EVALUATING INSTITUTIONAL ARRANGEMENTS TO SUPPORT WATERSHED-SCALE CUMULATIVE EFFECTS ASSESSMENT IN THE GRAND RIVER WATERSHED, CANADA

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ABSTRACT

The Grand River watershed (GRW) lies within a designated urban growth plan area known as the Greater Golden Horseshoe (GGH) region in Southern Ontario, Canada. Development activities within this watershed cause environmental effects that accumulate over space and time resulting in degradation of water resources. Some of these cumulative environmental effects include poor water quality and quantity, increased sedimentation and surface run-off. In light of such cumulative effects issues, this research study attempts to advance watershed-scale cumulative effects assessment (W-CEA) by evaluating institutional arrangements (IAs) to support it in the GRW.

The methods applied in evaluating these IAs include document review, a focus group and semi-structured interviews. The document review both positioned the research study within the current literature of watershed management and cumulative effects assessment and revealed important resource management information related to W-CEA in the GRW, while the focus group yielded an evaluative framework for existing institutional arrangements. A semi-structured interview schedule was then developed to investigate in-depth the status of institutional arrangements within the GRW. Twenty-nine interviews were conducted with academic experts; project proponents; government and watershed agencies; non-governmental organizations; First Nations; and others. Interviewees discussed eight themes related to institutional arrangements identified as prerequisites for supporting W-CEA: lead agency; multi-stakeholder collaboration; CEA baselines, indicators and thresholds; multi-scaled monitoring; data management and coordination; vertical and horizontal policy and planning linkages; enabling legislation and financial resources**.**

Data analysis reveals varying opinions on the capacity of existing institutional arrangements to support W-CEA at present due to different understanding of the tasks and duties required for W-CEA, and a plethora of management mandates within the watershed. The interview data also show that scattered monitoring data and lack of a strong responsible authority for W-CEA in the GRW also hamper institutional capacity. Study participants raised questions about whether existing science in the watershed is ‘mature’ enough to conduct W-CEA at this time, and there is a documented need to identify a potential funding authority for watershed-scale initiatives. Lessons learnt help to advance W-CEA frameworks in Canada and abroad.

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TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

BMP	Best Management Practices
CAs	Conservation Authorities
CAs Act	Conservation Authorities Act
CEA	Cumulative Environmental Assessment
CEA Act	Cumulative Environmental Assessment Act
CEAA	Cumulative Environmental Assessment Agency
CEAM	Cumulative Effects Assessment and Management
CHRS	Canadian Heritage Rivers Society
CWN	Canadian Water Network
CWRA	Canadian Water Resources Association
DFO	Fisheries and Oceans Canada
EA Act	Environmental Assessment Act
EEM	Environmental Effects Monitoring
ENGOs	Environmental Non-Governmental Organizations
GGH	Greater Golden Horseshoe
GSH	Great Sand Hills
GRCA	Grand River Conservation Authority
GRFMP	Grand River Fish Management Plan
GRW	Grand River Watershed
IAs	Institutional Arrangements
IWRM	Integrated Water Resources Management
MMAH	Ministry of Municipal Affairs and Housing
MNR	Ministry of Natural Resources
MOE	Ministry of Environment

MOU	Memorandum of Understanding
MPIR	Ministry of Public Infrastructure and Renewal
NRBS	Northern Rivers Basin Study
NRTEE	National Round-Table on Energy and Environment
OCWA	Ontario Clean Water Act
OMAFRA	Ontario Ministry of Agriculture and Rural Affairs
ON	Ontario
OWRA	Ontario Water Resources Act
SSHRC	Social Sciences and Humanities Research Council of Canada
SSW	South Saskatchewan Watershed
TRCA	Toronto and Region Conservation Authorities
VECs	Valued Ecosystem Components
W-CEA	Watershed-scale Cumulative Effects Assessment

Chapter 1

INTRODUCTION

1.1 Impetus for the study

Environmental assessment (EA) is a family of tools as well as a process designed to predict, evaluate and mitigate the effects on the environment due to development activities (Noble, 2010b; Kilgour et al., 2006). Within the field of EA, 'cumulative environmental effects' have increasingly been the subject of research since the early 1990s (e.g. Canter, 1999; McCold and Saulsbury, 1996; Smit and Spaling, 1995; Spaling and Smit, 1993; Contant and Wiggins, 1991), in part related to increasing awareness of regional-scale environmental issues (Therivel and Ross, 2007; Dowlatabadi et al., 2004). For example, in the southern Ontario area known as the Greater Golden Horseshoe (GGH) region there is a need to accommodate regional-scale urban growth and development, as well as better manage water resources in the area to meet consumer demand, given current and projected rates of use (e.g. Gayler, 2010; Veale, 2007; Ontario Ministry of Public Infrastructure Renewal, 2006; Ontario Ministry of Municipal Affairs and Housing, 2005; Ontario Government, 2005; Leadlay and Kreutzwiser, 1999).

Water quality and quantity within the rivers and creeks that comprise Southern Ontario watersheds are impacted by the cumulative effects of anthropogenic stress from multiple sources, including development activities such as urbanization, aggregate mining, and channelization, just to mention a few (Mulvihill and Ali, 2007; Scott and Imhoif, 2005). These accumulating effects may not only degrade or impede watershed ecosystem functions but may also have serious consequences for human health (Ramachandra et al., 2006; Koycheva, 2003).Development pressures within many watersheds are intensifying and lasting impacts due to cumulative environmental effects are visible not only in Ontario's watersheds but elsewhere in Canada, as evidenced by recent basin-wide studies (see for example: Seitz et al., 2011; Sheelanere, 2010; Squires et al., 2009). However, the problem is that while a significant amount of attention in the EA community has been devoted to cumulative effects assessment (CEA) in both project-based and regional studies (e.g. Squires et al., 2009; Dubé et al., 2006; Culp et al., 2000a, b, c), little work has focused on the institutional arrangements that would be necessary to evaluate and

manage cumulative effects on a watershed basis. Specifically, there has been little support for the development of governance structures reflective of a watershed approach (de Loë et al., 2009; Heathcote, 2009; NRTEE, 2009; Hooper and Lant, 2007). This is despite increased recognition of the need for regional-scale environmental effects analysis, such as for a watershed (Seitz et al., 2011; Noble, 2010b; Sheelenare, 2010; Heathcote, 2009; Squires et al., 2009; Ward and Pulido-Velázquez, 2008; Veale, 2007). The regional scale requires assessment and analysis strategies commensurate with the cumulative effects of multiple stressors upon water resources (Noble, 2010a; Harriman and Noble, 2008; Dubé, et al., 2006; Dubé, 2003; Gentile and Harwell, 2001).

Few political jurisdictions adopt the watershed as a basic scale of administration to guide the range of agencies responsible for managing water resources. The common approach has been to divide responsibility according to specific water parameters such as water quality, water quantity, water supply infrastructure, etc., and as a result, development and growth are not often evaluated in light of managing cumulative effects. When a cumulative effects framework is utilized, impacts to a given receptor (i.e. watershed) are typically considered with the ultimate goal of mitigating these impacts and improving the quality of this receiving receptor (Canter and Ross, 2008; Therivel and Ross, 2007). For example, in the wake of the Walkerton disaster, the Ontario provincial government not only passed new acts and broad policies but strongly emphasized water resources protection through integrated planning across natural and municipal boundaries (Government of Ontario, 2005; Ontario Ministry of Municipal Affairs and Housing, 2005). However, despite increased support for water resources management on a regional scale, there is lack of evidence to show management practices of the agencies involved have linked their goals to CEA in most of Ontario's watersheds (Cervoni et al., 2008; Mitchell, 2005). Moreover, the *Ontario Environmental Assessment Act, 1990*, does not presently require CEA. Thus, there is considerable room to advance both the practice of CEA on a watershed scale, and the integration of CEA and watershed planning in Ontario, and elsewhere.

In light of the current emphasis on regional-scale approaches in the field of EA and the need to advance watershed management and water protection in southern Ontario, this research evaluates institutional arrangements to support watershed-scale CEA (W-CEA). More precisely, the purpose of this research is to advance current understanding of institutional arrangements necessary to support W-CEA, and in particular to develop an evaluative framework for use as a tool to appraise, on a macro-scale, the 'degree of readiness' of existing institutional arrangements to undertake W-CEA. By this, it is meant the crude way to determine the institutional capacity to

undertake a W-CEA at the watershed scale. The case of the Grand River watershed in Ontario, Canada, is used as a basis to develop and refine the framework. With this in mind, the specific research objectives are:

1. to develop an evaluative framework of institutional arrangements to support W-CEA;
2. to employ the evaluative framework in context of the Grand River watershed to identify the presence or lack thereof of supportive institutional arrangements for W-CEA and the region's overall 'degree of readiness' to practice it; and
3. to identify opportunities for advancement of W-CEA in the Grand River watershed, and watersheds elsewhere, based on the application of the evaluative framework.

Together, these objectives provide a means to investigate existing institutional arrangements so as to characterize those that might support and sustain W-CEA. This is especially important given that it is widely accepted many impacts to water resources are attributable to management and governance challenges (Cervoni et al., 2008). By clearly analyzing existing institutional arrangements, management goals may be better aligned with spatiotemporal scales specific to cumulative effects in the future. Results of this study may also assist water resources managers to achieve environmental and socio-economic goals for the Grand River watershed by suggesting possible areas of improvement in institutional coordination and communication. This is because a new perspective offered by the study of institutional arrangements to support W-CEA can reveal in-depth the current nature of interactions, philosophies and relationships among institutional arrangements. Shannon (1998) noted that it is through such interactions and relationship building that innovation can arise and become institutionalized.

The ultimate goal of this research study is to provide a platform to establish a cumulative effects management plan that originates from the various water management agencies within the Grand River watershed. New and specific knowledge of the 'degree of readiness' for Ontario's institutional arrangements to support and sustain W-CEA might potentially help to facilitate new institutional arrangements, or consolidate or reform existing ones. Equally as important, this research study may help to pinpoint redundancy and inefficiency in management practices currently utilized in the watershed and/or serve as a basis to formulate appropriate policies and directives for the W-CEA.

