require proponents to consider additional or marginal effects of their projects using current environmental conditions as the baseline. Interestingly, the impacts from proposed projects are not required to be included in any assessment of cumulative effects (Griffiths et al. 1998).

Under all three jurisdictions, the assessment of cumulative effects in the SSW is typically project-based; however, more regional approaches to CEA are currently underway. For example, the Canadian Water Network sponsored regional CEA program - "The Healthy River Ecosystem Assessment Systems (THREATS)" is aimed at developing a CEA and management framework to address multiple stressors accumulating in the SSW (Dubé et al. 2007). In addition, the Alberta government is developing a regional land use framework that adopts management of cumulative effects in major watersheds of Alberta including a portion of SSW (Alberta Environment, 2008).

Table 3.2 Summary of the legislative and administrative arrangements pertaining to cumulative effects in three jurisdictions

Authority	**Legislative instrument**	**CEA Provisions**	**Responsible agency**
Federal	*Canadian Environmental Assessment Act* Section 16(1)(a)	Every screening or comprehensive study shall include a consideration of any **cumulative environmental effects** that are likely to result from the project in combination with other projects or activities that have been or will be carried out.	Canadian Environment Assessment Agency
Alberta	*Environmental Protection and Enhancement Act* Section 49(d)	An environmental impact assessment report shall include a description of potential positive and negative environmental, social, economic and cultural impacts of the proposed activity, including **cumulative**, regional, temporal and spatial considerations.	Alberta Environment, Alberta Energy and Utility Board and Natural Resource Conservation Board
Saskatchewan	*Environmental Assessment Act*	None	Saskatchewan Environment
	Draft Guidelines for EIA report *Section 5.0*	In an environmental impact statement, long-term and **cumulative effects** should be considered.	

Source: CEAA, 1992; Alberta Environment, 1993; Saskatchewan Environment 1979-80; Griffiths et al. 1998.

Parallel to these studies is a Social Sciences and Humanities Council of Canada sponsored research project, of which the current thesis research is a part, to advance these science and planning frameworks toward a more integrated, watershed-based approach to CEA. Overall, however, current tools and approaches to assess and manage cumulative

effects in the SSW remain inadequate; hence the need for an ongoing CEA process that assesses monitors and manages cumulative effects at the watershed scale.

3.3 Data collection

Two research methods, namely document reviews and semi-structured interviews, were used to carryout this research (Figure 3.2).

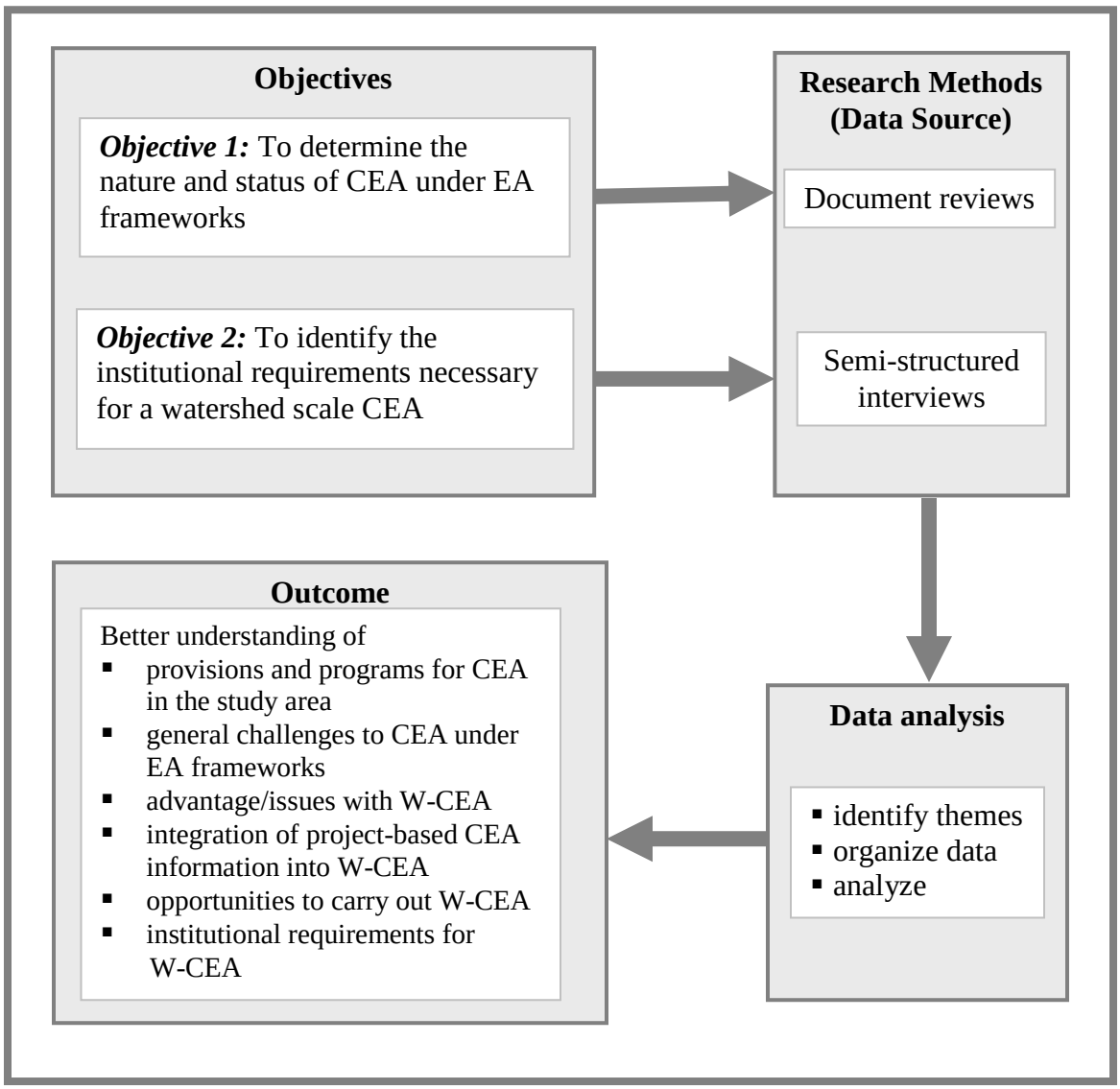

Figure 3.2 Schematic representation of research methodology

3.3.1 Document reviews

Document review broadly refers to the various procedures involved in analyzing and interpreting data generated from the examination of documents and records relevant to a particular topic (Schwandt, 2007). Further, document review assists in assessing the current perspectives in the literature relevant to the topic of interest (Marshall and Rossman, 1999). This approach provides a framework for establishing the importance of the research as well as a benchmark for comparing the research results with other findings. The systematic way of document review includes locating, reviewing, evaluating and summarizing the literature related to the topic of interest (Creswell, 2003).

In this research, document reviews were conducted primarily to identify, review and synthesize existing EA provisions, practice and frameworks within which CEA operates in the SSW. Document reviews also supplemented the information on challenges associated with the CEA under current EA frameworks. Different types of documents that were reviewed to understand the status and nature of CEA under EA frameworks include books and journal articles (EA and CEA related); acts and regulations (e.g. *Canadian Environment Assessment Act, Alberta Environmental Protection and Enhancement Act, The Saskatchewan Environment Assessment Act*); and watershed plans and reports (e.g. SSW technical report). Information gathered from these documents were verified and explored, where relevant, during the interview process.

3.3.2 Semi-structured interviews

The semi-structured interview is a verbal interchange where an interviewer attempts to elicit information from participants by asking a set of predetermined questions that are

self-conscious, orderly and partially structured (Longhurst, 2003). This method allows researchers to collect a diverse range of information from participants and allows participants to express the issues that they feel are important. Interviews provide an opportunity to explore where differences of opinion may exist, and where there is general consensus on the issues (see Dunn, 2000). This approach facilitates a more natural conversation and accommodates for change in the presentation of questions to ensure specific themes could be fully explored and developed (Flowerdew and Martin, 2005; Dunn, 2000). Further, semi-structured interviews allow for structure in the organization and categorization of information based on a predetermined framework of evaluation

As discussed in chapter one, understanding institutional requirements is vital for the assessment and management of cumulative effects as it provides impetus for the implementation of a W-CEA process. In this context, semi-structured interviews were carried out primarily to collect varied perspectives on the institutional requirements necessary to conduct watershed scale CEA. In addition, the exploratory nature of semi-structured interviews (e.g. face-to-face interview and telephone interview) was used to verify information from document reviews and fill any gaps in understanding of the current status of CEA under EA frameworks that the document reviews were unable to bridge effectively.

3.3.2.1 Selection of Participants

Typically an EA or CEA exercise involves the regulator, the proponent, and the various communities (e.g. experts, general public). In the context of this research, four groups of participants were identified for semi-structured interviews with intent to collect

diverse perspectives on institutional requirements for W-CEA in the SSW. These four groups include government representatives (e.g. regulators), watershed agencies, EA practitioners, and the scientific community. The regulators are the federal and provincial governments (Alberta and Saskatchewan) officials who are involved in reviewing EA and CEAs submitted by proponents (i.e. project owner or developer in the watershed); the watershed agencies refer to the organizations in the SSW which are mainly involved in watershed management activities (e.g. monitoring programs, baselines preparation); practitioners are EA experts/consultants hired by proponents to conduct CEA or EA of their projects; and the scientific community refers to academics, scientists, and environmental organizations (ENGOs) involved in CEA related research activities. Participants from above groups are directly or indirectly involved in CEA and watershed management activities, and hence provide diverse perspectives on the research questions.

A total of 30 interviews were conducted between June and October 2009. Nearly 58 participants were contacted for this research and 10 of them did not reply and 18 of them could not participate for various reasons. Since the SSW was focus of the research, which geographically spreads across Alberta and Saskatchewan, participants were selected from both jurisdictions of the watershed (see Table 3.3). Interviews conducted were either face-to-face interaction (in-person) (n = 19) or telephone-based interviews (n = 11). Telephone-based interviews were used when in-person interviews could not be scheduled or where participants were reluctant to participate in a face-to-face interview. Telephone interviews can be as effective as face-to-face interviews (Sturges and Hanrahan 2004).

Table 3.3 Total number of participants interviewed in each group and their jurisdictions

Participant Groups	**Jurisdiction**			**Interviews**
	SK	**AB**	**Federal**	
Government representatives (Regulators)	5	4	3	12
Watershed organizations	4	3		7
Practitioners	2	3		5
Scientific Community	4	2		6
Total	**15**	**12**	**3**	**30**

An initial list of participants was compiled based on the information available in the grey literature (e.g. impact statements, watershed reports) and their contact information was obtained from the respective websites. The participants were then contacted either through e-mail or telephone to request their participation in the research. Additional participants were identified using a *'snowballing'* technique in which the initial participants were asked to suggest other potential participants whom they considered could provide information on the research questions (see Flowerdew and Martin 2005). An invitation letter describing the summary and significance of the research was sent to all participants prior to interviews. After obtaining their consent to participate, a convenient time was scheduled for the interview. Interviews ranged from 35 to 60 minutes in duration. All in-person interviews took place at the participants' respective offices and three interviews were conducted at the School of Environment and Sustainability, University of Saskatchewan, Saskatoon, SK. Upon obtaining the consent of the participant, interviews were audio taped so as to facilitate analysis.