1.2 The watershed as a regional basis for cumulative effects assessment

Cumulative environmental effects are those effects, which when considered individually are often minor but when considered jointly can cause significant impacts to the environment given their additive, interactive, synergistic and irregular nature, and ability to accumulate over space and time (Canter, 1999). Cumulative effects assessment (CEA), therefore, is the process of systematically analyzing and assessing cumulative environmental change (Spaling, and Smit and 1993). Cumulative effects assessment is practiced so as to identify, mitigate and possibly avoid any triggers that may result in changes of such nature (Gunn and Noble, 2010; Herring, 2009). A watershed is simply the physical catchment of a river(s) system (Ramachandra et al., 2006); an ecological entity defined by the interrelationship of its parts and functions (Reid, 1993). As such, a watershed has ecologically pre-defined spatial boundaries that set an obvious context for the consideration and management of cumulative environmental effects.

For a watershed specifically, cumulative effects are those directed toward water bodies such as lakes and rivers. They are the outcomes of ongoing land use activities within the basin, as well as physical water processes including the generation and transportation of watershed products (Blomquist and Schlager, 2005; Plummer et al., 2010; Culp et al., 2000b; Reid, 1993). Cumulative watershed effects typically result from multiple stressors (e.g. road and infrastructure developments, effluent discharge), accumulating through multiple pathways (i.e. land use activities and watershed processes), and originating from multiple sources (i.e. on-site and off-site) (see Sheelenare, 2010; Reid, 1993). In other words, they arise from the interactions of various physical and biological processes, which make it possible for impacts to accumulate over space and time. Often, the impacts from these effects are not localized or identifiable as point sources (Reid, 1998; Buckley 1994). Cumulative watershed effects can impact the function of the whole watershed system or any of its parts thereof, including soil moisture, aquatic organisms, or nutrient levels at a given river reach (Squires et al., 2010; Reid, 1998; Buckley, 1994; Reid, 1993). Such effects have a tendency to become more concentrated in water bodies long after their triggering activity has taken place (Sheelanere, 2010; Ramachandra et al., 2006; Plummer et al., 2005; Reid, 1993). For these reasons, understanding and managing the pathways and sources of watershed cumulative effects is important if we are to manage their impacts properly.

Yet, despite the wealth of knowledge about potential sources of cumulative effects developed in numerous fields of study such as ecology, hydrology, aquatic biology, limnology,

engineering, and land-use planning, regional-scale CEA and W-CEA in particular is seldom ever practiced. At the present time, only a few watershed studies with a CEA focus have been completed in Canada (see for example, Sheelanere, 2010). Specifically, studies of the institutional arrangements that could support CEA and related management strategies have been slow to evolve in the fields of EA and watershed planning. So far, research has concentrated mainly on integrated water resources management (IWRM) frameworks and supporting science.

1.3 Integrated water resources management frameworks and supporting science

Different types of development activities within a watershed demand water use at differing rates, and also release by-products differentially resulting cumulative watershed effects (Chen et al., 2004). Understanding how cumulative watershed effects occur by examining their multifarious natures, pathways and the sources, allows watershed management practices to be developed so as to protect both the ground water and point water sources (Ferreyra et al., 2008; Ivey et al., 2006; Ivey et al., 2002).

At present, integrated water resources management (IWRM) is the mostly widely accepted framework for management of water resources at the watershed level (Cervoni et al., 2008; Hooper and Lant, 2007; Genskow and Born, 2006; FitzGibbon et al., 2006). Integrated water resources management is a process that promotes the coordinated development and management of water, land, and related resources in order to maximize economic and social needs in an equitable manner, without compromising the sustainability of important ecosystem functions (Mitchell, 2005; Agarwal et al., 2000). In principle, IWRM is based on an ecosystem approach as it incorporates knowledge of the physical and biological interactions within a watershed into the management of the water resources. Managers and academics have widely endorsed the concept, given that this is a comprehensive way of managing water resources (Cervoni et al., 2008; FitzGibbon et al. 2006; Agarwal et al., 2000; Gordon, 1998). Notwithstanding this support, Mitchell (2005) identified a number of problems and challenges facing the IWRM framework, mainly related to the lack of a legislative and policy basis for implementation. Integrated water resources management is also criticized for being too broad a concept, given different definitions by different groups and creating confusion around exactly what the concept means (Nicholson, 2010; Hooper and Lant, 2007; Mitchell, 2005; Agarwal, et al., 2000; Hooper et al., 1999; Shrubsole, 1996). In practice then, it is evident that a watershed

may not be protected if there are ambiguities surrounding IWRM and how to conduct it. These types of issues emphasize the need to clearly define and implement a concept like W-CEA.

Around the same time IWRM re-emerged in the 1990s[1] as a recommended framework to address the competing uses of water resources (see Cervoni et al., 2008), CEA research in a watershed context was already in progress. In fact, supporting science has evolved quite considerably since 1990s, when Smit and Spaling (1995) conducted an in-depth evaluation of available methods to support CEA. Since then a number of methodologies and techniques for addressing impacts from both stressor-based and effects-based perspectives have been advanced (see for e.g. Squires et al., 2010; Dubé et al., 2006; Dubé, 2003). These studies draw on hydrological principles and ecology, for example, to develop a more rigorous baseline data analysis. Such baseline data provide information for quantifying pollutants for the purpose of establishing thresholds values for a given set of water parameters (Squires et al., 2009). As evident in the Athabasca model river, scientific research helped determine the appropriate sampling reference such as a river reach or entire tributary. Science is further applied to determine the most appropriate indicators for use in predicting impacts to the valued ecosystem components (VECs) (see Seitz et al., 2011). Despite recent progress in the science of assessing watershed cumulative effects, watersheds in Canada are still plagued with continued degradation due to development activities (Seitz et al. 2011). Squires et al., 2009 argue a clear conceptualization of cumulative watershed effects is fundamental to preserving ecological integrity of water resources.

To this end, not only is the science of identifying specific thresholds of change for select valued ecosystem components important, for example, (Dubé et al., 2006; Culp et al., 2000c; Gentile and Harwell, 2001), but so is understanding the institutional structures and arrangements needed to support W-CEA. This is because in tackling complex environmental management issues, and particularly cumulative effects issues, the ultimate challenge is to coordinate jurisdictional mandates and decision-making, as well as find ways to share responsibility for problem solving, given the great many stakeholders involved (Hooper and Lant, 2007; Dale and Newman, 2007; Buckley, 1992). Well-defined, well-functioning institutional arrangements are

[1] The literature is split between two origins of IWRM. The first group suggests IWRM was introduced at the Earth Summit of 1992 in Rio de Jenairo, with an even stronger emphasis of its principles arising in 1996 with the formation of the Global Water Partnership (GWP) by the World Bank, United Nations Development Program and the Swedish International Development Agency (see Mitchell, 2005; Matondo, 2002; Agarwal et al., 2000). Others argue that IWRM was deployed much earlier than that, since its principles were discussed at the United Nations Water Conference in Mar de Plata, March 14-25, 1977 (see Cervoni et al., 2008).

critical to support the roles and responsibilities of a 'lead' agency, for example, as well as roles in monitoring programs, and data management and coordination (Sheelanere, 2010; Ramachandra et al., 2006). They are also important in directing financial resources in the process of W-CEA as well as ensuring legislation and policies enable the practice of W-CEA (Sheelanere, 2010). However, little research has been done to examine institutional arrangements and the extent to which they allow or hinder 'good' W-CEA to take place.

1.4 Institutional arrangements to support W-CEA

Institutional arrangements are understood as the dynamic set of formal and informal regulations; policies and guidelines; administrative structures; networks and alliances for collective action; and inter-agents coordination which can range from public-private cooperation to organizational networking (GSH RES, 2007; Ivey et al. 2006; Geels, 2004). Institutional arrangements therefore include both tangible and non-tangible directives for a certain program such as W-CEA to be accomplished. They are just as important as the scientific and technical aspects of understanding and conducting W-CEA because they establish a template for reproducing patterns of relationships and administrative mechanisms to manage cumulative effects (Shannon, 1998).

Institutional arrangements within any given basin by definition accomplish a broad range of goals due to the fact that they encompass myriad political boundaries and resource sectors (Ward and Pulido-Velázquez, 2007; Agarwal et al., 2000; Koonce et al., 1995). Evaluating existing institutional arrangements to determine which may support W-CEA is critical so as to understand the extent to which the necessary ingredients for conducting a 'good' W-CEA are both present and engaged in by relevant parties such as proponents and regulators (Sheelanare 2010). However, the institutional arrangements necessary to support W-CEA in most Canadian watersheds are not yet well understood. Shannon (1998) and Dixon and Montz (1995) noted that the implementation of CEA generally is constrained by institutional processes within and between agencies; organizational, disciplinary and jurisdictional boundaries; allocation of functions; as well as coordination between agencies, developers and others within policy communities. Shannon (1998: 530) further states that in order to overcome jurisdictional and organizational boundaries, *"efforts to create a more holistic and integrated ecosystem-based policy must first overcome these jurisdictional and organizational boundaries"* (emphasis

added). Thus, there is a clearly documented need to better understand the ways in which institutional arrangements affect the advancement of W-CEA.

Specifically regarding the Grand River watershed, various government agencies engaged in a multitude of institutional arrangements are currently responsible for the management of various water parameters (Mitchell, 2005; Plummer et al., 2005). Although relevant partnerships and agencies are in place in the Grand River watershed, no research on the network of institutional arrangements has yet been done to determine the extent to which existing institutional arrangements may or may not support a concept such as W-CEA.

Improving institutional capabilities to carry out and sustain W-CEA is highly possible at present time, given that scientific and technical capabilities to support CEA have greatly advanced in the past two decades. More attention given toward developing complementary institutional arrangements would help reduce significant barriers to improved environmental management and CEA (Duinker and Greig, 2006; Dixon and Montz, 1995; Smit and Spaling, 1993; Buckley, 1992). By identifying key supporting institutional arrangements and capacity-building requirements, it will be possible to advance the concept and practice of CEA on a regional basis, and generate recommendations to support 'good' W-CEA in Canadian watersheds, and internationally.

1.5 Thesis organization and research products

Following this introduction is a literature review (Chapter 2.0), which describes the current state of regional CEA and institutional arrangements research. Topics reviewed include: CEA; W-CEA; EA practices in Canada and Ontario; the Grand River Conservation Authority (GRCA); integrated water resources management; water governance; policy evaluation; and institutional arrangements. The purpose of the literature review is to synthesize what is already known with regard to managing watershed resources, and thereby position this particular research within the current body of knowledge (Morse and Richards, 2002). The literature review also indicates current gaps in knowledge with respect to the advancement of CEA on a watershed basis, and it underscores the timely nature of this particular research study.

Chapter 3.0 outlines the research methods used in data collection and analysis. Research methods employed in this study are qualitative in nature. Qualitative research methods are widely used in multi-disciplinary and interdisciplinary studies and very common in social science-based investigations of environmental assessment. Methods used include document

review, a focus group, and interviews. Analysis of interview and focus group data was inductive in nature. An inductive approach allows meaning and trends to emerge from data: it is reflective of reality as experienced and communicated by the research interviewees. All data were first manually coded and subsequently analyzed using NVivo 9.0© software.

Chapter 4.0 reports the results and the discussion of the investigation. It discusses key trends and other important findings derived from the focus group and interview data. The discussion includes a range of illustrative quotes contributed by study participants. Trends reported are mainly those indicative of regularities or patterns, (Miles and Huberman, 1994). While the data often showed a strong tendency toward subject agreement, opposing views were also noted at times among research interviewees. Both types of trends are reported on as such opposing data can illuminate phenomena in a more nuanced fashion. The last chapter, Chapter 5.0, contains broad conclusions and recommendations and includes suggested areas for future research.

Chapter 2

LITERATURE REVIEW

2.1 Introduction to W-CEA

This chapter builds a case for investigating the institutional arrangements to carry out and sustain W-CEA in the case of the Grand River watershed in Ontario, Canada, and reports on the state of research in this area. It begins by defining cumulative effects, summarizing current CEA practices in Canada with special emphasis on the Ontario context, followed by a discussion of current attempts to protect watershed resources in Ontario in the absence of W-CEA. The focus is then brought back to watershed cumulative effects so as to summarize what is known about these types of effects thus far. Finally, the chapter also looks at the current state of institutional arrangements for managing complex environmental systems such as watersheds, and the capacity to engage in management of such complex environmental systems. These are all important building blocks for the W-CEA concept and approach to assessing and managing watershed cumulative effects. Literature specific to W-CEA is not extensive, however, there has been a recent drive toward understanding management of cumulative effects on a watershed basis (for example: Sheelanere, 2010; Noble, 2010b). Because of its focus on the characteristics of current W-CEA practices, this recent body of research is highly germane to investigations of institutional arrangements to support W-CEA in the Grand River watershed and elsewhere.

2.2 Understanding cumulative effects

Canter (1999:406) defines cumulative environmental effects as "…those effects, which when considered individually are often minor but when are considered jointly can cause significant impacts to the environment given their additive, interactive, synergistic and irregular nature, and ability to accumulate over space and time". However, this is just one of a range of definitions. In practice, there are numerous ways cumulative environmental effects are defined and understood and each of these perceptions brings about a different approach to analyzing these effects. Cumulative environmental effects have been conceptualized in planning frameworks (e.g. Glasson, 1999; Baker and Shoemaker, 1995), EA frameworks (e.g. Duinker and Greg, 2006; Dubé, 2003; Baxter et al., 2001; Canter 1999; Burris and Canter, 1997; Girts et al., 1997), as well as in strategic environmental assessment frameworks (e.g. Gunn and Noble,

2010; Gunn and Noble, 2009; Noble, 2008; Harriman and Noble, 2008). They have also been defined based on their nature, origins and pathways (Noble 2010b; Sheelenare, 2010).Given there is no universally agreed upon definition of cumulative environmental effects, it is useful to review a few that have appeared in literature since the early 1990s:

> The accumulation of human-induced changes in Valued Ecosystem Components (VECs) across space and over time that occur in an additive or interactive manner (Spaling and Smit 1993:3);
>
> A change in the environment resulting from multiple initiatives of the past, present and reasonably foreseeable future, which combine in an additive, amplifying or discontinuous manner. Key instances occur when such interactions threaten or induce impairment or loss of valued environmental components (Shoemaker, 1994)
>
> Changes to the environment caused by an action in combination with other past, present and future human actions (Hegmann et al. 1999:17);

Sheelanere (2010) and Noble (2010b) note that other literature has defined cumulative environmental effects based on their nature, origins, and pathways of accumulation, underscoring just how many ways there are to conceptualize them. It is imperative to understand that any of these definitions may be adopted and as a result, it is no surprise various frameworks and approaches exist to assess and manage cumulative environmental effects.

2.3 Cumulative effects assessment

Cumulative effects assessment (CEA) is the process of systematically scrutinizing and evaluating the cumulative environmental change (Spaling and Smit, 1993) so as to identify, mitigate and possibly avoid triggers, which can result in these types of changes (Gunn and Noble, 2010; Herring, 2009). In Canada, CEA is legislated under the *Canadian Environmental Assessment Act, 1992 (CEA Act),* which is applicable to projects initiated, funded or permitted to occur by one of more than 100 federal departments or agencies, as well as private proponents if their projects trigger the *Act* and are listed in the Inclusion List Regulations under the *Act* (Sinclair and Doelle, 2010; Herring, 2009). Each of the provinces and territories in Canada has their own requirements for the types of the projects required to undergo environmental assessment.

In the case of Ontario, EA is generally practiced under the Ontario *Environmental Assessment Act, 1990*(EA Act), however some types of development activities are excluded from environmental assessments and are instead addressed under the *Planning Act, 1990*; *Water*

Resources Act,1990;*Aggregate Resources Act, 1989;* and *Conservation Act, 1946*. The *EA Act* is applicable to public undertakings as defined in the *Ontario Regulation 334*. Public undertakings are classified based on four program groups: designations, declarations, 'class' EAs and individual EAs. Class EAs consist of routine undertakings whose environmental effects are generally predictable and able to be mitigated and therefore the class EA follows the planning cycle and consultation requirements that have already been prescribed for that particular class of undertakings (Lindgren and Dunn, 2010; Government of Ontario, 1990a). They might include municipal engineering projects administered under the Municipal Class EA, and/or the flood and erosion control projects administered as part of the Conservation Authorities of Ontario Class EA. Private undertakings are subjected to the *Act* only if they are specifically designated by regulations or are requested by interested parties to undergo an EA (Lindgren and Dunn, 2010; Graci, 2009). The *EA Act* in Ontario, however, does not require the consideration of cumulative environmental effects at the project level.

Unlike the Ontario provincial *EA Act*, the Canadian federal *CEA Act* requires proponents to assess cumulative environmental effects. Section 16(1)(a) decrees for every comprehensive study of a project and every mediation or assessment by a review panel there should be consideration of "the environmental effects of malfunctions or accidents that may occur in connection with the project and 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." Section 16(2) of the *CEA Act* also states:

> 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).

The *CEA Act* does require the consideration of cumulative effects, however the *CEA Act* is only applied to one single project at a time, which means any cumulative effects resulting from smaller projects in combination could still cause significant environmental change and might not always be considered within a given EA processes (Duinker and Greig, 2006; Benevides, 2004; Kennett, 2000). This phenomenon has been referred in literature as 'death by a thousand cuts' (Noble, 2005). What is more, limiting the *CEA Act* to individual projects means that only a 'stressor-based' approach to CEA is taken. A stressor-based approach focuses on identification

of environmental stressors associated with a specific project (such as dioxins from a pulp mill, for example) and their potential effects on valued ecosystem components (VECs) as identified in the project assessment such as fish population (Dubé, 2003). Seldom do proponents thoroughly assess potential cumulative impacts beyond their own project's spatial and temporal scales (Gunn and Noble, 2010; Noble, 2008).

Although Harriman and Noble (2008) and others recognize that a 'stressor-based' approach to analyzing cause-effect relationships between a project and the host environment is valuable on a micro (project) level, this approach to CEA is inherently inward-focused and cannot fully predict cumulative effects not entirely linked with a specified development project. Often, the focus of 'stressor-based' approaches to CEA indicates the environmental consequences due to an additional development project to an environment, which is already experiencing stress from other existing development projects, making the context of stressor-based approaches to CEA causal in nature. Such a view of cumulative effects defies the purpose of a 'good' CEA, which requires that the changes due to multiple stressors in both spatial and temporal scale to be assessed (Noble, 2010 a, b, c; Squires et al., 2009). Therefore, at this project level using the stressor–based approaches, CEA is solely practiced so as to identify the stressors that may result cumulative effects based on just the proposed project perimeters, which are limited in its spatiotemporal scale because they are based on one project only. This is to say that the accumulating effects from the stress caused by this newly proposed project alone, have little regard to the incremental and synergistic aspects of the total cumulative effects from the general environment, given that the stressor-based approaches ignore the stressors from other projects in the same environment.

Duinker and Greig (2006) suggest the most appropriate and sensible approach to CEA within EA is as part of land use planning at a regional scale. This is analogous to regional CEA, which has been informally conducted by academic institutions, government researchers and public agencies, both outside and as part of the formal Canadian EA process (Sheelanere, 2010; Squires et al., 2009). Regional CEA has evolved quite considerably since EA was first introduced in Canada in the early 1970s through initiatives carried out for both the terrestrial landscapes and aquatic environments (see for example: the Great Sands Hill Regional Environmental Study, 2007; and the Northern River Basin Study, 1992-1996).

2.3.1 Integrating project-based CEA and regional CEA

Recently, literature on CEA suggests that assessing cumulative effects due to development activities is best practiced at a regional scale, as this scale is better suited to the management of environmental changes caused by cumulative environmental effects and can offer better protection of the environment from the future consequences of development, as opposed to the site-specific scale typically adopted in project-based CEA (Seitz et al., 2011; Noble, 2010 a, b, c; Squires et al, 2009; Noble, 2008; Duinker and Greig, 2006; Dowlatabadi et al., 2004; Baxter et al., 2001). The regional context allows for linkages across multiple scales of assessment and thus allows for both the project specific impacts to be observed as well as those effects resulting from the interaction of perturbations beyond the project developer's control (Noble, 2010a,b,c; Noble, 2008; Dubé, 2003). Allowance of such linkages among scales of assessment has dubbed this approach for CEA the name of 'effects-based' approach (Squires et al., 2009; Dubé 2003; Gentile and Harwell, 2001). Effects-based regional CEA allows the consideration of impacts that may otherwise be insignificant when considered individually from the perspective of a single project. It emphasizes the combination of other projects within the watershed area and consideration of future foreseeable development activities, whereby there may result substantial impacts to ecological systems.

In essence, regional-scale CEA adopts a scale that is not necessarily congruent with jurisdictional divides but rather, is ecologically defined (Noble, 2010a,b,c; Harriman and Noble, 2008). Regional-scale CEA allows for an expanded temporal scale of assessment given that the various projects to be considered are not already approved to occur and also those, which have staggered implementation time frames. This is an important progression given that cumulative effects may take a long time to fully emerge. The 'effects-based' approach to CEA sets the context for watershed-scale CEA (W-CEA). In this approach, the watershed is viewed from a systems perspective to understand how a range of regional stimuli may provoke an environmental response. In this approach, the mechanisms which cause the response are not the basis for undertaking CEA, but the observed response is (Squires et al., 2009; Reid. 1993).