3.3.2.2 Interview schedule

The interview schedule focused primarily on the following four topics:

i. nature and current state of CEA under project EA

ii. the concept of W-CEA

iii. institutional requirements for W-CEA (key ingredients)

iv. foreseeable challenges to W-CEA

Participants were asked several sub-questions to explore their views on, and experience with each of the above (Table 3.4). Interview questions differed slightly based on each participant's expertise with respect to CEA and EA. The detailed information sent to participants are given in appendix A

Table 3.4: Interview schedule

Topics	**Sub-topics**
Nature and current state of CEA under project EA	a) Nature of cumulative effects b) Sources of cumulative effects c) How cumulative effects are being assessed in the watershed d) Challenges with current project-based approaches to CEA e) Whether CEA is worth doing as part of project EA
Concept of W-CEA	a) Advantages of W-CEA b) Interaction between project-based and W-CEA approaches c) Current W-CEA initiatives in the SSW
Institutional requirements for W-CEA (key ingredients)	a) Lead agency or responsible authority for W-CEA b) Roles and responsibilities of different groups and individuals c) Legislation d) Capacity or resources requirements f) Data requirements, transparency and sharing issues
Challenges for W-CEA	a) Foreseeable challenges to W-CEA

3.4 Data Analysis

Taped interviews were transcribed and subjected to qualitative analysis. Qualitative data analysis offers great value, especially when little research has been done on a particular topic (Creswell, 2003). Therefore, in the current research, qualitative analysis provided significant benefits since the institutional requirements for W-CEA are not well explored. Interview data was coded based on the range of themes that emerged from the participants' responses and document reviews. Coding was done to organize and evaluate the data in an effort to understand categories and patterns in the interview text (see Cope, 2003).

Interview data were analyzed using the ATLAS - ti © software program. This software program facilitates easy handling of large amounts of text, as well as the management of annotations, concepts, and complex structures including conceptual relationships that emerge in the process of interpretation (Muhr, 1991). Apart from organizing text, it allows for easy location of quotations and multiple perspectives on a category or a theme (Creswell, 2003). The overall focus of data analysis was to identify common themes amongst participants' responses to understand the status of current practice of CEA in the SSW, and also to identify the areas of consensus and dissent on the institutional requirements necessary to advance CEA from the project to the watershed scale.

CHAPTER 4

RESULTS

4.1 Introduction

The findings of the semi-structured interviews and document review are presented in this chapter. The results are presented thematically. First, participants' perspectives on cumulative effects, the current state of CEA practice, and general challenges to project-based approaches to CEA are presented. The concept of W-CEA is then examined, with a discussion on the need for linking project-based CEA and W-CEA. This is followed by the institutional requirements for W-CEA. The Chapter concludes with foreseeable challenges to implementing W-CEA, as identified by research participants.

4.2 Understandings of cumulative effects in the South Saskatchewan Watershed

Cumulative effects are defined in various ways in the literature (e.g. Spaling and Smit, 1993; Cocklin et al. 1992), and may be characterized based on the source of change or from the perspective of impacted system (Sonntag et al. 1987). Not surprisingly, then, interview participants variably defined cumulative effects, providing diverse interpretations. Some participants suggested that cumulative effects are simply the accumulation of stressors on the landscape. For example, one academic participant defined cumulative effects as "… the accumulation of whole variety of stressors and they might be additive but they also might behave non-linearly too if there is synergistic effects." Few other participants noted that cumulative effects are the sum of effects on any ecosystem component or indicator that is chosen for assessment. As one interviewee

explained, a cumulative effect is “the net result of a series of independent events on an indicator of interest.”

Some participants emphasized that cumulative effects can also be defined in terms of individual projects that contribute to cumulative change; although a cumulative effect itself constitutes a net effect on the landscape. For example, one practitioner mentioned that:

> “From the practitioner level working with the cumulative effects right now today means really looking at the project scale and working with clients to minimize or reduce the use of the resources as much as they can and take into account the other existing sources with in the existing regulatory framework.”

In others’ view, a cumulative effect is an arbitrary issue because the environmental ethos that guides acceptable levels of human activities is based on human perceptions of the problem. Within this context, the guideline that defines acceptable and unacceptable activities is always shifting. An EA administrator provided the following analogy:

> “It is whether or not you as a general population agree that the change is not something you can live with and that to me is when you do cumulative stage. You could live with the river drying up because you have got other sources of water that are sufficient, then you can agree that is not cumulative and you are just making a change on landscape. So cumulative effects to me is arbitrary, it is completely arbitrary, it is human artifact and we have decided that for our short period of time on this planet, that from our perspective it is too much of a change but the next generation wouldn’t know what was it like before and the next generation may decides for other reasons the change will have to take place and then it is not a cumulative effect.”

A representative from provincial government similarly described that:

> “When you are looking for cumulative effects, it will be very important to determine what the measurements are going to be to define how you will know whether you’ve seen change in the first place because every one has a different idea of what change constitutes and if you are going to try and portray cumulative effects across a watershed you will need to have defined what your measurement tools going to be.”

It is evident from the interviews that understandings of cumulative effects vary considerably from one participant to the next, and from the science to the regulatory language used in the watershed context. Participants referred to cumulative effects as either a project's incremental effects or the total effects from a variety of stressors on an environmental component. Also, cumulative effects were identified as something that may be defined and assessed based on the specific issue being addressed. For example, if water quality and quantity are issues of concern in a region, then a watershed level understanding of cumulative effects may be more appropriate to effectively assess and manage cumulative effects. In contrast, from a proponent's perspective, it was noted that the focus may be on the specific contribution of the individual project to that larger-scale, cumulative change.

Regardless of the different understandings and interpretations of cumulative effects, there was general consensus amongst participants that agricultural practices, urban (i.e. population pressures), and industrial developments are the main drivers or sources of cumulative effects in the SSW, and decreased water quality and quantity are the cumulative effects of concern. Several participants noted that water withdrawals from the South Saskatchewan River are becoming increasingly noticeable, resulting in further cumulative effects to water quality. Many of the identified sources of stress contributing to cumulative effects in the SSW are largely non-point sources. These non-point sources do not fall under any regulatory requirements for assessment, including EA, and thus do not get captured in formal impact management strategies and monitoring programs.

These non-point sources, particularly agricultural runoff, were identified by participants as potentially affecting several water bodies that are linked in the watershed.

4.3 Current state of CEA practice in the South Saskatchewan Watershed

Three administrative authorities (Federal, Alberta and Saskatchewan) are involved in the assessment of cumulative effects of certain developmental projects in the SSW. The assessment of cumulative effects is conducted largely under legislated EA-based frameworks (i.e. project–specific assessment) (see Chapter 3), and is required for project assessments under both Federal and Alberta legislation, but not in Saskatchewan. Previous research by Baxter et al. (2001) suggests that despite the requirements, the assessment of cumulative effects is rarely done. An EA administrator describing the current state of the practice in the SSW explained that:

> "Cumulative effects are always part of EIA. To the most part it is very few that I have seen and certainly we haven't done a lot in the south office because we don't get a lot large projects down here. Ones that we have had have been primarily related to water storage, reservoirs, dams and that kind of things..."

Another interviewee, a CEA practitioner from Alberta, was much more critical, and expressed clearly that:

> "We are not conducting CEA as part of project EIA, the policy says that we are supposed to, but the reality is we don't. Right now we basically don't do CEA, what we have is, what I call EIAs. We have consultancies and folks in the research community who look at individual projects, generally in small amounts of area, in small amount of time and that is what we have done and that is not helping us and it doesn't help society understand the full speed of benefits or liabilities that are caused by land use practices." So it just not CEAs, it is working on one project, even though there is a policy requirement to do that, it is not done."

4.3.1 Challenges to project-based EA approach to CEA

Under current project-based EA, the focus of assessment is to identify the potential environmental effects associated with a specific agent of change (e.g. a mining activity). The typical requirement of CEA in this context is to identify how outputs from the proposed activity may impact different environmental components and how they might interact with other impacts of human activities in the project's environment to bring about potential cumulative environmental change (Cocklin et al. 1992). The literature indicates that CEA is particularly challenging when applied under EA frameworks. Duinker and Grieg (2006), for example, argued that both conceptually and operationally, CEA is not well suited for inclusion in project level EA. Further, many authors have discussed the constraints to conducting CEA under EA frameworks (e.g. Therivel and Ross, 2007, Cooper and Sheate, 2004; Baxter et al. 2001, Piper, 2001, MacDonald, 2000, Kennett, 1999, Cocklin et.al, 1992).

These challenges were similarly identified by study participants, and can be grouped into four main categories, namely scale issues; data; thresholds; and lack of capacity to assess cumulative effects at the individual project scale. The views expressed by the participants concerning these challenges were primarily based on their experiences either in reviewing CEA reports or having participated in the assessment process of cumulative effects, and were identified as not necessarily unique to the SSW experience.

4.3.1.1 Scale issues

Among the challenges to assessing cumulative effects under project-based EA is the issue of scale, which includes both spatial and temporal aspects. It is suggested in the

literature that CEA requires VEC-centered assessment (see Therivel and Ross, 2007; Duinker and Grieg 2006), but project-based approaches typically focus on only the project's incremental stress to the VEC. As a result, project-based EA may not effectively consider the implications of other actions or effects that could potentially affect the VEC of concern. Hence, a project-based approach to CEA was identified by participants as not providing sufficient opportunity to determine all other actions potentially affecting VECs in a watershed. As one EA administrator explained "…we ask them [proponents] to justify the site selection, describe the existing environment, describe the effects of the project on the environment, and describe cumulative effects." The participant goes on to explain that these effects are "…not really cumulative effects at all, but it's just the incremental, additive effect of this particular development on top of whatever else is out there already or known to be proposed within the immediate vicinity, and what measures have been taken for mitigation". Similarly, a practitioner pointed out that the restrictive spatial scale selected for project-based EA affects the quality of CEA. The participant explained that:

> "In project scale, you are only looking at one event in the isolation of basically everything else. So it doesn't give you the opportunity to look at the total change or the effective change in your indicator as driven by all land uses and all natural disturbance regimes. And in EIA an individual project assessment only looks at that individual project, generally in a small area and generally in a small chunk of time. It typically looks at not only one land use but only one project in a land use."

Some participants noted that the current project-based EA approach, although it helps to deal with the incremental effects of point sources accounting specific contaminant or effluent inputs associated with one activity, it overlooks many other non-

point sources, which usually fall outside the scope of EA. For example, a practitioner described the current state of CEA practice in this regard as follows:

> "I think that the current approach…[is] by and large ignoring the non point sources, and those take place over the long time frames and larger spatial extent. And I think what we are seeing now is a transition to the point sources being dealt with and non point sources are becoming the problem for some of the major drivers and for some indicators. By and large under the current requirements just those things are getting ignored."