2.3.2 W-CEA as regional CEA

It is well known that Canadian rivers exposed to increased urbanization, agricultural, and industrial developments can experience cumulative effects with significant changes to water quality and quantity. This is due to increased water withdrawal, discharge of effluent, infiltration,

surface run off, and other similar phenomena (Squires et al., 2009; Scott and Imhoif, 2005; Leadlay and Kreutzwiser, 1999; Girts et al., 1997). Analysis of these changes suggests that the need to improve CEA for river systems (Seitz et al., 2011; Squires et al., 2009; Girts et al., 1997). At a watershed level, effects-based CEA should be able to address the consequences of individual projects in combination; and also predict their significant environmental impacts more readily due to recently improved regional science and interpretive strategies for river health (Seitz, 2011; Squires et al., 2009; Gentile and Harwell, 2001). The total anthropogenic stress upon the watershed can be understood more fully by observing changes to environmental parameters such as soil, water and nutrients (of incremental, additive or synergistic nature), together with natural processes of change in the watershed such as bank erosion. As such, the nature of the inter-related cumulative watershed effects arising from the water resources uses in a given basin, which considers both the on-site and off-site cumulative watershed effects can then be advocated.

The application of a more extensive temporal and spatial scale, as in regional CEA, allows for new tools to be developed and new types of predictive measurements to be applied in measuring watershed ecosystem health (Squires et al., 2009; Gentile and Harwell, 2001; Culp et al., 2000a,b). A regional approach to watershed management is congruent with regional sustainable development, which aims to better plan shared land, and water resource uses and better manage water sources to meet for human and ecosystem needs (Leendertse et al., 2008; Hedelin, 2007;Gibson, 2006; Cooper and Sheate, 2004). In addition, if W-CEA is conducted systematically, it can influence regulatory change by providing evidence to decision-makers proving why there ought to be new regulations, which was the case in the Northern River Basins Study in Northern Alberta, Canada (Culp et al., 2000b).

Currently, some significant challenges to regional CEA and W-CEA and river systems in particular do exist due to analytical science approach that has been taken in advancing research in these areas. Noble (2008) argues that with respect to regional CEA, far more emphasis has been placed on procedural evaluations such as for modeling systems that compare historical data, with less emphasis on future scenario building (planning) that can offer alternatives to developments activities. Another identified challenge in regional CEA has arisen from the diverse impact analysis measurements, numerous employed methodological frameworks and uncoordinated data collection as a result of procedural differences (Seitz et al., 2011; Wildesen, 2009; Dubé et al., 2006; Brown et al., 2001; Cocklin et al., 1992a,b). Furthermore, regional CEA

studies often remain disconnected from development decision-making and so far have had limited influence in the formal EA process in Canada (Noble, 2010a). Sheelanere (2010) also highlights concerns over who has authority to make decisions, and how recommendations for managing cumulative effects identified in this type of assessment will be implemented.

Other systematic challenges exist in the realm of W-CEA as well. For example, methodological components of W-CEA derived from natural science such as hydrology and ecology are the ones that have evolved most, and become most prominent (Dubé et al., 2006; Dubé 2003; Culp et al., 2000a; Reid, 1993).Biological and chemical indicators for stressors are currently being developed as part of Canada Water Network research initiative. These indicators demonstrate how development of natural resources in a chosen watershed impacts corresponds to observed changes in various valued ecosystem components (VECs) (Dubé 2003). Components of W-CEA related to the social-political frontier and the institutional context for decision-making still lag behind physical science advancements, as evident from lack of literature that examines these spheres. There remains a great need to investigate how institutional arrangements are or are not set up to support W-CEA since in Canada there is no specific policy framework to guide CEA at a watershed level. As well, provincial environmental policy frameworks have multiple and sometimes competing objectives spread amongst various jurisdictions whose aim is may be to attain broad management goals instead of specific environmental ones (Plummer et al., 2005).

2.4 Cumulative environmental effects in watersheds

A watershed is an area or region drained by a river, lake or sea (Heathcote, 2009). A river watershed constitutes a critical link between land and sea. Watersheds provide habitat within their wetlands, rivers and lakes for 40% of the world's fish species, some of which migrate between freshwater and marine systems; and for terrestrial species as well (Nicholson, 2010; Ramachandra et al., 2006). Therefore, a watershed is an ecological unit whose parts, functions and interactions define how it works as a system (Reid, 1993). The watershed ecological system is complex, adaptive, and evolutionary in nature (Nicholson, 2010; Hooper and Lant, 2007; Olewiler, 2004). It can provide a context to address a whole range of factors affecting watershed health (Benson 1996). The watershed system can also be viewed as a storehouse of natural capital like soil, flora and fauna that produces both marketable commodities (e.g. crops) and non-marketable ecosystem services (e.g. nutrients cycling) (Hooper and Land, 2007).

This unit provides an integrated system that, given to its holistic nature, can be used in

understanding human-environment interactions (Nicholson, 2010; Heathcote, 2009). Girts and others (1997:310) note " a river basin (watershed) or a hydrologic unit is normally the most appropriate system in which to study fish, water quality, riparian vegetation, wildlife, recreation and cultural values". Thus, a watershed as a type of region provides an ecologically pre-defined spatial boundary that can indicate what types of cumulative effects to be cognizant of, as well as given the fact that some of the impacts take longer time to be observed, this scale served as a reference to such impacts which require a varying duration and frequency to be visible (Reid, 2010; Heathcote, 2009; Reid, 1993).

When one watershed process or product is altered by development activities, the others change to compensate it (Reid, 1993). Although many developmental activities may directly affect a small number of environmental parameters such as soil properties, flora and fauna, topography and chemicals, these parameters can in turn influence the production and transportation of water, sediments, organic matter, chemicals and heat (Reid, 2010; Reid, 1993). For the watershed specifically then, watershed cumulative effects arise from multiple land-use activities and from the generation or transportation of watershed products, which can impact the whole watershed system or its parts thereof (Seitz, et al., 2011; Reid, 1998; Reid, 1993).

Cumulative watershed effects are complicated by the properties of watersheds in that ecosystem processes may obscure the relationship between causes (stressors) and effects. Effects may be delayed until far beyond the time when a triggering activity has occurred (temporal decoupling), and frequently the location of an impact is removed from the original land-use or development activity (Reid, 2010; Girts et al., 1997; Reid, 1993). Some changes may slowly and unnoticeably accumulate until a threshold is reached and a catastrophic change is triggered, without any evident forewarning. For example, slow channel incision may progress slowly until stream banks are high enough to fail. Other effects may accumulate slowly until the occurrence of an external triggering event like a large storm follows before any impacts are visible or expressed on riparian areas for example. These effects also may not be evident until after preventative measures are no longer possible. Such threshold-type changes are particularly sinister from a management perspective, because precedents for their occurrence may not exist (Reid 1998; Reid 1993). Such effects can be predicted only from a basic understanding of the processes contributing to them. These thresholds-type changes may be part of the reason uncertainties exist as to whether and how development proponents should be accountable for impacts arising from their project.

2.4.1 Categories of watershed cumulative effects

Development activities and other land-use activities within a watershed together with the natural processes of the watershed itself, can significantly impact the health of the river system that drains a given watershed (Seitz et al., 2011; Heathcote, 2009; Reid, 1993; Coggins, 1991). This is because the modification of any environmental parameters such as topography may provoke changes in the watershed processes. If a watershed process or product is modified, others will change in compensation (Ramachandra et al., 2006; Reid, 1993). Water is known to be a sensitive receptor; therefore environmental impacts within the watershed such as those resulting from multiple land use activities and transportation of watershed products and processes can accumulative in the water bodies given the interrelations of water and land (Ramachandra et al., 2006; Plummer et al., 2005; Reid, 1993). To be able to predict and manage cumulative watershed effects, and to ensure sustainability of water resources, we must first understand how such effects are generated, interact with each other, how they are expressed upon the environment and how a watershed, as a system, responds to them (Seitz et al., 2011; Noble, 2010b; Sheelanere, 2010; Reid, 1993). Almost all development activities and land-use activities can cause cumulative watershed effects because most of these activities alter the soil, water, vegetation and other biological components in an ecosystem. They also affect systemic relationships that act to stabilize, maintain and enhance each other and thus the watershed system as a whole (Coggins, 1991).

Cumulative watershed effects can be categorized either as ‘on-site’ or ‘off-site’ (downstream) based on the types of interactions generating them. On-site cumulative watershed effects take place when a triggering change or the resulting impact is long lasting, or if changes generated elsewhere are brought to a site and interact with other on-site changes or natural watershed processes (Sheelanere, 2010; Ramachandra et al., 2006; Reid, 1993). Impacts generated by on-site changes become cumulative when such changes exacerbate watershed processes by: (1) causing multiple responses (some perhaps unanticipated), and/or (2) provoking interactions or chain events which lead to different kinds of environmental effects altogether (Reid, 1993). An example of an on-site cumulative watershed effects would be interference with soil moisture or nutrients cycles due to changes to infiltration rates resulting from road or parking lot construction.

Off-site cumulative watershed effects take many forms. All of them involve altered transport processes or watershed products (such as water, sediments, organic material and heat).

Impacts from off-site watershed cumulative effects occur when watershed processes are altered for long enough that discernable change accumulates over time (Reid, 1993). Watershed cumulative effects also occur when responses from multiple sites are transported to a common site, or when the transported responses interact at another (activity) site (Reid, 2010; Hooper and Lant, 2007; Reid, 1993). Because transport entails re-deposition and re-entrenchment and so, watershed responses from such effects usually lags the changes which drive them, resulting geographic decoupling of the cause-effects relationships and masking of the impact expressions (Girts et al., 1997; Reid, 1993). Cumulative watershed effects often occur far from the activity triggering them: for example, irrigation and domestic use can augment flow downstream of a specific development project by importing water from other areas of the river system (Ramachandra et al., 2006; Reid, 1993). Off-site cumulative watershed effects are more pronounced at the process level of interaction, because processes are influenced by changes that result from different types of development activities at the watershed. Cumulative effects would then occur as a result of environmental parameters interacting in different rates and ways. By understanding the nature of the cumulative watershed effects both on-site and off-site, watershed management practices can be designed to intervene upon and protect various watershed resources such as groundwater and point water sources (Nicholson, 2010; Ferreyra et al., 2008; Ivey et al., 2006; Ivey et al., 2002). Figure 2.1 provides a simplified framework for understanding on-site and off-site cumulative watershed effects. The classification of on-site and off-site indicates that it is important to understand both the watershed processes and the influence of development activities in order to manage cumulative watershed effects.

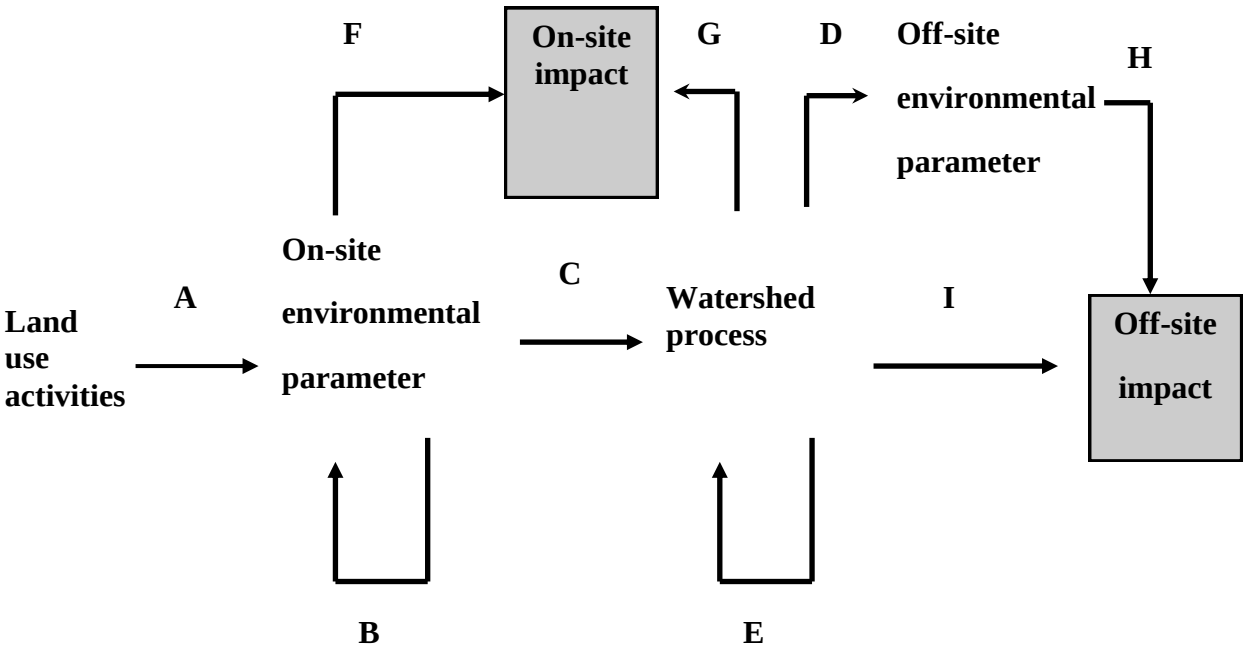

Figure 2.1.Influences that generate on-site and off-site cumulative watershed effects. Land use activities can have direct influence upon on-site environmental parameters (e.g. flora and fauna) (Path A). Changes in vegetation, soil characteristics, topography, chemicals, water, pathogens, and fauna can induce compensatory changes in one another (path B) and 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 influence environmental parameters (path D), and they can also interact (path E). Changes in either environmental parameters or watershed processes can generate on-site cumulative watershed effects (paths F and G), but only changes in watershed processes can produce off-site cumulative watershed effects (paths H and I) (adapted from Reid, 1993).

2.4.2 Cumulative environmental effects in the Grand River watershed

The Grand River watershed continues to experience anthropogenic stress due to population growth coupled with development pressure. Anthropogenic stressors from development activities cause both 'on-site' and 'off-site' cumulative watershed effects as explained above, and illustrated in Figure 2.1. Some of the main activities contributing to cumulative watershed effects in the Grand River watershed include: aggregate mining; agricultural activities; flood control and electricity damming; sewage treatment; and urban development (Ontario Ministry of Environment, 2009; Scott and Imhoif, 2005; Plummer et al., 2005; Olewiler, 2004; Baker and Shoemaker, 1995; GRIC, 1982). Geologically, the Grand River watershed contains rich gravel resources and these are utilized in the construction of roads and other infrastructure. Given its proximity to the Greater Toronto Area where demand for

aggregate products is high, as well the revitalization and expansion of urban centers within the Grand River watershed itself, the watershed has become one of the most important and productive sources of aggregate in the province (GRCA, 2010; GRCA, 2009). Aggregate mining to extract sand and gravel for construction requires dredging to create a gravel pit. This leads to evaporation from the pit pond, and leveling off the groundwater table across the pit (GRCA, 2010), all of which results in impacts to groundwater resources. Aggregate mining is a significant concern within the watershed given that 82% of residents depend on groundwater for municipal use (GRCA, 2010; Koychova, 2003).

Agricultural activities such as farming and animal husbandry are the major contribution of non-point source of water pollution in the Grand River watershed (Olewiler, 2004). It is estimated that about 79% of rural municipalities are engaged in agriculture as their main development activity (GRCA, 2009). Agricultural activities increase the phosphorus loading into the Grand River resulting impacts to the surface water, which affect both human and aquatic species. Flood control and electricity damming such as the dams at Caledoni and Dunnville, they create impoundment of water, resulting impacts downstream (Winter and Duthie, 1998). Due to such damming, sedimentation increases, the water temperature and natural flow regimes are altered, creating further impacts to the micro-invertebrates as well as other aquatic species such as fish. Sediments in streams damage spawning areas by reducing respiratory efficiency (Scott and Imhoif, 2005; Olwewiler, 2004). The Grand River has been renowned for its world-class fisheries, but at this moment, this highly regarded record applies just to its upper tributaries (Olewiler, 2004). It is known that such impoundments generally deteriorate water quality given that elevated nutrients concentrations are often observed downstream (Winter and Duthie, 1998).

There are currently 26 sewage treatment plants on the Grand River and four surface water treatment plants for drinking water (WTP). The WTPs are the Holmedale (City of Brantford); Manheim (Region of Waterloo); Dunnville (County of Haldimand); and Ohsweken (Six Nations of the Grand River). There are also numerous groundwater treatment plants and monitoring wells in the area. Although treatment facilities exist in the Grand River watershed, with almost one million residents serviced by them (GRCA, 2009), there is still high nutrient loading into the Grand River, which raises questions with regard to the assimilative capacity of the watershed for such waste and wastewater (Olewiler, 2004).

In addition to these water-based activities whose environmental effects are expressed within the watershed cumulatively, urban development is also a major challenge to ecosystem

integrity given that it inherently reduces vegetative cover, and increases erosion due to channelization under municipal works (Region of Waterloo, 2010). Urban development also contributes to sedimentation due to surface run-off associated with highways, parking lots, and other impervious surfaces. This phenomenon is ever-increasing in the watershed given the land-use changes municipalities are initiating to accommodate the influx of new residents and supporting industry and infrastructure (Scott and Imhoif, 2005). As a consequence of all of these development activities, the Grand River has become one of the top three Ontario rivers in receipt of a total phosphorus load that exceeds the Ontario provincial water quality objective of 30 µg/L (see Figure 2.2) (Ontario Ministry of Environment, 2009).

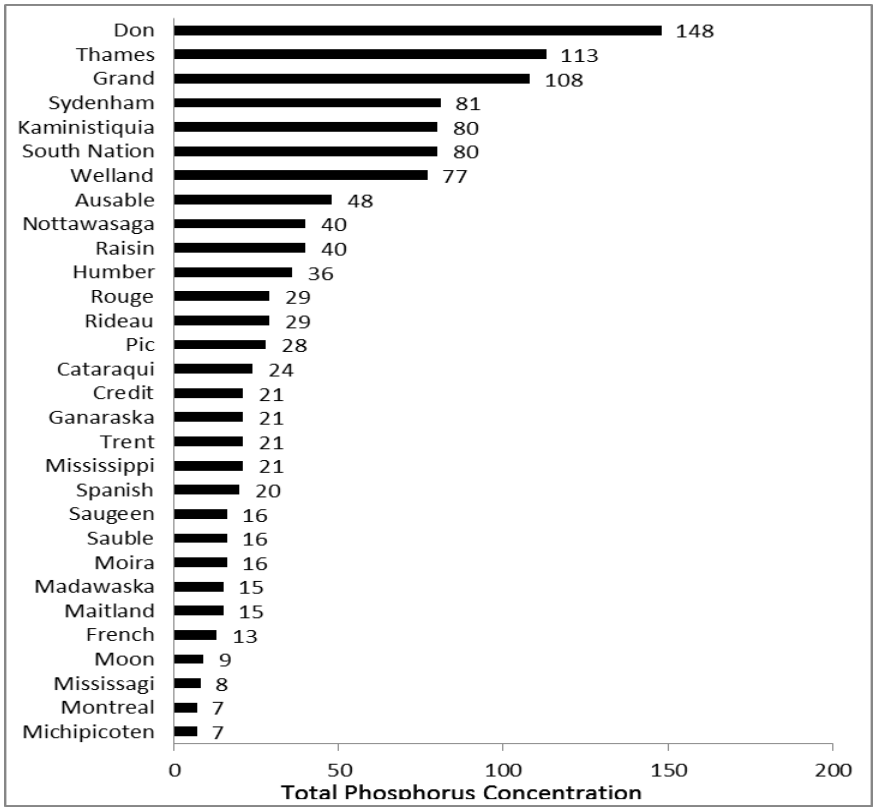

Figure 2.2 Total Phosphorus concentration in 30 Ontario rivers based on sampling from 2001-2006. Adapted from Ontario Ministry of Environment, 2009.

To emphasize the kinds of anthropogenic stress experienced by the Grand River watershed, Table 2.1 below summarizes the points discussed above and provides examples of related impacts observed in the watershed. With far less than pristine watershed conditions, as well as the need to balance future demands for water resources, it is an opportune time to endorse the W-CEA concept. This is especially true in light of the following observation made by Shrubsole (2004: 7), who noted: "..current institutional arrangements for wetland management

(in the GRW) have had limited success in protecting the ecological functions and areal extend of natural areas". The general approach to watershed management and protection in Ontario is now discussed in Section 2.4.3.