The other part of the scale issue is the temporal aspect of assessment. The current legislative instrument for assessing cumulative effects under project-based EA suggests the proponent consider the effects of other past, present and reasonably foreseeable activities in a project area. However, EA legislation offers limited guidance to proponents as to what past activities and what future activities need to be included in CEA – the effects from which proponents may know little about or have no control over. For example, an EA administrator expressed that:

> "…the big problem is that even though they [project proponents] are supposed to be taking into account cumulative effects, they can only take into account of cumulative effects of what is existing at that point of time and what is known to be considered for the future; and for the future piece there is too many unknowns, so they are not able to provide any context into where their project will fit as far as all of the other future things going on that a lot of that which are not regulated.

Similarly, another representative from government described his concern about the temporal constraints to project-based CEA as follows:

> "I would suggest that the forecasting future or planned developments and what impact those developments will have over time, so the temporal side of the CEA I think is quite lacking and that is complicated by a narrow scope or narrow focus of project-based EIA".

The identification of appropriate scales is crucial CEA to determine the significance of project-induced cumulative effects. However, unclear or restrictive spatial and temporal scales selected for CEA under the project-based approach often result in the cumulative contributions of project stressors being considered insignificant.

4.3.1.2 Data limitations

A second area of concern in assessing cumulative effects under current EA frameworks is the lack of required or appropriate data. Assessing cumulative effects involves information gathering from a much greater variety of sources than for assessing individual project effects, especially information about other existing and planned activities (Ross, 1998). For example, an assessment of cumulative effects of a proposed mining operation in a forest area may require information about existing forestry activities, coal mines, oil and gas activity and other planned projects. However, information about those other projects (past and/or proposed), is seldom available, and when available seldom shared. Obtaining the necessary data/information for CEA is challenging for the individual proponent. For example, one government representative expressed that:

> "Some of the current challenges from my perspective or from a policy's perspectives that I would see are the availability of regionally relevant geo- spatial information including such things as land use plans, regulatory controls, existing or proposed developments; environmental monitoring data. I don't think we have very many systems in place which consolidates this information for the use of environmental assessment practitioners."

Thus, the quality of CEA depends on the availability of relevant data regarding existing and/or proposed projects. As Ross (1998) notes "in reality, availability of good

information might determine, not only a proponent's ability to do a CEA, but also the methods a proponent might end up using to predict impacts". One practitioner expressed his views about the need for information or data as follows:

> "How do you make a valid cumulative effect assessment when you are not sure of your data? When you are not sure of who is doing what now or even into the future? Especially going into the future, that is the scary one. And so EA is done, the thing is put on the shelf and the next guy comes in and he has to do CEA of his project, without knowing what other guy did, is anybody is saying by the way oh use this study to do help you assess cumulative effects."

In order to facilitate accessibility to good quality data, some participants suggested the need to link project and watershed -scale assessments. One practitioner expressed such a view as follows:

> "If a project assessment is done, the proponent is happy; he gets his permission and goes away. But who is adding that into the database and who is coordinating with the regional level or at the watershed level and providing that information for future people who comes through? These got to be linked some how."

However, as a result of the lack of necessary information about other projects, inconsistencies prevail in CEA. An EA administrator, for example, expressed that:

> "Quite often the data that is used is not always transferable, even if you do have number of projects and this has been the case, for example, up in the oil sands area where there are multiple projects, that have to go through an EIA, but they are collecting and using their own data and it is all analyzed differently or has different spatial component or accuracy. So then it becomes very difficult to compare across the different projects, because of the lack of standardization in how data is collected and how data is analyzed."

4.3.1.3 Unclear thresholds

A third area of concern in current project-based EA is the difficulty in defining appropriate thresholds. Thresholds are defined as scientific or social standards that

identify the point at which an indicator changes to an unacceptable level (Environment Canada, 2006). Theoretically, if a project's effects exceed threshold, then the effect is considered significant (Hegmann et al. 1999). However, in practice, it is difficult to define appropriate thresholds for an individual projects' cumulative effects (Duinker and Grieg, 2006), and the project-based approach raises two important questions with regard to thresholds: i) whether a small incremental effect can be considered significant if it crosses a threshold, and ii) whether cumulative effects could be considered insignificant if cumulative effects of two or more activities are below thresholds (see Creasey and Ross, 2005). For example, as one practitioner described:

> "On a marginal basis most things look like a very small change and then at least to the question does this small measure of change put you over the top? is that small marginal change is on top of everything is unacceptable? and I think nobody really knows the answer to that question and the reason nobody knows answer because it is a difficult question to answer."

The interviewee goes further:

> "How much is too much? That one extra drop is put us over some kind of thresholds and you are not allowed. For example, the average total dissolved solids (TDS) is 0.01 over the threshold, so you can't do it and then that would force a reply that says why is that too much? What is your basis for that and in reality there is little or no basis to those kinds of thresholds because it is too difficult to pin down."

Another practitioner similarly indicated that there are no appropriate thresholds. The participant noted that "… if people are just looking at their incremental contributions-which is the current state, yes we are making a contribution but it almost always insignificant in CEA language because there is no standard to relate to."

In addition to the lack of appropriate thresholds, another interviewee emphasized that there is a lack of agreement on the existing thresholds, noting that "most CEAs lack context, you need a measure against something and have common agreement that this is the appropriate contexts." Overall, a lack of clarity in defining thresholds for project-based EA and lack of agreement about the existing thresholds pose challenge to the assessment of cumulative effects under project-based EA approach.

4.3.1.4 Lack of Capacity

A lack of clarity in establishing boundaries of assessment, combined with the lack of necessary information and unclear thresholds for assessing cumulative effects, make it difficult for an individual proponent to conduct CEA under project-based EA frameworks. Collectively, these three issues limit the capacity of a proponent to carry out 'good' CEA. Many participants argued that the onus of conducting CEA cannot be placed on individual project proponents, noting that proponents lack the capacity and authority to apply the tools necessary for conducting good assessments of cumulative effects. For example, one academic explained that:

> "It is not fair to expect proponents to look at everything around them in the past and in the future to look at the cumulative effects. They don't have the capacities to do it. It is too expensive, it is not their responsibility."

In addition, regulators are also constrained by the lack of information and by insufficient timelines to provide good guidance or 'terms of reference' for individual projects to consider cumulative effects. For example, a federal administrator described the problem as follows:

> "Both proponents and those reviewing EIS (regulators) within the government agencies are working against time lines, there is limited ability or capacity to go out and try and piece together the full range of information that would need to be brought on proper or adequate CEAs. Where would you go to find what you needed to know about land use planning in the given area and the application of regulatory controls and that is not something I think readily available for EA practitioners."

Similarly, another federal administrator emphasized the problem noting that "cumulative effect by its nature is usually broad and commonly beyond the boundaries of what a regulator might want to look at or may have the authority / jurisdiction with in the legislative authority to act on. As a result, the regulators are unable to really address the breadth of the problem." The lack of capacity of both proponents and regulators was identified as a major challenge to conducting good CEA under current project-based EA frameworks.

4.4 The concept of watershed scale CEA

In the second stage of the interview process, the concept of W-CEA was explored. The geographical extent of project-based EA does not provide enough information to represent relevant watershed processes and connect upstream causes to downstream effects (see Montgomery et al. 1995; Reid, 1993). In the project-based approach, if the on-site effects of a project are held to an acceptable level, then the project is acceptable (see Reid, 1993). However, this cannot necessarily mean that all individual projects that are below an acceptable level are insignificant; individual projects are collectively responsible for significant cumulative effects in a watershed. As one participant from an environmental organization explained, citing the example of the Athabasca river basin, "… if you look at the impact of each projects on the Athabasca in terms of people living

downstream, each project may be deemed to have an acceptable level of impact." However, the participant goes on to explain that, collectively, activities on the Athabasca River have resulted in significant adverse effects - they "… can't be linked back to any individual projects, but they can absolutely be linked to the cumulative impacts of what has happened."

Arguably, then, the assessment of cumulative effects requires broader spatial scales, such as watersheds, which play an important role in the characterization and assessment of cumulative effects. The majority of participants agreed, indicating that the watershed provides an ideal unit for understanding the cause and effect relationships of cumulative effects to freshwater systems, and can define an appropriate assessment context for individual projects. For example, a representative from an environmental organization stated as follows:

> "I think that the watershed scale CEA will give you the context in which your project is happening. It will give you the sort of baseline information that will tell you ok my project impact in the broader context of this entire watershed what does it actually mean; sort of gives that a meaning and gives that a context."

The potential advantages of a more watershed-based approach to CEA have been widely discussed in the literature (e.g. Duinker and Grieg 2006; Dubé 2003; Serveiss 2002; Imperial, 1999; Reid, 1998; Cocklin et al. 1992) Interviewees similarly noted the value of watershed level assessment in, among other things, identifying type and location of the stressors as well as the total effect of these stressors on ecosystem components. For example, an interviewee noted "it is easier to tackle the problem if you know where are the things coming from, what its impacts are going to be if everything coming together."

In addition to accommodating the full range of human impacts on VECs, a watershed-based approach to CEA may provide an opportunity to consider the various interactions and linkages that typically occurs in a spatially defined geographic unit (i.e. watershed processes), and accordingly characterize total impacts (see Reid 1998; Cocklin et al. 1992). The information generated through a W-CEA process can then guide ecosystem-oriented land use planning and development of landscape-specific management prescriptions (Montgomery, 1995). As one federal administrator explained:

> "CEAs at a broad scale is a tool to generate information to feed into other decision making processes. It should not be characterized as a planning tool. It is not, it is an information gathering tool and information of this nature is used by a multi disciplinary team usually to try and determine the carrying capacity…of any geographic region, its ability to host various activities agriculture, forestry, mining and all those different activities and what it seek to do is provide management decisions to those activities where best, to what extent, to what volume, so that it feed into that and CEA should feed information to the scientific community to help determine carrying capacity."

W-CEA was also identified by participants as potentially providing a methodology that identifies thresholds and directs prioritization of restoration opportunities. For example, one practitioner explained that "... if you are looking at the watershed scale you can see changes and you can see again more effective utilizations of resources by focusing on the things that really matter. It becomes easier to identify those things that really matter and management at that scale is ideal." In addition, as other participants noted, the watershed-based approach can be a useful way to mobilize interests and support from individuals, groups and multiple governments to focus on common problems and develop an overall strategy to plan for and guide development in a watershed. Consistent with Serveiss (2002), participants identified the strengths of the

watershed-based approach in its emphasis on a naturally defined geographic area, on partnerships and stakeholder involvement, and on basing decisions on sound science.

An additional issue that was raised by a few participants regarding W-CEA concept is that a single watershed may not necessarily form an ideal unit to study effects on certain environmental components, such as biodiversity, or air quality, and hence different levels of assessment may be required to better assess and manage cumulative effects. As an EA administrator explained, "the challenge is how are we defining watershed, watershed works for water, it doesn't necessarily work for biodiversity, wildlife for example…It doesn't necessarily work for air but for many components it certainly a start of giving you one spatial unit." Similar contention was expressed by another official from government, who said that "if we were going to measure, we are going to have to define what cumulative effects and what are the measurements are going to use to track that way and there will be so many measurements you could use...you have got to define what you are going to measure right at the beginning and do it in terms that will be of vested interest to your participants." Another interviewee from an environmental organization similarly emphasized the need for multiple scales of assessment to better address cumulative effects, noting:

> "…. even looking at a watershed basis may not be enough. A good example is acid rain like acid rain from oil sands is an atmospheric impact but this atmospheric impact is going to damage water and it will do so in more than one watershed. ….So just being able to regulate in one watershed won't necessarily fix your problem …. You can't just limit yourself to a single watershed you may have to look at multiple watersheds."

In summary, participants collectively supported the view that watershed-based approach to CEA is valuable; provides information on various stressors and effects

relationships and offers better contexts for project-based CEAs. Participants also emphasized the need for different scales of assessments and integration of information in each scale to assist the planning approach to effectively manage cumulative effects.

4.4.1 Interaction between watershed CEA and project-based assessments

All participants expressed that project-based EA can supply information to W-CEA, and assessing cumulative effects under project-based EA is useful if it is done within a broader context and with a link to analysis at a higher level. The scale, data and threshold challenges to the project-based approach can be addressed in a more watershed or regional context, which in turn can better define the scoping and assessment attributed to the individual project (Baxter et al. 2001). As an EA administrator explained, "the need for project assessment is still going to be there, but it will be in a different context and so if we are doing assessment at a regional scale, in doing those assessments we should be aligned in addressing some of the data needs and data standardizations…and the project would have to follow those kinds of protocols in assessing the impacts of their project." The majority of participants expressed that there needs to be better integration of information from project-based assessment to inform watershed-scale assessment and planning exercises in order to increase the efficiency and effectiveness of development decision making. For example, a federal administrator noted that "project specific information could be used to help determine effects at a larger scale that then could feed to planning exercises of various resource management communities. So it [project-based EA] is really an information feed into a broader exercise."

As discussed earlier, information generated in a W-CEA could assist in establishing thresholds for project development. Emphasizing this, one practitioner explained that "….the broader scale assessment helps to establish a set of targets or guidelines in order to identify the desired state of a region; it is a target or a threshold to manage to and then project specific assessments can consider their contributions relevant to that target or guideline. But it requires that to be pre established or pre defined." Another interviewee illustrated this concept with the following hypothetical example:

> "Let us say regional CEA is done for intensive agriculture in the South Saskatchewan River basin. If you did the regional CEAs, you could determine how much nutrients are possible to runoff into the watershed or into the rivers and still be acceptable to the stakeholders. And by doing that if your landscape could tolerate let us say14 feedlots and you only have 8 right now, and if you want to go up to your limit you would just accept six more or whatever would fall beneath your target. So that is how CEA and EIAs could work together.

In other words, the desired outcomes and acceptable targets set for a watershed or region under such a broader scale assessment has the potential to guide individual projects and whether and how individual projects can be developed. Supporting this perspective one practitioner stated that:

> "Broader scale assessment sets what a desired outcome is and build some objectives in terms of what is going to be acceptable or not, so that before a proponent spends a lot of money planning to do a project they can actually identify whether or not to even feasible for them to go or not".

On the other hand, cumulative effect information from project-based assessment could be used to help determine effects at a larger scale (e.g. monitoring). As an EA administrator described, "project EA would be very useful if we agreed what residual impacts from a project are relevant to manage, and use that information to contribute to a larger knowledge of the change in the environment in the broader perspective." The

participant went on to explain that if the evaluations for individual projects are done in the desired fashion, then it is possible to "know the contribution of the residual effects of each development into a larger framework to understand the overall changes". Similarly, one participant from a watershed agency recommended that there has to be "integrated monitoring," noting that "it is one thing to collect information or collect data on individual sites but there has to be some degree of integration" in order for it to be useful at either the watershed or project scale.

Several participants expressed that a systematic process or a framework is required to provide guidance to influence individual projects' design to meet broad scale objectives. This process would substantially improve the practice of CEA and implementation of decisions (Grifths et al. 1998). In addition, consistency in data collection and analysis across similar type of individual activities in a watershed can be achieved. For example, a scientist who specializes in cumulative effects processes emphasized the need for a framework to guide individual project-based CEAs, stating that: "what needs to happen is they [individual project proponents] need to be told how to do it and the way they do it fits into a larger regional CEA frameworks, so their information becomes part of the bigger picture but they are not responsible themselves for the bigger picture". Similarly a representative from watershed organization noted that:

> "I think if there is some guidance for how a proponent is going to say ok we are going to measure and we are going to have plan so we are managing cumulative effects. If they don't really have an over arching guidelines or some support for doing that, then each proponent may try different way of doing it and therefore you are not going to get that consistency and you still may end up with the same problem."

By recognizing stressors through project-based CEAs (e.g. industry, mine) and effects through broader watershed scale assessments (e.g. degraded water quality) (see Dubé, 2003), the overall cumulative effects in a region can be better assessed and managed. It implies that the integrated approach of both project and watershed-based CEA is required to better assess and manage the cumulative effects in a watershed. Further, the integrated assessment facilitates effective decision-making process about developments of different types in a watershed or a region. However, the effectiveness of integrated process depends on the capability of management authorities to integrate different scales of assessment in a feasible way. An EA administrator indicated that no process currently exists for this:

> "I think that they [proponents] need to provide some of the information on how do they set up the arrangements. I guess we don't know the answer right now; we are starting to think about that but certainly they [individual project owners] are partners in the work. So, are they obligated to pay upfront? or do we require them to data in certain way to feed into it? Do we give them a specific role? I don't know that there is an answer for that there yet. But absolutely there has to be a connection between the two."

Overall, participants noted an opportunity for increased efficiency and effectiveness for project-based EA when they are conducted within the broader strategic assessment and spatial planning context. At the same time, such broader scale assessments were noted to potentially benefit from project-based stressors information. A systematic process is required to focus on integrating different levels of assessment that allows efficiency and effectiveness to the overall assessment and management of cumulative effects in the watershed. However, there are concerns over the ability or capacity to integrate these two assessment models to advance such a system of W-CEA.

4.5 Institutional requirements for watershed scale cumulative effect assessment

Generally, institutional arrangements refer to the structures, processes and policy approaches for making public decisions (Watson, 1996). Some key institutional variables identified in the literature that influence the management of cumulative effects include administrative agency and its structure; legislative instruments; financial arrangements and key stakeholders (see Dixon and Montz, 1995; Mitchell, 1989). The findings from semi-structured interviews suggest these institutional arrangements are, at a minimum, necessary to effectively manage and assess cumulative effects.

4.5.1 Lead agency

Resource management requires involvement from different levels of government (i.e. federal, provincial and local), and from within each level of government (e.g. agriculture, forestry, fisheries etc); however, a single agency is often necessary to lead resource management processes, within a directive framework in order to drive decision-making (see Mitchell, 2005). A lead agency is necessary to report, communicate and coordinate the information that may be required for regional CEA (Parker and Cocklin, 1993; Reid 1993). For example, one academic participant recommended that government needs to create an agency responsible for W-CEA, and require other departments to feed information and make decisions in accordance with the responsible agency. The participant explained as follows:

> "Right now it [management] is in pillars, for example wildlife, environmental protection etc. People that permit the industries are different than the people that do EA, which is different than the people doing the long term environmental monitoring. We have to stop working in pillars and if you want to do CEA you cannot set up your institutions in pillars. You have to have the pillars but then you

> have to form this horizontal box called CEA branch and that branch stays no matter what. If all these pillars are apart because of political reasons or there is not enough money and the one that always remains is that CEA branch, Government has to set up an agency that sits on top of these pillars and are mandated to feed information into this [CEA] box in a way that the box requires it.

One practitioner interviewed similarly emphasized that either a government or a watershed agency could take the lead, noting that "it is some kind of a government agency or watershed agency I think would be the only avenue that would be effective over the long term."

Some participants expressed that an independent consortium outside the government could be established to lead W-CEA. However, they also noted that it would not be effective without the government's support. For example, one academic participant emphasized the need for government to operate at a broader scale, and also mentioned

> "..another possibility is sort of an independent consortium where you have stakeholders and so the trick is to get reasonable people who are not just advocates for their interests but are really interested moving beyond that to coming up with a larger framework or an umbrella that is going to work for multiple stakeholders and I think the problem when you have a multiple stakeholders is whenever decisions are made there is an opportunity for to debate and people to disagree."

One representative from environmental organization mentioned that regional governments should be given authority to implement actions required to manage cumulative effects, noting that, "it is better to make sure that if the regional people have the resources, either provide them with the data or give them the authority to enforce because they are more likely to do it because they live there, provincial enforcement doesn't work."

Consistent with Peterson et al. (1989), Kennett (1999) and Kennett (2002), more number of interviewees agreed that the assessment and management of cumulative

effects can only be achieved through a body with wide-ranging powers necessary to plan, encourage and regulate economic activity and hence, realistically, the government is an appropriate agency. Similarly, it was agreed by most participants that the government should lead the assessment and management of cumulative effects at the watershed/regional level. One practitioner emphasized that the government should take the lead, noting: "You can't do it without the government. They have to set the vision, strategy and the framework, basically the process and the expectations." Another interviewee similarly noted that a "provincial governing body should lead this and different stakeholders have to represent each of the major land uses forestry, energy, agriculture, transportation, residential and tourism."

Some participants also mentioned that the federal government also needs to work with provincial governments for the assessment and management of cumulative effects, particularly, in cases such as the SSW, which is a cross-jurisdictional watershed. As one academic participant explained, "it is governments' responsibility to do it, provincially and federally. They both have a shared mandate to deliver on CEAs." Similarly an EA administrator stated that the responsibility " … comes down to either provincial or federal; federal government role should be ensuring that accountability of what is occurring between borders or is just between two provincial governments."

Interview results reveal several reasons why the government should be the lead for W-CEA. The primary reason is that the government undertakes several monitoring programs, which make it possible for the integration and sharing of information and also helps in obtaining consistent information during a large-scale assessment. For example, an academic participant explained that the government should take the lead "... because

governments are largely charged with the monitoring programs" and it is "appropriate for governments to also operate at the level of the larger umbrella." The participant went on to note that "in order to do that, there has to be a framework or process in place that can be used by the whole diversity of individuals who would represents the government and the different groups that would need to come together." Similar to this view, another participant from a watershed organization emphasized the importance of government leadership in the monitoring of VECs and indicators noting that "…we need government involvement in the monitoring side of things because everybody can monitor data slightly differently and perhaps you are not getting that consistency set of data that you would like. So may be that is the role why only one organization [government] doing all monitoring."

Second, participants noted that private organizations, such as watershed groups, may not have the capacity to implement different regulations when stakeholders recommend it. For example, a participant from an environmental organization described as follows:

> "I think you need a transparent process so that everybody can kind of see what's happening. If you don t have the government at the table you lack the ability to regulate. Without the government at the table and without actual regulations and enforcements of those regulations you are stuck."