Table 2.1 Activities that cause 'on-site' and 'off-site' cumulative watershed effects in the Grand River watershed

Activity	Resultant Stress and Impacts to the Watershed
Aggregate Mining	• Sand and gravel deposits used for aggregate resources also form the aquifers for groundwater storage and recharge areas. Their removal causes disruption to water storage and flow regimes (e.g. Townships of Erin and Puslinch). • Disruption of flora and fauna. • Disturbance of water table and local wetlands due to formation of pits and quarries, thus impacting water quality. • Adverse visual impacts from dust and noise due to hauling of products from the mining sites
Agricultural Activities	• Non-point source water pollution due to discharge of agricultural products that stimulate growth of algae and cause severe oxygen depletion in summer months. • Agricultural run-off from manure piles, and direct pollution from poultry farms (e.g. turkey farms) along the river impacts water quality due to addition of toxic substances and trace contaminants (*E. coli*) • Agricultural run-offs also increases total phosphorus loading into the Grand River and its main tributaries.
Flood Control and Electricity Damming	• Water withdrawal and soil erosion (channelization) result from activities such as construction of flood control structures and reservoirs • Impacts due to large old dams such as increase in water temperature and alterations of the natural flow regimes (example at Caledonia and Dunnville.)
Urban Development	• Reduced recharge of ground water due to impervious surface. • Evapo-transpiration and increased surface run–off (due to impervious surfaces such as streets, parking lots and building coverage, and containing contaminants such as petroleum hydrocarbons, road dirt and salt) both alter the regional water 'budget' and affect water quality. • Sedimentation from surface run-off/storm water run-off/highway run-off also impacts stream channels by increasing their width and decreasing their depth, thereby increasing the likelihood of flood damage.
Sewage Treatment	• High load of nutrients and undesired chemicals (i.e. pharmaceuticals) released from sanitary sewage treatment facilities strains the watershed's capacity to assimilate wastewater overall • Oxygen-demanding organic wastes from municipalities deplete water oxygen supplies.

Source: Derived from Ontario Ministry of Environment, 2009; Scott and Imhoif, 2005; Plummer et al., 2005; Olewiler, 2004; Winter and Duthie, 1998; Baker and Shoemaker, 1995; GRIC, 1982.

2.4.3 Management and protection of watershed resources in Ontario

Generally, the management of watershed resources in Ontario is fragmented among many jurisdictions that naturally beget a multitude of institutional arrangements, each with its separate goals and objectives. This fragmentation has been noted and criticized in the literature consistently since the 1980s through to the first decade of the new millennium (Cervoni et al., 2008; Hill et al., 2008; Mitchell et al., 2005; Plummer et al., 2005; Shrubsole,1996; Koonce et al., 1995; Mitchell and Shrubsole, 1992; Mitchell, 1989). This is not a new phenomenon and definitely not characteristic of Ontario alone. A similar situation exists in many other provinces and territories in Canada (Hill et al., 2008). Despite this common impediment to coordinated management, Ontario took bold moves in delegated water management governance long before other provinces in Canada attempted to do so (Watson, 2004). Institutions such as the conservation authorities of Ontario, though which watershed resources management decisions were taken at a local level (by community living within the watershed), began as early as the 1940s (Watson 2004; Mitchell and Shrubsole, 1992). Also, early acknowledgement of challenges to implementation of the integrated water resources management (IWRM) strategies in Canada can be accredited to Ontario (discussed further in Section 2.5).

Ontario presents a unique case in terms of watershed resources management due to the presence of conservation authorities (CAs). The conservation authorities were formed under the *Conservation Authorities Act*, *1946* (*CAs Act*). The *CAs Act* stipulates that CAs should operate with a watershed as their management unit (Veale, 2007; FitzGibbon et al., 2006; Mitchell, 2005, Plummer et al., 2005, Veale, 2003; Shrubsole, 1996; Mitchell and Shrubsole, 1992). This concept is one of six founding principles for CAs. The other five founding principles include: the formation of a CA has to be a local initiative; has to be formed as a provincial-municipal partnership; has to support a healthy environment and economy; has to adopt a comprehensive approach to watershed management; and lastly, has to function cooperatively and in a coordinated fashion with other management bodies and the community at large (Fitzgibbon et al., 2006; Watson, 2004; Shrubsole, 1996). The *CAs Act* also proclaims that CAs should be corporate bodies with reporting relationship to the Ontario Ministry of Natural Resources (Veale, 2007). Operating under a partnership-funding model, CAs were made financially viable through general and special projects levies. The province also directly dispenses provincial funding for projects it deems eligible, although this provincial support has been decreasing since the early 1990s (Veale, 2007; Veale, 2003; Shrubsole, 1996).

Of Ontario's 36 CAs, most are focused on areas within southern Ontario; an area in which 90% of the province's population resides (FitzGibbon et al., 2006). The Grand River Conservation Authority (GRCA) was among the first CAs to be formed (Mitchell and Shrubsole, 1992). Early intentions of the GRCA were to make water and land management at a watershed scale more effective, and manage the destructive impacts of flooding and pollution in populous areas of the watershed (Mitchell and Shrubsole, 1992). Although these intentions were well conceptualized, given the founding operating principles of the *CAs Act*, it wasn't long before other newly formed institutions with similar mandates began to emerge. These institutions quickly caused overlap and redundancy in operations. Shrubsole (1996: 325) noted during this period (roughly 1992-1996) "the issue of which agency has responsibility and leadership for water resource management in Ontario became less clear".

The important and enduring question of water resources leadership was highlighted in 1993 when the Ontario government underwent a provincial agencies restructuring program. It was then that agencies such as the Ministry of Environment and Energy, among others, were re-organized to adopt an ecosystem approach rather than maintain a 'functional resources' management strategy (Shrubsole, 1996; Mitchell and Shrubsole, 1992). This movement was a critical one to ensure proper management strategies were in place and to survive in an era of reduced funding: the shift was part of the government's financial restraint efforts at the time (Shrubsole, 1996). Moreover, the reform of the *Planning Act* in 1992-1995, the introduction of the Ontario provincial policy statement as a new directive for municipalities to follow, and the formation of the region of Waterloo as a new form of government structure also compounded the now quite indistinguishable role of the GRCA in watershed management. These changes reduced its legitimacy in decision-making about developments (Plummer et al., 2005; Shrubsole, 1996; Baker and Shoemaker, 1995; Mitchell and Shrubsole, 1992).Newly formed agencies and provincial government departments were not obligated to support GRCA decisions and only considered them as recommendations (Watson, 2004). As a result, responsibility for managing the cumulative environmental effects of development activities in the watershed has been left to no one agency in particular.

2.5 Integrated water resources management in Ontario

Watershed management and planning initiatives such as integrated water resources management (IWRM) suggest that by establishing a management system that observes change

based on an ecological unit like a watershed, attention is given to the overall understanding of watershed processes and the responses of the environment to these changes (Meek, 2010; Blomquist and Schlager, 2005; Reid, 1993). The watershed is therefore a scientifically prudent scale that acts as a framework for practicing sustainable water resource management (Heathcote, 2009; Cervoni et al., 2008; Heathcote 2008; FitzGibbon et al., 2006). The watershed allows managers of these resources to identify problems such as poor water quality, diminishing water quantity, aging water infrastructure, and water withdrawal (Ferreyra et al., 2008; Ivey et al., 2006; Mitchell, 2005). In this way, IWRM can serve as a planning and management framework to capture watershed-wide concerns and solutions, even though many of the problems that exist at the watershed level are often intergovernmental in nature (Leendertse et al., 2008; Harrison, 2002). Under the IWRM framework, some cumulative watershed effects are taken into consideration, however there is no mechanism to link concern for cumulative watershed effects to the formal EA system, and this remains a challenge in assessing and managing cumulative watershed effects in general (Canter and Ross, 2008).

Despite its potential contributions to cumulative effects assessment, support for IWRM in Ontario has been dwindling in recent years (Heathcote, 2008). The present lack of support for IWRM in Ontario stems from two facts. First, lack of financial support (in operating budgets) and highly trained personnel in the Ministries of the Environment (MOE) and of Natural Resources (MNR) (Heathcote, 2008; Kreutzwiser and de Loë 2010). Second, in reality, watersheds are still managed for a range of single-purposes uses (Hooper and Lant, 2007) with little discussion among the affiliated managers about the environmental management strategies employed, and little inter-agency coordination, thus resulting in a water governance challenges (de Loë et al., 2009).

When the MOE and MNR experienced funding cuts in the 1990s, a number of programs were erased which resulted in a loss in focus on IWRM. For instance, the 2006 report on *Sustainable Water Management: State Of Practice in Canada And Beyond* by the Canadian Water Resource Association (CWRA) recommended to provincial governments that Ontario re-establish stable support for IWRM initiatives (FitzGibbon et al., 2006). Two years later in 2008,the CWRA's Annual Conference was themed: *"Integrated Watershed Management in Ontario: Current Practices and Future Direction*". The conference revisited the concept of IWRM, once again advising of the significant threats to water quality and quantity and viewed the existence of conflicting expectation in water management in the province as a result of such

budgetary cuts (Heathcote, 2008). Budgetary cuts tend to increase institutional, organizational and human resources management constraints and thereby reduce institutional capacity (Veale, 2007; FitzGibbon et al., 2006; Veale, 2003).

Integrated water resource management strategies have been difficult to implement in general. Watson (2004) argues IWRM has remained an academic and professional 'myth' with a large implementation gap exacerbated by institutional barriers and policy translation failures. When approaching the management of a watershed as a single administrative unit, competing goals naturally arise and agencies may be fundamentally divided on whether these goals should be development- or conservation-focused (Nicholson, 2010). Hooper et al. (1999) also note there is often only a superficial understanding of integrated management because integrated approach may be defined too broadly in a watershed management planning process.

This 'myth' phenomenon is reinforced by the fact that the concept of IWRM is widely debated and its definition is hazy (Agarwal et al., 2000). It is widely thought that IWRM must be place-based and relevant to a particular locale. However, in Ontario, there has not been a formal definition of 'what' or 'where' IWRM specifically is. Furthermore, there are practical difficulties in integrating the various institutions that manage some components of water resources, given blurry lines of responsibility among the many agencies responsible for water management (Plummer et al, 2005; Mitchell, 2005; Shrubsole, 1996). This is due to the fact that the legitimacy in the network governance structure that is applied in water management based on IWRM principles appears invisible, due to the fact that power is not officially delegated to all the stakeholders involved (Gearey and Jeffrey, 2006). The adoption of a watershed as a management unit by itself does not overcome the challenge of identifying a suitable decision-making authority (Cervoni et al., 2008; Ivey et al., 2006; Blomquist and Schlager, 2005).