Government is chiefly responsible to manage different resources (e.g. water, land) and hence can deal with the geographic context of regulating the entire watershed.

Finally and quite importantly, only government has the authority to make the financial arrangements that would be required to implement the actions to assess and manage cumulative effects at a watershed scale. As one practitioner expressed, the government has a critical role in facilitating the financial arrangements noting that "... if

we are going to assess CEA we need to have a centralized user pay part of money that somebody else is using to do the assessment instead of individual proponents…that has to be done by some kind of government process. I am not saying everybody else should not pay into it but it has to be managed and centralized by the government." The inabilities of a private organization to better gather technical (data) and economic resources, and also to effectively deal with the complexities involved in a cross boundary issue, further implies that the government needs to take lead responsibility for W-CEA. The impracticality of having a private organization to lead W-CEA was described by an EA administrator as "…kind of utopian, in that, realistically government would have to support 1) with money 2) with data and information and our experience in this watershed planning advisory councils is that it is probably cheaper for the government to do it themselves than to try and do it through grants and contracts." An EA administrator agreed, noting that "you can't leave that [W-CEA] to an industry or an individual or an organization, at least not at the start; perhaps once it is up and running and agree to framework then another body or institution may take it on, but the lead initiative should come from government." It is evident that the assessment and management of cumulative effects requires direct leadership from the government, and a framework to integrate information and to facilitate decision making by requiring other decision makers to make decisions in accordance with objectives of W-CEA is required.

4.5.2 Multi stakeholder involvement, roles and responsibilities

In addition to the need for a lead agency, a key issue emerging from interviews was who else should be involved in W-CEA. Watershed cumulative effects, which occur at

different spatial and temporal scales across different environmental components, require an interdisciplinary team of analysts to assess the range of effects (Reid, 1993). For example, Reid (1998) suggests that a team of experts including fisheries biologists, anthropologists, archeologists, soil scientists and geologists will be needed to evaluate cumulative effects of logging on the riparian habitat. In addition, a group of stakeholders representing different levels of governments and nongovernmental organizations are required to implement the assessment plan. Stakeholders may represent various departments of the government (e.g. agriculture, environment, fisheries etc), and other groups such as industries, environment and watershed organizations, scientific community (e.g. academics, consultants) in the watershed.

Representatives of government and non-government agencies currently engaged in water management in the SSW are shown in Table 4.1. These groups have particular mandates for the management of different watershed components. However, understanding and assessing watershed cumulative effects necessarily encompasses all of these components; hence it is crucial that these groups and departments work together to decide on the objectives, strategies and action plans to manage cumulative effects in the entire watershed. The following quote by a practitioner emphasizes the need for such stakeholder participation:

> "To make the plan acceptable that has to have appropriate representations from the stakeholders which means the major industries and ENGOs, the scientific community and all of those groups have a role. You have to have each of the major land uses and each of the major natural disturbances and all of the major stakeholder representatives."

An EA administrator similarly highlighted the need for stakeholder participation and collaboration, and went on to explain that "You have to have broader general public and

Table 4.1 Water governance institutions involved in the South Saskatchewan Watershed

Federal	**Inter provincial**	**Provincial**		**Local organizations**	
		AB	SK	AB	SK
Fisheries & Oceans Canada	Prairie Provinces Water Board International Joint Commission	Alberta Environment	Saskatchewan Watershed Authority Sask Water	Alberta Irrigation Project's Association	SSRB South west Development area and Lake Diefenbaker Development area
Agriculture & Agri -Food Canada	Agri-Environment Service Branch	Alberta Agriculture, Food and Rural Development	Saskatchewan Agriculture and Food		
Environment Canada The Canadian Environmental Assessment Agency Natural Resources Canada Parks Canada		Ministry of Sustainable Resource Development Natural Resource Conservation Board (NRCB)	Saskatchewan Environment	Sustainable Resource Developme nt	Saskatchewan Soil Conservation Association
Health Canada Transport Canada		Alberta Health and Wellness	Saskatchewan Health		Saskatchewan urban Municipality Association Saskatchewan Municipal Government

Source: Patino and Gauthier, 2009; Orrego, 2007 and interview data

first nations involved as well as among the parties agreeing that this is the operating context and here is the change we are willing to live with and here are the indicators that are relevant to tracking."

An important issue identified concerning multi stakeholder involvement was the roles and responsibilities of the various stakeholders in W-CEA. Specifically the lead agency, project proponents, watershed agencies, and scientists in academia and other non-government/non-industry organizations.

4.5.2.1 Lead agency

There was a general consensus among participants, as discussed above, that the provincial government(s) should take the lead initiative in W-CEA. As a federal administrator indicated "the provincial governments should have a responsibility to feed information into the various exercises…. the provincial governments should have a protocol for sharing the information, so that we [the federal government] can assist the jurisdictions in developing their respective areas of resource management…then the provinces could take on a role to manage that information collectively and feed into the appropriate decision makers." Another key role for government (lead agency) that was suggested by interview participants is to establish objectives, thresholds and strategies to implement W-CEA. For example, an administrator stated that "the role of government is to establish regional planning priorities and at-least be responsible for coordinating the public debate on setting thresholds". In addition, few other interviewees suggested that the government (lead agency) should develop a process to facilitate financial support that would be required for W-CEA.

4.5.2.2 Project proponents

Once a framework for W-CEA is developed, then the key role for individual project proponents is to follow the framework by fulfilling the EA information and adopting mitigation measures in accordance with the goals and objectives of W-CEA. For example, one practitioner, suggested that "there is an opportunities to build implementation schemes where proponents can contribute to part of a broader scheme by consistent monitoring of their own effluents or their own footprints depending on the indicator that are considered in W-CEA." Other participants suggested that individual proponents could provide financial contribution to W-CEA. Overall, the interview results confirm a role for individual project proponents in planning, data sharing, and monitoring processes of W-CEA.

4.5.2.3 Watershed agencies

Apart from individual project proponents, other stakeholders, mainly watershed organizations, should also be involved in W-CEA process. For example, an academic participant suggested that the lead agency could involve some watershed organizations and it should empower these organizations with technical and financial support. Further, a watershed organization representative indicated that they are keen to participate in the W-CEA process. The participant explained that watershed organizations are "... sort of an umbrella organization looking at some of the issues that are out there, providing advisory comments to the government as far as technical, monitoring and that type of things."

4.5.2.4 Scientific community

Another important stakeholder identified by participants was the scientific community (e.g. researchers, consultants). Several participants emphasized that their expertise is required to develop tools and methods to address technical difficulties of conducting W-CEA. For example, a practitioner emphasized the importance of involving the scientific community in W-CEA as follows

> "the role of academic community will continue to be to take a look at the indicators and the approaches that are looked in and provide an independent evaluation that is based on science and the new and upcoming issues are identified and considered as part of the program design."

Similarly, another practitioner suggested that:

> "Primary role of scientists is to provide mathematical equations that help tie indicators to transform landscapes. So if a landscape becomes more fragmented and one of the indicators is grass land bird species, how does a fragmented landscapes influence a bird species? That information typically comes from the scientific community. The role of scientist is to help in the attributions of models what we call response curves, so that is the primary role of scientists."

The scientific community was identified as playing a key role in providing technical guidance to decision or policy makers about the conditions of VECs and/or indicators that are being affected by cumulative effects. Participants viewed the scientific community as an important stakeholder of the W-CEA process.

4.5.3 Establishment of thresholds and identification of VECs and indicators

Aside from the organizational structure, an effective W-CEA involves identification of i) current conditions i.e. the state of different components of the watershed (e.g. underground aquifer, surface water), and how different kinds of activities interact with

each other and with the water system in a watershed; and ii) desired conditions (e.g. thresholds), which assist in developing strategies to assess the impacts of developmental activities in a watershed (See Montgomery et al. 1995; Reid 1998). As anticipated, several participants advocated the need for developing thresholds for VECs based on the current state of the watershed in order to manage the problem of cumulative effects.

Thresholds help to prioritize and identify areas of concern in a watershed where development activities are planned. As one practitioner noted, an important aspect of W-CEA is "… defining thresholds and defining the extent…if you have a small project at one part of the river, if you want to put that into context for the CEAs then you need to define those limits and on a cumulative effect basis - you want to know that limits are in the watershed scale." The development of thresholds also helps to trigger management interventions before they are likely to be exceeded (Winton et al. 2008). It therefore implies, based on the results above that the responsibility of establishing the planning priorities and thresholds lies with the lead agency. For example, a practitioner emphasized that the government should take the active role "... where it basically set the direction and industry has to move or roll in that direction." In this regard, the "... role of government is to decide on what is the future and destiny of these landscapes and let industry work within that vision." Such thresholds are important to facilitate the decision making process for development, by requiring other decision makers to consider cumulative effects when making their respective decisions. For example, an EA administrator explained as follows:

> "Currently there are multiple decision makers making decisions on different types of developments…..So everybody is making all of these decisions and there is no commonality to what they are basing their decision on. So that comes back to the

> idea of identifying what we are all managing for on a regional basis, setting limits and thresholds based on that, and in making every decision maker accountable to taking the considerations of those regional capacities and limits when they make their decisions."

In addition to setting the thresholds, which facilitate decision-making, the need to identify relevant VECs and indicators was also emphasized by interview participants. Most participants suggested that VECs and indicators should be broadly defined to assist the identification of cumulative effects in a watershed-based approach. As one interviewee stated, "...at a broader scale you must have to select some very generalized indicators of course, perhaps as where people live versus where people don't live." Others emphasized that the identification of VECs should be based on science. For example, one practitioner explained as follows:

> "Setting indicators and VECs should be based on the standard principles...there are always tradeoffs; some VECs are easier to study and respond to certain activities differently than others so you still have to pick them based on the nature of the change that are influencing the water body and based on their importance and their response to the change."

Aside from the science point of view, however, it is also important to consider VECs from the management perspective. As an EA administrator suggested, it is useful to identify "simple and meaningful VECs with regard to the environment and start with something that we have some tools or governance approach to control." It was highlighted by another EA administrator that there is a need to focus more attention on identifying terrestrial VECs and indicators that are useful for the watershed based approach. The participant explained as follows:

> ".. we have good information on water quality and we can use those as indicators for the primary parameters of interest that is fairly easy. But there is a need for

> some work on the land side as to which of the best indicators. The literature is all over the place. I don't know how many hundreds of different indicators that are in the literature and some of them work at one spatial scale are not necessarily appropriate at another spatial scale. So yes there is a need to work on VECs and indicators and part of that work is identifying that what spatial scale that they most appropriate at."

Collectively, interviewees indicated that VECs and indicators that are relevant from both scientific and management perspectives need to be identified. However, there was no clear suggestion as which sets of those VECs and indicators need to be focused in the watershed-based approach.

4.5.4 Monitoring programs

In order to assess VEC conditions, regular monitoring programs need to be established. As an EA administrator explained, "we need monitoring, modeling, the development of outcomes and understanding what the indicators and thresholds are for those outcomes, very specific numbers to those outcomes tolerances." Further, it was emphasized by few other participants that the guidelines and protocols need to be established for successful monitoring programs. Supporting this view one participant from a watershed organization noted that "it needs to be almost like a government regulated monitoring system just to ensure that everybody is kind of doing at the right way… this is why there needs to be an over arching guidance source support system for that."

A practitioner interviewed similarly emphasized monitoring requirements for successful W-CEA, noting that "… monitoring requirements need to be linked to a specific criteria." The participant went on to explain that "… if there is one water quality

criterion, as an example, for one region or one set of benthic community…fish…or population numbers, then monitoring on basically a scientific design that has the power to detect those changes is what is required." Such monitoring programs, explained the interviewee, have the power to detect changes at the regional scale and are required for understanding cumulative effects at the watershed scale. All interviewees emphasized the importance of regular monitoring programs to constantly assess and monitor VEC condition, which will ultimately provide information needed to help management decisions concerning cumulative effects.

4.5.5 Data management and coordination

To understand the current state of environmental components, which is essential part of W-CEA, management and coordination of data are required. In this regard, an important responsibility of the lead agency in W-CEA is to establish and manage a watershed data system, and to provide guidance and standards for data collection, analysis, and monitoring. The real concern of an effective CEA is to ensure that the lead agency obtain the necessary information to perform analyses (Kennett, 1999; Peterson et al. 1989). The necessary information may constitute temporal and spatial data on variety of stressors, VECs and indicators in the watershed area, including the information collected as part of individual, small-scale projects (Parker and Cocklin, 1993). Participants agreed that an information repository was needed, and that shared accessibility and standard data are essential for the assessment and management of cumulative effects.

Ideally, the data needs to be gathered and accessed through a centralized process as this would provide opportunities to integrate future project scale information with regional scale information. This process assists to identify data needs and gaps rather than recreating data for individual projects that already exists from other projects. Thus, centrally managed and shared information would benefit proponents, regulators and practitioners for the assessment of individual projects. For example, a participant from an environmental organization emphasized the need for centrally managed data sharing system saying: "data should be available to everyone along the river basin, but it needs to be centrally gathered and assistance needs to be established for sharing it… that is one of the advantage of having a single body that is kind of responsible for the watershed and they would be central repository for data." Similarly, a practitioner noted that:

> "If there was a centralized collection of that data could do better job of keeping a closer eye on what is getting used and when it is getting patterns in use. But also plan what you are trying to get out of it, rather than just storing data, if you actually make a service available to the proponents for the purposes of watershed management and proponents could be small watershed with in the smaller watershed."

The collection and management of data to support W-CEA could be achieved through establishing collective agreements on the formats or standards that would help individuals and groups to handle and understand the information and use it appropriately. For example, an interviewee noted that "what government can do is create the framework, create the consistency and the data collection, created the codes for data collection and reporting and responding." The common concern among many participants, however, was that a large amount of valuable data is already stored in different departments' databases, which are mostly in non- digital format and are not

directly accessible for any type of assessments. Therefore, the opportunities to build networks among existing databases need to be explored. One of the options raised was to build networks is through providing incentives to individual research institutions or organizations to share their information.

4.5.6 Financial commitment

The above data requirements, of course, require also a financial commitment. Most participants identified economic resources as an essential requirement to sustain and manage a W-CEA process. Primarily, the interview results suggest that better funding mechanisms have to be established in order to implement and sustain such watershed-based assessment practices. Most participants emphasized that it's the general public that pays for W-CEA. As a federal administrator stated, the "public pays one way or the other…in terms of paying for a product." Similarly one practitioner said, "in my view it is just a cost of doing business…land uses create benefits, it creates liabilities, it creates benefits for society, for public [and] our tax dollars should be directed to doing CEAs"

As such, the government, being the lead agency, should manage the system to provide fiscal resources for the assessment and management of cumulative effects (see Kennett, 1999). One practitioner explained as follows:

> "I think that government pays for it. It is the government's responsibility for maintaining the integrity of the watershed. It is not the function of the individual proponent or development. So it is the government responsibility to provide relevant information to track the health of it."

Participants commonly supported the view that the government needs to adopt mechanisms or approaches to encourage the contributions from inhabitants, developers and other stakeholders to support W-CEA. These approaches may include, for example,

user pay fees, taxes, and license fees. For example, a federal administrator explained that "the cost of managing such a system has to be borne by the public sector and that is not to suggest that there couldn't be innovative approach to recovering costs through user fees." The interviewee went on to explain, "if a proponent wishes to access that information base, perhaps they should be paying for it." Another EA administrator shared the following example as an option to support W-CEA:

> "You can collect taxes and 2% of the taxes go into an institution or something that manages the information and analysis and then feed those results back in an annual reporting to government or something like that. There are different ways of gaining the money but ultimately you and I are going to pay in someway through our taxes or whatever, it is going to funnels through government in some way and then it will be up to government to decide ultimately who wants to manage all of it or portion of it and report back but then the response will again have to be through government."

As noted in previous sections, establishing thresholds, monitoring programs and expert panels in W-CEA, and ensuring its overall functioning, require stable financial support from the government. As one government administrator stated, "… the investment in environmental monitoring to support CEA has to be a government led function." However, two participants expressed the view that economic resources may not be a major concern because improved organization would reduce the expenses. For example, an academic participant explained "it is much better organization into a process. It is system level thinking. …If we were to better organize of what we have, right now, into a process and framework. It would probably cost us less than what is costing us now on the government side. Similarly, a practitioner suggested as follows

> "The approach that I favored is if you look relative to today you would be spending less money rather than more money to implement a program like this. But it would rely on efficiencies in terms of co ordinate data collection and basically less man power because everybody knows what their role is as opposed

> to hiring positions to fill all the roles to make sure that the things happen... So frankly I am not sure that the capacity is a challenge as people make it out to be. There is a huge inefficiency in our current system, rather than saying we need more money to do this."

4.5.7 Enabling legislation

Development of new legislation is regarded as one of the important means of achieving institutional adaptation to effectively implement a new or evolving action (Cortner and Moote, 1994). However, participants' views differed widely regarding the need to develop a legal instrument to implement W-CEA and related management actions. Some participants suggested that the success of W-CEA cannot be achieved without formal commitments through legislated guidelines to ensure implementation of the recommendations emerging from W-CEA. For instance, if the impacts on an indicator are intolerable in the watershed, some of the current activities must cease, or proposed future activities cannot be undertaken, unless impacts can be reduced. Legislative instruments enable the responsible administrative agency to take the necessary actions in such situations.

A provincial administrator, for example, explained that legislation "… is probably the only way you get it done. There are some things you just can't get done on a voluntary basis and that is also a good vehicle to engage in discussions." In the view of this participant, legislation assists implementation of W-CEA by mandating participation by all stakeholders. Legislation also ensures a set of procedural regulations to enforce accountability and transparency, and requiring other stakeholders including government departments to make development decisions in accordance with W-CEA principles and findings. As a participant from an environmental organization stated, "the best way to do this is to develop an over arching act or set of regulations that it would need to be in place

and that all government departments would be required to hear to the regulations that are there."

Conversely, about half of the participants expressed that they are not sure whether legislation is a necessary component of W-CEA. They explained that since W-CEA involves consensus among various stakeholders, it is difficult to develop legislation. Rather, volunteer programs providing incentives to the groups to follow the recommendations may be effective. For example, a representative from government noted:

> "..one of the key ingredients is a motivating force to identify and engage a champion or catalyst for the process. Why would the key players want to form a partnership to address cumulative effects in the south Saskatchewan? Is there an impending crisis? Is there a crisis you want to avert? How are you going to motivate the players to engage? I am not sure that legislation alone is going to be sufficient to do that. … I don't think legislation is a panacea, I don t think it is going to solve the problems that we have with our CEA currently."

Similarly another interviewee from a watershed organization described that legislation may not be required at the start of a process, noting that legislation "is the last thing…I don't mean that we don't need it but I just think from timing point of view that is probably the last thing to happen.' The participant explained, "new legislation is not going to change anything without willingness to enforce …so I am not sure whether legislation is needed."

An interviewee from an environmental organization argued that there should be a delicate balance between legislation and cooperation, noting that legislation "…needs to come in extreme events when there is a human health hazard or environmental health hazard that is involved", but "… you can't legislate everything…I don t think that it will be very well received." Overall, then, there was no consensus among interview

participants about the need for legislation to ensure W-CEA success; where some interviewees opinioned it helps facilitation of W-CEA, others were not sure. This diversity of opinions was evident even within each participant group, for example, not all participants who represented government were in support of legislation.

4.6 Anticipated challenges

In the final part of the interview, participants were asked to identify the problems that they foresee with W-CEA. While promoting the implementation of W-CEA, it is important to recognize the challenges that are anticipated with the W-CEA in order to manage the institutional structures that support it. The task of assessing and managing cumulative effects may pose variety of challenges. First, and of particular importance, is the issue of coordination. A W-CEA process requires engaging divergent views about the uses of a resource. As such, participants noted that consensus among different stakeholders about the usage limits and restoring actions for the watershed resources will be a difficult to achieve. In addition, gaining co-operation across different groups and government departments to operate at a large spatial scale was identified as posing a major challenge, and does not conform to current institutional arrangements, which are divided by resource rather than by watershed unit. An EA administrator, for example, noted the difficulty, stating: “some of the main challenges are getting some sort of societal consensus of what it is that they want to see for their watershed because you have such a divergent point of views.” Similarly another interviewee from government noted:

> “I think the challenges would be how to allocate the resources for land uses and how to allocate the land and water for different type of the development. For example the waste water and storm water loading impact on the bow river how we

> are going to allocate these loadings to the different developments, who gets what percentage how to share the limited resources we have in the basin."

In addition, as most participants expressed, the awareness or education about the need for W-CEA is difficult to achieve. The land users and project proponents may find it difficult to understand the implications of the ways they use the resources (i.e. land or the water). The inability of land users, land managers and project proponents to work at a large scale would ultimately limit actions to manage cumulative effects. One academic participant emphasized in particular the challenge of lack of awareness, noting that "we are not used to thinking at this big scale we just don't do it; we tend to think in terms of river reaches and with regard to our research or an industry I think we tend to think in regards to the effluent coming out of the pipe." Similarly, an EA practitioner explained that "most people don't understand the need for it; so the landscape is deteriorating incrementally and most people don't understand that, most people are not putting pressure on politicians to require them to the legislation that leads to regional CEA."

Other common challenges to W-CEA identified across participants included the lack of financial commitment, political will, and difficulties in establishing cause-effect relationships for a mixture of stressors. It is evident from the interview results that the challenges to implement W-CEA are mostly related to organizational or institutional structures. Further, the need for establishing or formulating institutional structures to support W-CEA was agreed upon by majority of the participants who represented governments, practitioners, academics, and environmental organizations as core to the success of W-CEA.