Integrated governance structures for the purpose of carrying out IWRM have been the subject of literature worldwide, not just in Ontario (see Kreutzwiser and de Loë, 2010; de Loë, et al., 2009; Hooper and Lant, 2007; FitzGibbon et al., 2006; Mitchell 2005; Agarwal et al., 2000). Integration problems arise from complexities of working at a watershed scale and the need for clear collaboration and cooperation mechanisms among the multiple stakeholders (Ferreyra et al., 2008; Hooper and Lant, 2007; Blomquist and Schlager 2005; Watson, 2004; Matondo, 2002; Agarwal et al., 2000). According to Kreutzwiser and de Loë (2010), integration can only be achieved in water management if important links, relationships, and priorities among the stakeholders are acknowledged in decision-making processes. For the joint management of water

resources to overcome integration barriers, there has to be far less ambiguity and vagueness with respect to governance structures and the institutions involved (Fleeger and Becker, 2008; Ivey et al., 2006; Dinar and Salted, 2005; Watson, 2004; Hopper et al., 1999).

It is apparent that in principle, combining scientific input with resource planning and management frameworks at a watershed scale is possible, however there has to be an accompanying focus on supporting governance structure as well as a concrete set of directives to follow in order to produce desired outcomes. Given the current shortcomings, limitations and difficulties of implementing IWRM generally, and for Ontario in particular, it has become imperative to approach cumulative watershed effects from some other angle, namely W-CEA, so as to safeguard the watershed resources for both ecosystem health and human use.

2.6 Institutional arrangements to support W-CEA

Institutional barriers rather than scientific or technical knowledge often result in the monumental obstacles experienced in the process of managing complex environments such as a watershed (de Loë et al., 2009; Hooper and Lant, 2007). Complex environmental management requires institutional arrangements that are different from the conventional and inflexible institutional arrangements based on traditional command-and-control regulatory policy frameworks, which have so often been relied on for managing point sources rather than multiple sources over a larger geographic area (Hooper and Lant, 2007). This is because the impacts experienced in complex systems such as a watershed, are not localized and span beyond the sectorally defined institutional arrangements.

Institutional arrangements (IAs) are defined in several ways. Ivey et al. (2006: 945) define institutional arrangements as "legislation and regulations; policies and guidelines; administrative structures; economic and financial arrangements; and political structures and processes". In environmental assessment, the Great Sand Hills (GHS) advisory committee for the Great Sand Hills Regional Environmental Study defined IAs as consisting mainly of government departments and agencies, and legislation (GSH RES, 2007). Institutional arrangements are therefore both tangible and non-tangible directives for a certain task to be accomplished or managed. For the purpose of this study, the definition adopted is that offered above by Ivey et al. (2006). The overall purpose of IAs, therefore, is to provide guidance and decision-making instruments to the stakeholders responsible for water resources management. Scoping existing IAs for W-CEA is necessary to ensure the capacity to conduct a 'good' W-CEA is both present

and established, by all parties involved. In other words, it is important to gauge for example whether proponents and regulators are capable of understanding their responsibilities towards W-CEA. By establishing clear and systematic IAs, it should be possible to reduce overlap and redundancy both in terms of water management initiatives and with respect to Canadian EA systems and other forms of joint resource management (Sinclair and Diduck, 2009; Dinar and Saleth, 2005; Harrison, 2002; Koonce et al., 1995).

At the present time, IAs in Canadian watersheds necessary to support W-CEA are not well understood, and the few studies that do exist have not investigated the existing institutional arrangements in depth. For example, in the studies of the Northern River Basins Study (NRBS), the Athabasca River Basin and that of the Moose River Basin in Northern Ontario (Seitz et al., 2011; Squires et al., 2009; Dubé and Munkittrick, 2001; Culp et al., 2000a,b, c; Gummer et al., 2000; Abraham, 1998)the scientific team collected information from various stakeholders and forwarded the recommendations to the regulatory body for potential change (Culp et al., 2000a).This approach did not specifically investigate the existing regional institutional arrangements for the purpose of implementing W-CEA, but did indicate a network for carrying out watershed-wide assessment does exist. In the Grand River watershed, studies have been done to show how and where existing IAs fall short of meeting amalgamated water and riparian zone resource management needs (Mitchell, 2005;Plummer et al., 2005), but this is not the same as investigating IAs for W-CEA because the principles and goals of CEA were not the focus of the studies. While partnerships and agencies like the GRCA are in place, no specific research on the network of existing IAs has yet been done to determine whether there is a sufficient level of organization, cooperation and coordination to accomplish ‘good’ W-CEA. With this in mind, the goal of this research is to evaluate the institutional arrangements with intent to progress the practice of CEA and W-CEA specifically beyond the status quo. Supporting research methods are elaborated on in Chapter 3.0.

Chapter 3

RESEARCH METHODS

3.1 Introduction

The goal of this research is to appraise the existing 'degree of readiness' among institutions to undertake watershed cumulative effects assessment (W-CEA) in the Grand River watershed. To achieve this, the research proceeded in a step-wise fashion. First, an evaluative framework of key institutional arrangements necessary to support W-CEA was developed based on generic themes earlier developed by Sheelanere (2010) in an investigation of the South Saskatchewan watershed. Next, the generic evaluative framework was customized to reflect the governance and administrative context of the Grand River watershed. Finally, an evaluation of existing institutional arrangements in the Grand River watershed was undertaken based on the customized framework. This chapter provides details of the study area and methods selected for data collection and analysis.

3.2 Study area

The Grand River watershed is the largest in southern Ontario, and one of significant heritage importance in Canada (Region of Waterloo, 2010; Veale, 2003) of its rich physical and cultural attributes. It covers approximately 6800 $km^2$of land and stretches from the highlands of Dundalk in the county of Dufferin from the north, to Port Maitland on Lake Erie in the south (Lake Erie Region Source Protection Committee, 2010; Olewiler, 2004). The ground surface elevation ranges from 500 m above sea level near the Dundalk highlands to 175m at the Lake Erie shoreline. The topographic features of the watershed include the moraines, clay/till plains, drumlin fields and incised river valleys and gorges (Lake Erie Region Source Protection Committee, 2010). The delineated sub-watersheds within it are the Upper Grand, Central Grand, Conestogo, Speed, Eramosa, Nith, Fairchild, Whiteman's, McKenzie/Boston and the Lower Grand (see Figure 3.1). The length of the Grand River itself is 300 km, and the watershed's width is recorded as 36 km at its widest point (Lake Erie Region Source Protection Committee, 2010).

municipalities, and includes the traditional lands of two First Nations bands, which are the Six Nations of the Grand River (Reserve # 40) and the Mississauga of the New Credit (Reserve 40a) (Lake Erie Region Source Protection Committee, 2010;Glauser et al., 2008).

The Grand River watershed is nestled almost entirely within the Greater Golden Horseshoe (GGH) Growth Plan Area, a formal planning area designated by the *Places to Grow Act, 2005*. Within the Grand River watershed, approximately 79% of land is designated rural or agricultural; 18% consists of 'natural' areas, and 3% is urban (GRCA, 2009). Regional administrative units within the GGH area include the County of Wellington, the Region of Waterloo, the County of Brant, and Haldimand County, County of Dufferin, (MPIR, 2006; Koycheva, 2003). Some cities within these counties are centers of rapid growth currently undergoing processes of revitalization/re-urbanization, modernization, and expansion of existing urban boundaries in response to population projections for the year 2031 (see Table 3.1) (MPIR, 2006; Regional Municipality of Waterloo, 2002). These cities include Guelph, Waterloo, Kitchener, Cambridge, and Brantford. Rural and urban water consumption within the Grand River watershed is forecasted to increase by multiple folds by 2031 (Lake Erie Region Source Protection Committee, 2010Regional Municipality of Waterloo, 2002).

This expected rise in water consumption would place tremendous strain on the watershed in terms of meeting the demands of both the aquatic systems and human settlements. Water withdrawals and diversions, discharge of sediments from agricultural, commercial, industrial and residential waste, as well as fragmentation by damming and road building can negatively impact aquatic species, while resulting in irregular river flows and polluted and contaminated water (Norman et al., 2010; Scott and Imhoif, 2005; Plummer et al., 2005). With regard to human consumption, pressure on the watershed may result uncertainty with regard to water availability, especially given that approximately 82 % of the watershed municipalities use groundwater (Lake Erie Region Source Protection Committee, 2010; Leadlay and Kreutzswiser, 1999). Increased impermeable surfaces due to development activities may further limit recharge of groundwater (Region of Waterloo, 2010; Scott and Imhoif, 2005).

Table 3.1. Expected population growth and distribution for some of the counties within the Grand River watershed, 2001- 2031.

Name of County	Population (Figures in 000s)			
	2001	2011	2021	2031
County of Wellington	85	91	269	321
Region of Waterloo	456	526	623	729
County of Brant	35	39	157	173
County of Haldimand	46	49	53	56

Source: Ontario Ministry of Public Infrastructure Renewal (OMPIR), 2006

The Grand River watershed has a rich history of watershed management via the Grand River Conservation Authority (GRCA). The GRCA is considered one of the most technically capable conservation authorities among the 36 members of Conservation Ontario, a network of local watershed management agencies (Plummer et al., 2005; Shrubsole, 1996; Mitchell and Shrubsole, 1992). In addition, the unique geographic location of the Grand River watershed and its wealth of natural resources have resulted in the watershed being crisscrossed by the jurisdictions of many governance and administrative bodies responsible for various aspects of water resources management. Unlike the GRCA, many of these do not operate on a watershed basis, but rather coincide with political boundaries and/or land ownership divisions (Plummer et al., 2005). This situation persists despite that the GGH Growth Plan emphasizes the need for the municipalities and the GRCA to prepare watershed-centered plans for the purpose of guiding future developments decisions. Such institutional fragmentations support the argument that water resources management functions are divided among a plethora of institutions that crisscross the Grand River watershed at all levels of governance.

The fragmentation begins at the federal level of governance and also exists at lower levels of provincial, regional and municipal governments. Table 3.2 lists some of the federal and provincial institutions responsible for watershed management in the Grand River watershed, and indicates the water resources parameters they are responsible for and their respective regulating legislations or mandates. This blend of jurisdictions and resource management mandates makes it essential to investigate existing IAs to better understand how cumulative environmental effects within the watershed are assessed and managed.