4.7. Summary

This chapter presented the results from interviews regarding the current state of CEA under project EA frameworks, and the key institutional requirements for W-CEA. The interview results suggest that the cumulative effect assessments under project EAs are rarely undertaken in the SSW, and the project-based EA approach is faced with considerable challenges. The project-based EA challenges suggested by interview participants are similar to the ones discussed in the literature, and are primarily related to the lack of guidance to proponents regarding boundaries of assessments and thresholds, the lack of data from other project EAs in the watershed, and the capacity of both proponents and regulators to achieve a good CEA under project EA. Interview results also suggest that these challenges could be addressed by establishing regional objectives at a broader scale, which could provide better context to project-based approaches.

Interview results revealed several opportunities for the government to take the lead in implementing and sustaining W-CEA, but a multi-stakeholder approach is essential to W-CEA success. The results also suggest that the establishments of thresholds and data management are necessary components of W-CEA, but that the need for legislation concerning such thresholds and W-CEA initiatives is not agreed upon. At the same time, results emphasize that the coordination and education among various stakeholders will be difficult to achieve. The lack of financial commitment, political will, and difficulties in establishing cause-effect relationships currently impede the practice of W-CEA.

CHAPTER 5

DISCUSSION AND CONCLUSIONS

5.1 Introduction

The need to advance CEA to the watershed or regional scale so as to encompass broader regional understandings and considerations of the sources of cumulative effects is well accepted and supported by the scientific and management communities across Canada (e.g. Harriman and Noble, 2008; Duinker and Greig, 2006; Dubé et al. 2003). Developing such a broader watershed or regional CEA requires integration of cumulative effects information from both point (i.e. individual projects) and non-point (i.e. watershed processes) sources. Implementation of such an integrated watershed-based approach to better manage cumulative effects also requires a strong understanding of both the science and institutional requirements of CEA and management. The issue, however, is that the science of how to do watershed-based CEA is progressing whereas the understanding of institutional and capacity requirements to sustain CEA is simply not in place. In this regard, this research was aimed to understand the current nature and state of CEA under EA frameworks and to identify the institutional requirements to advance and sustain a W-CEA. These objectives were pursued within the context of EA in the South Saskatchewan Watershed – a watershed spanning the Saskatchewan-Alberta border, and subject to EA laws and regulations under the governments of Saskatchewan, Alberta, and Canada. The sections that follow summarize the primary research findings, prescribe institutional requirements to implement and sustain an integrated watershed-based approach to CEA in the SSW, and also highlight areas that require future research.

5.2 Current state of CEA in the South Saskatchewan Watershed

At present, the primary approach to assessing cumulative effects in the SSW is project-based EA. Project-based EA legislation in the SSW is quite unique in that it falls under three jurisdictions, namely federal, Alberta and Saskatchewan. The legislation to assess cumulative effects under project-based EA is set out by *the Canadian Environmental Assessment Act* (CEAA), and the *Alberta Environmental protection and Enhancement Act* (AEPEA). However, at present, there are no requirements or provisions to assess cumulative effects under project-based EA under Saskatchewan's *Environmental Assessment Act*. The federal CEAA triggers EA for certain projects that fall under the federal jurisdiction, and the AEPEA requires that proponents assess cumulative effects for a list of projects of a certain nature and size. Accordingly, not all developments or land uses are subject to EA under the respective legislations in the SSW. In other words, EA is not applicable to all human activities that, while often considered individually minor, may collectively cause significant cumulative effects. Since only limited project activities listed under federal and/or provincial EAs legislation are assessed, the cumulative effects from several non-point sources typically go unchecked.

The scope of EA is thus a critical concern for cumulative effects. The key drivers of cumulative effects in the SSW are mainly non-point sources, such as agriculture and various stressors associated with population and urban growth. Stressors thus originate from several non-point inputs (e.g. runoff from agriculture, construction sites, road development, abandoned mines, recreation, etc) and are often transported over land, underground, or through the atmosphere to the receiving aquatic system (Carpenter et al. 1998). The current project-based EA approach is not a sufficient tool to address these

non- point sources of cumulative effects in the SSW, and a broader watershed scale approach is very much required.

Consistent with the literature, this research suggests that the effectiveness of project-based EA is limited also due to technical and institutional (capacity) constraints. These constraints or challenges are mainly related to scale issues, data limitations, lack of thresholds, and capacity to operate beyond the individual project. The primary challenge concerning project-based EA is scale, which includes both spatial and temporal aspects. As per the legislative requirements, individual projects, while assessing the significance of project effects, must consider impacts from other past, current and future projects. For example, the federal EA act requires that cumulative effects of a new project must be considered "in combination with other projects or activities that have been or will be carried out." However, proponents often end up selecting the boundaries for CEA that are not sufficient to identify and determine the true significance of the project's cumulative effects in combination with other activities on the landscape. Due to unclear or restrictive spatial and temporal scales often selected for CEA under the project-based approach, the cumulative contributions of project stressors are always considered insignificant (see Duinker and Greig, 2006). Also, current practice overlooks many other non point sources, which usually fall outside the scope of formal EA.

Parallel to the scale issue, there is a lack of data about other project EAs that is available to a proponent to conduct good CEA. Assessing cumulative effects requires information about other existing and planned activities. However, the challenge from a proponent's point of view is that information or data about other projects (i.e. current, past and proposed) is very difficult, if not impossible, to procure (see Noble 2010).

Limited data means proponents employ various cumulative effect analyses with no quantitative data, or with different data sets, which ultimately affects the quality of understanding cumulative effects beyond the project scale. Related to this is the lack of clarity in defining thresholds or targets for project-based EA, against which to assess cumulative change, and the lack of agreement about those limits and thresholds that do exist in terms of the significance of individual project contributions. These challenges, coupled with insufficient timelines and guidance, impede the capacity of both proponents and regulators to carry out 'good' CEA under project-based EA.

In order to overcome these challenges, this research, consistent with emerging literature, argues for a more regional or watershed level assessment process. The regional watershed scale can provide appropriate contexts or targets for individual project assessments, and such that broader scale assessments can assist in the availability and accessibility of information or data that may be required to assess cumulative effects under project-based EA. As such, a framework needs to be established to integrate the results from these two assessments approaches in order to drive management actions and to assist both watershed cumulative effects management and future project-based EAs.

5.3 An integrated approach to manage cumulative effects in the SSW

The project-based approach to CEA focuses on potential project's incremental contributions and how the proposed project's stressors may impact the environment; broader regional assessment focuses on the capacity of a region and the total effects of all stressors so as to determine what level of development can be supported (Griffiths et al. 1998). As Harriman and Noble (2008) suggest, "CEA plays a different role at each tier of

assessment, emphasizing different types of cumulative effects and thus generating different types of assessment outputs." The research results confirm this perspective, that each of the assessment level (i.e. project and watershed) addresses different cumulative effects at their respective scales; however, the results emphasize that both kinds of assessment can benefit from each other. Interviewees indicated that project-based EAs will be provided with better contexts through establishing broader scale objectives that, in turn, helps to achieve effectiveness in EA and efficiency in project level planning. At the same time, such broader scale assessments were noted to potentially benefit from project-based effects information. Further, the interview results recognize that the integration of different levels of assessment, particularly with regard to establishing development scenarios and spatial planning objectives, can provide guidance to future individual project assessments. A systematic framework is required for CEA to focus on integrating different levels of assessment that allows both efficiency and effectiveness to the overall assessment and management of cumulative effects in a watershed.

5.4 Institutional requirements for W-CEA

The immediate need to understand the institutional requirements at a watershed scale is well justified (e.g. Duinker and Grieg, 2006; Harriman and Noble, 2008). In this regard, the research attempted to understand the key institutional requirements to implement W-CEA. Both the CEA and watershed management literature suggests that the following institutional aspects need to be investigated when developing a framework to implement a broader scale management process (Kennett, 1999; Slocombe, 1998; Cortner and Moote, 1994; Peterson et al. 1989), namely: leadership; opportunities for a

cooperative process and to build on existing administrative units and institutions; back-stop legislation and economic instruments; and periodic reviews.

In terms of leadership, the research results suggest that provincial governments should lead the process of W-CEA, with some level of involvement of federal government to assist in the process. Some participants expressed the possibility of creating an independent organization outside government to handle W-CEA; however they also expressed concerns over the stability of such a system without government support. The results suggest government leadership in the implementation of W-CEA is necessary for three fundamental reasons. First, government is the only organization that can direct the integration and sharing of information across different government departments, proponents, other public and private agencies, and their respective monitoring programs. Such data from a variety of monitoring programs can supply continuous information to the lead agency in assessing and managing cumulative effects. This also implies that the government as a lead agency can significantly reduce the costs for implementing process by linking actions and post -implementation monitoring inside and outside government departments (Heathcote, 2009: 397). Second, government has the capacity to use different tools and regulations to enforce CEA mechanisms when needed. Finally, only government has the authority to make the financial arrangements that would be required to implement coordinating actions to assess and manage cumulative effects at a watershed scale.

In addition to the need for government leadership, the results suggest the need for a multi-stakeholder approach to ensure successful W-CEA. In this regard, a key issue explored was who should be involved in W-CEA and what are the roles and

responsibilities. Watershed cumulative effects, which occur at different spatial and temporal scales across different environmental components, require an interdisciplinary team of experts in which different groups and departments work together to decide on the objectives, strategies and action plans to manage cumulative effects in the entire watershed. Interview participants identified that government departments, project proponents, watershed organizations and the scientific community are the key stakeholders in the implementation of W-CEA, and that each of these stakeholders needs to be mandated to facilitate the implementation of W-CEA. The government as a lead agency must establish objectives, thresholds and strategies, in consultation with other stakeholders, and also be responsible for managing the necessary information. Project proponents then need to provide EA information in a required format and participate in the prescribed monitoring programs to assist W-CEA. Watershed organizations can be empowered to help direct planning and implement and enforce required activities (e.g. data collection, monitoring). Finally, a key role for scientific community will be to provide technical guidance to decision or policy makers about the conditions of VECs and/or indicators that are being affected by cumulative effects.

The third institutional factor identified was the need to establish regional thresholds or targets that assist to develop strategies to manage cumulative effects of development activities in a watershed. Also, such thresholds are important to facilitate the decision making process for individual developments and other land-use decisions by requiring other decision makers to consider cumulative effects thresholds when making their respective decisions. Further, interview participants recommended to identify VECs and indicators relevant from both scientific and management perspectives to support

consistent CEA and monitoring processes. There was an expressed need for regular monitoring programs to constantly assess and monitor VECs conditions, which, in turn, will ultimately provide information needed to help make management decisions concerning cumulative effects. The data from these monitoring programs, and from many other sources, must be managed through a repository of data with a shared accessibility and data networks.

Undoubtedly, then there is a need for financial commitment to manage the data and to implement other action plans. Most participants suggested the need for better funding mechanisms, such as user pay fees, taxes, and licenses to manage the overall system of W-CEA. However, participants' views differed concerning the need to develop a legal instrument to implement W-CEA and related management actions. About half of participants suggested the need to develop a legislation to achieve effective implementation of W- CEA; others expressed that they are not sure whether legislation is a necessary component. This finding from the interviews, however, contradicts perspectives from scholarly literature. Many authors have clearly emphasized the need for regional CEA legislation noting that the lack of existing legislative and regulatory frameworks is one of the main reason to the current state of regional CEAs in Canada (Harriman and Noble, 2008; Duinker and Grieg, 2006). In addition, it is evident from the discussion presented in section 5.2 of this thesis that the legislation that supports current approach to CEA is not at all effective to support what needs to be done for W-CEA. Furthermore, successful examples like the Oak Ridges Moraine Conservation Plan (see Hanna et al. 2007) clearly highlight the importance of developing a legislation to

accommodate ecologically based planning (e.g. W-CEA) and regional planning in Canada.

When identifying the institutional requirements for W-CEA, an attempt was also made to understand the foreseeable challenges that would impede its implementation. The research results indicate that the W-CEA will encounter inevitable challenges given the complexity of the large-scale assessment, and participants emphasized that the level of necessary commitment, coordination and education among various stakeholders will be difficult to achieve. The lack of financial commitment, political will, and difficulties in establishing cause-effect relationships are other major challenges to the implementation of W-CEA

5.5 Opportunities for sustaining a watershed-based CEA

The results of this research suggest four over arching institutional elements that would be useful for the implementation of W-CEA within the context of the SSW. First, the government must assume the leadership to implement W-CEA with the responsibility of establishing regional objectives, thresholds and data management tools. Second, a multi-stakeholder approach involving different levels of government and different government departments is required to form an analytical and planning team that decides on and implements the actions necessary to avoid or to mitigate cumulative effects. In addition, each of these stakeholders must be designated different roles and responsibilities concerning monitoring, implementation, reporting, and enforcements. Third, legislative or regulatory-based instruments need to be developed to: i) facilitate participation from different sectors and to designate roles and responsibilities; ii) manage

data; iii) implement management actions; and iv) assist decision making with regard to individual projects and other land-uses. Finally, economic instruments need to be established to regulate financial arrangements to manage W-CEA processes.

Based on the above key institutional requirements, an institutional framework is proposed that would be useful to facilitate W-CEA (Figure 5.1). The framework identifies government as an administrative lead agency that consists primarily of two teams; i) an interdisciplinary analytical team (i.e. scientists); and ii) a multi-stakeholder planning team (i.e. managers). Hence the government being the lead agency is essentially a collaborative organization of government, watershed agencies, researchers and others. The responsibility of the lead agency is then to establish thresholds and provide direction for monitoring programs at the watershed and project scale. It must therefore support the work of the EA branch of government to provide terms of reference to carry out individual project EAs, specifically in terms of identifying targets, thresholds, and indicators for monitoring. In addition, the lead agency collaborates with other decision makers (e.g. agriculture, fisheries, transportation, etc) to make their own respective land-use decisions within the context of the cumulative effects thresholds established. Further, the institutional arrangement consist of overarching regulatory guidelines or cooperative agreements to: i) establish a mechanism or process to involve participation from different government and non-government agencies; ii) designate roles and responsibilities of various government departments; iii) acquire data as necessary and in a format that is required by the CEA lead agency; and iv) establish and manage a financial mechanism for W-CEA

The research recognizes that the proposed institutional structure may be useful when a watershed is confined to one political jurisdiction; however, watersheds involving more than one jurisdiction (as in the case of SSW) may require individual frameworks operating within their own regulatory environment so as to identify and achieve the targets or thresholds for CEA implementation. However, the thresholds need to be established with the consultation from both jurisdiction representatives. It is suggested here that the federal government plays a key role in such cross-boundary issues.

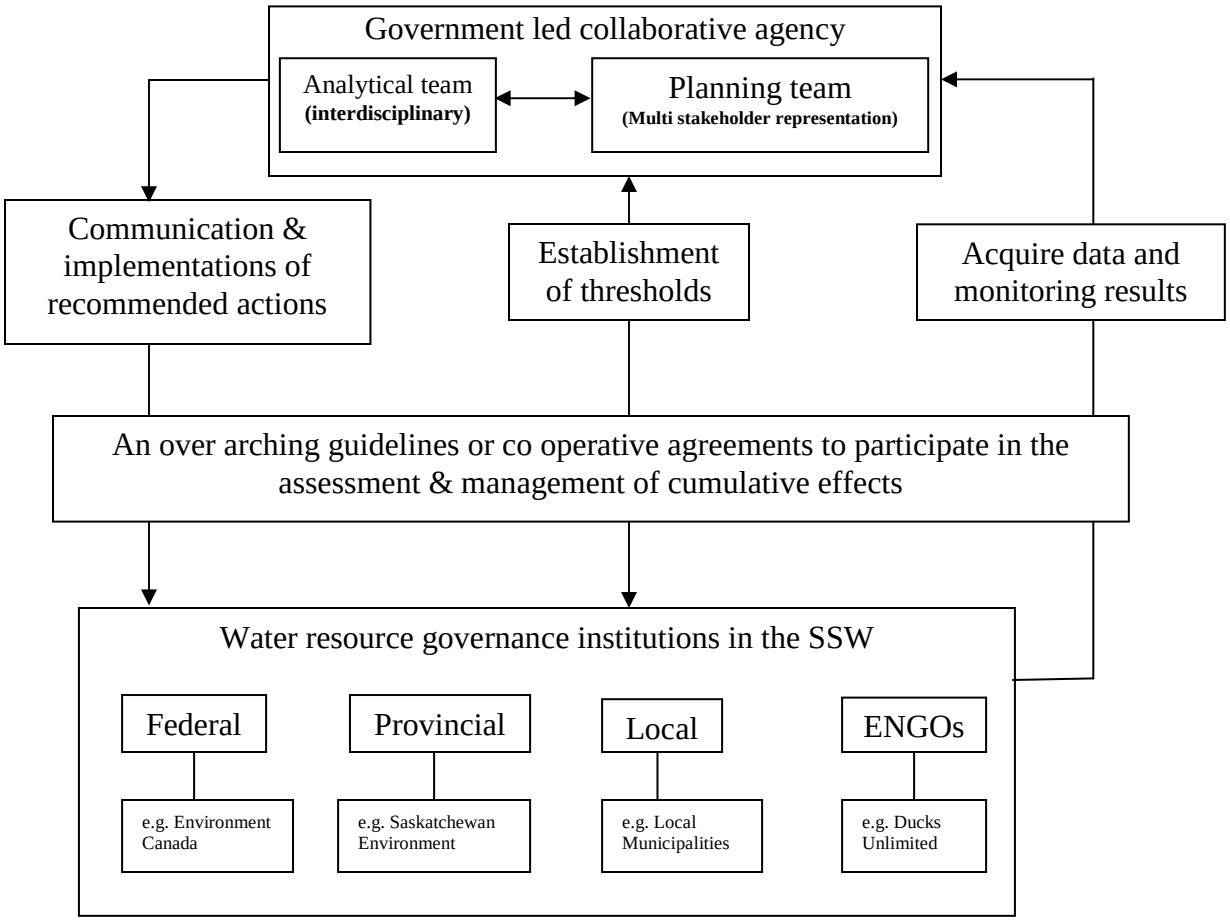

Figure 5.1: Proposed institutional framework for W-CEA in the South Saskatchewan Watershed

5.6 Research contributions

This research contributes to the knowledge and understandings of institutional design that needs to be developed to successfully implement W-CEA. It also provides stakeholder knowledge and interpretations about existing CEA provisions and opportunities to improve CEA in the SSW. Additionally, this research provides a description on the current perspectives of scientific, management and administrative representatives` willingness to move forward with a broader approach to CEA in the SSW. Investigation of these participants' experiences is an important contribution as it estimates potential requirements to develop an institutional framework to support W-CEA, and helps to understand the barriers or challenges to implementation. The results may serve as a study model for similar research in other watersheds, and provide a framework to evaluate the 'readiness' of watersheds to advance CEA to the watershed-scale.

At the same time, it is important to note the limitations associated with this research. The interview participants in this research represented a diverse set of administrative and technical groups; however, it may have been insightful to include also as the views of individual landowners, particularly agricultural landowners, in the research process. The understanding of views and interests from individual landowners may have been useful because the daily and seasonal land management decisions made by these landowners result in an increment of environmental change (see Spaling and Smit, 1993). In addition, more direct responses from individual developers or proponents rather than practitioners may have been further assisted in defining what roles they are willing to play in W-CEA.

5.7 Future research

It is suggested through this research that the integration of information from different levels of assessments is key to the success of W-CEA, and institutional design plays a significant role in developing such an integrated framework. Further research is now required to examine the current capacities to develop and implement such an integrated framework for W-CEA, and the opportunities to 'link-up' with project EA. Additional research is also required to develop a set of Valued Ecosystem Components (VECs) and indicators that will be useful for this integrated assessment and management of cumulative effects. The results of this research clearly suggested that the VECs and indicators for W-CEA should be selected based on the science and regional socio economic perspectives, and also useful for both watershed CEA science and project CEA management. Finally, future investigations need to be designed to test the recommended institutional elements in this research to assist and produce an explicit model or institutional framework for W-CEA. Investigations are needed to explore options for economic instruments and other approaches (e.g. market-based approach) that can be used to coordinate W-CEA activities.

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APPENDIX A: List of interview topics.

Dear _____,

Thank you for agreeing to participate in this research. I am including below, for your reference, a list of the general topics that I would like to explore with you during the interview. There may be certain areas that you deem to be more important than others or some areas that you may not be able to comment on. Please treat this list as a general guide only. I look forward to speaking with you soon.

Sincerely,

Poornima Sheelanere

1. Nature and current status of CEA under EA practice

This first topic explores, in general, the current state of practice of cumulative effects assessment under project-based environmental assessment in the watershed. Some specific topics for discussion include:

- The main drivers or sources of cumulative effects in the watershed.
- How the cumulative effects of development are currently assessed and managed in the watershed.
- What is working under the current approach, and some of the current challenges under this approach to assessing and managing cumulative effects.
- Whether CEA is worth doing as part of the project EA process.

2. The concept of watershed CEA

The following focuses on establishing the concept of watershed CEA. Specifically, I am interested in your view on:

- The advantages to assessing and managing cumulative effects at the watershed scale, beyond the scale of individual project

- Who should be the lead agency or responsible authority, and what are the potential roles of different stakeholders (e.g. governments, watershed agencies, industry, academia, etc)
- How CEA at the watershed scale could link-up with the current project EA process; how they might best relate or interact.
- Current CEA programs/activities in the watershed that assess, monitor, or manage cumulative effects at the watershed scale, and your agency's current role.

3. Institutional requirements

This set of topics examines what is needed to make CEA work beyond the project scale, at the watershed scale. Attention is focused on trying to identify the key ingredients or factors for success. The big question here is:

- If we were to implement a watershed CEA framework for the South Saskatchewan Watershed, one that crossed borders, what would it look like?
- In other words, what would be needed - the keys to make it work, or the factors for success?
- For example: regulation, capacity issues, data needs, roles and responsibilities, etc

4. Final thoughts

I am hoping that the above topics and discussion will help identify what is needed to start advancing the concept of watershed CEA. I am also interested in:

- Any other advice you might be able to offer, to facilitate the advancement of CEA to the watershed scale
- The challenges/ barriers you foresee in making watershed CEA work.