Table 3.2. Selection of prominent water resources responsible authorities and their corresponding jurisdiction

Responsible Authority	Institutions Responsible	Legislation/Mandate	Water Resources Parameters Managed
Federal	Fisheries and Oceans Canada (DFO) and Environment Canada	Fisheries Act (1970)	Fish habitat protection and provisions (Natural habitats and aquaculture operations).
	Fisheries and Oceans Canada (DFO)	Canadian Environmental Assessment Act (CEAA)(1992)	Siting of aquaculture operations, and management of escape and transfer of aquatic organisms and their ecological interactions with wild fish populations.
	Health Canada	Environmental Protection Act (1999) and Guidelines for Canadian Drinking Water Quality.	Drinking water monitoring programs and development of guidelines for wastewater systems protocols on Federal and Aboriginal lands.
Provincial	Ministry of Environment (MOE)	Ontario Water Resources Act (OWRA) (1993)	Allocation and withdrawal of water (both surface and groundwater). Directs water quantity aspects.
	Ministry of Environment (MOE) and Ontario Clean Water Agency (OCWA)	Ontario Clean Water Act (2006) and Safe Drinking Water Act (2002).	Source water protection for human drinking water through developments of watershed management plans.
	Ministry of Natural Resources (MNR)	The Lakes and Rivers Improvements Act (1990).	Regulate impoundments in river streams.
	Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA)	Nutrients Management Act (2002).	To diffuse agricultural pollutions; regulates nutrients management and fertilizers applications on farms which may contaminate water sources.
	Ontario Ministry of Municipal Affairs and Housing (MMAH)	Planning Act (1990) and Provincial Policy Statement (2005)	Wise use and management of water resources.
	Ministry of Public Infrastructure and Renewal (MPIR)	Places to Grow Act (2005)	Policies to support growth and management of water and wastewater systems.
	Ministry of Environment (MOE)	Ontario Environmental Protection Act (1990)	Governs the operations and management of anaerobic digesters and receiving facilities.
Regional	Waterloo Regional Council	Waterloo Region Official Plan	Specific policies for wastewater treatment facilities expansions, application of a long-term water supply strategy and the regional water efficiency master plan for wellhead.
Municipal	Ontario Ministry of Municipal Affairs and Housing (MMAH)	Municipal Official Plan (as directed under the Planning Act) and the Municipal Act.	Land use planning including meeting water. Supply, treatments and wastewater needs.
Watershed	Grand River Conservation Authority (GRCA)	Conservation Authorities Act (1946)	To conserve, restore, develop and manage of natural resources other than gas, oil, coal and mineral at a watershed.

Sources: Government of Ontario (2010); Fisheries and Oceans Canada (2010); Health Canada (2010); Region of Waterloo, 2010; Hill et al., 2008; MPIR, 2006; Plummer et al., 2005; Leadlay and Kreutzswiser, 1999; Gordon, 1998; Shrubsole, 1996; Baker and Shoemaker, 1995.

3.3 Research design and methods

Given the purpose of this study and its objectives—essentially to investigate the nature of IAs—it was appropriate to adopt qualitative methods. Qualitative methods provide a way to query human subjects, learn from conversations and written records, and discover common viewpoints and core concerns (Morse and Richards, 2002). The research design includes document review, a focus group, and semi-structured interviews as methods to satisfy the objectives as outlined in Figure 3.2. Focus groups and interviews are often relied on in qualitative research as a means to ensure triangulation of data (Longhurst, 2003), while document review provides a basis to corroborate interview data. Through inductive analysis of the empirical data, it was possible to identify key trends and ensure rigor in drawing conclusions for the study (Denzin and Lincoln, 2005; Bryman, 2004; Morse and Richards, 2002).

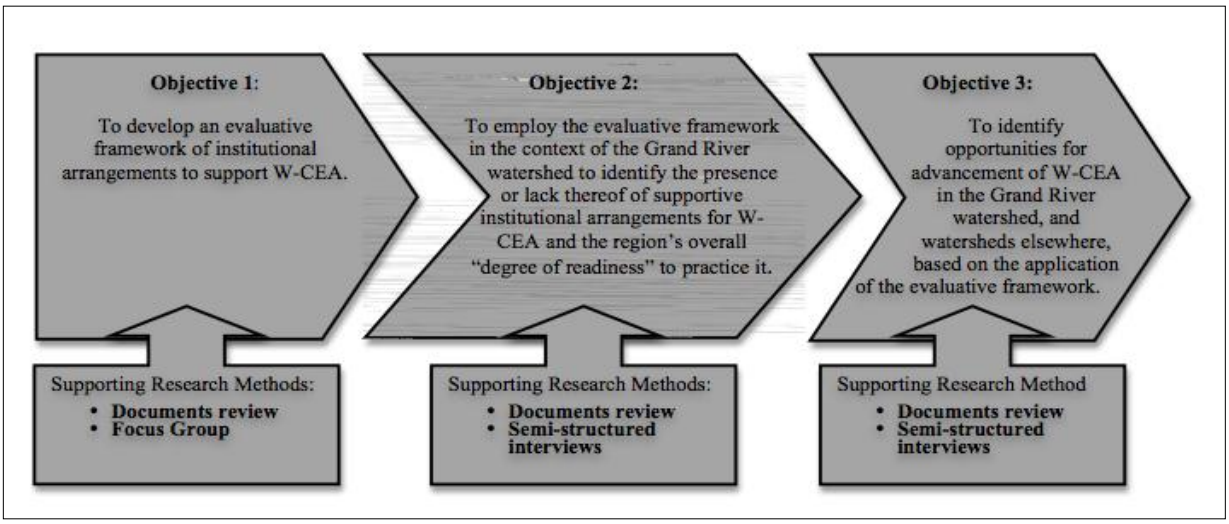

Figure 3.2. Research objectives and supporting research methods

3.3.1 Document review

Document review is a widely accepted and practiced method in qualitative research. It provides a basis to understand the current status of the topic being researched and situates it within the wider academic literature (Bryman et al., 2009; Bailey, 2007). Documents provide a modest measure of the validity of primary data given that they are non-reactive (Bryman et al., 2009). Not only can document review be used to corroborate interview data (or refute it as the case may be), but it can also provide an additional, independent source of data to address research questions and in this case, assess institutional arrangements. Documents reviewed in-depth for the purposed of this study included internationally peer-reviewed journals, government

documents, and other 'grey' literature. The internationally peer-reviewed sources were taken from journals such as Impact Assessment and Project Appraisal; Environmental Impact Assessment Review; Journal of Environmental Planning and Management; Journal of Water Resources Planning and Development; and Planning, Practice and Research, just to mention a few.

Government documents included: Canadian federal and Ontario provincial acts and regulations; official regional plans such as the Greater Golden Horseshoe plan and the Grand River watershed management plan; and GRCA internal documents. Other watershed-focused literature reviewed included: forum minutes of the Regional Municipality of Waterloo planning division; conference proceedings of GRCA and those from the National Round Table on the Environment and the Economy (NRTEE); Lake Erie Region Source Protection Committee watershed characterization reports; and case reports from the Environmental Assessment and Planning in Ontario Project. The 'grey' literature was found to provide detail similar to that found in the peer-reviewed sources mentioned above. Bryman et al. (2009) argue non-peer-reviewed sources can still be authentic and meaningful to research, due to the fact that often they are more comprehensive. Documents reviewed in this study were in printed, visual and retrievable (from the world wide web) format. Overall, the main topics of review included: CEA;W-CEA; EA; IWRM; and institutional arrangements in natural resources management, ecosystem management, watershed planning, sustainable development, and water governance. The document review proved fruitful in terms of supporting all of the research objectives, and was on-going throughout the study as indicated in Figure 3.2 above.

3.3.2 Focus group

The focus group method allows for novel ideals to be discussed by a range of stakeholders, often with divergent perspectives, and for thought-comparison to take place among knowledgeable interviewees (Dobson, 2004; Morgan 1998). This method lets interviewees speak and hear different opinions and views on a given topic and allows them to bring up any issue they feel is important or significant (Bryman, 2004; Longhurst, 2003). For the purpose of this research study, 17 potential focus group interviewees were contacted in April 2010 by telephone and email. Given the low response rate to this first attempt to recruit interviewees, a second attempt at contact was made via email in May 2010. Three individuals agreed to participate

based on this second attempt at recruitment. While these interviewees of the focus group were ultimately not able to meet in person due to irresolvable scheduling conflicts, an alternative form of group interaction did occur via an online process whereby a set of predetermined questions were circulated to all three interviewees upon which to base their comments (see Appendix A1). The modified focus group then took place on May 12th, 2010.

The initial 17 focus group contacts, of which three ultimately became study interviewees, were identified based on their contributions to relevant international literature or other noted involvement in watershed management initiatives in the Grand River watershed. Their names and contact information were located through the documents review process and via Internet searches. The three study interviewees were experts with extensive knowledge in EA, water resource management and management of the Grand River watershed. They were asked to review the generic framework of institutional arrangements to support W-CEA, and comment on whether those themes held true for Ontario's context and the established EA and watershed management processes there.

The focus group was a necessary step in the research, given that the themes reviewed were adapted from an earlier Social Sciences and Humanities Research Council of Canada (SSHRC) funded W-CEA study done for the South Saskatchewan watershed (see Sheelanare, 2010). This parent research study aims to identify the institutional arrangements and capacity-building requirements necessary to develop and support watershed-based CEAM on a Canada-wide basis. Because the Ontario scenario of environmental assessment and water resource management was possibly quite different from that in Saskatchewan, the initial W-CEA framework developed in Saskatchewan had to be 'checked' for accuracy and relevance to Ontario's context. Based on the results of the focus group, it was possible to revise the initial framework developed for Saskatchewan and the newly revised set of themes were much more representative of the status of institutional arrangements in the Grand River watershed. The outcome of the focus group method was a more place-based framework from which a semi-structured interview guide was subsequently developed (see Appendix A2).

3.3.3 Interviews

Social science researchers use interviews extensively because they enable them to ask questions directly related to their research study (Bryman et al., 2009; Bailey, 2007). Interviews

also allow for a convenient way of capturing a participant's interpretation of questions more readily than other observation methods, whereby a researcher may need to spend a considerable period of time with the participant or observing the participant to collect similar information. Moreover, interviews can be done via telephone and thus do not typically require the researcher to adjust his or her schedule or location extensively (Bryman et al., 2009). The three types of interviews used by researchers are structured, semi-structured, and unstructured interviews.

The unstructured interview requires little standardization, follows a free-flowing conversation process and the participant may talk broadly about any aspect of the research or a related topic (Bailey, 2007). This kind of an interview does not follow a rigid interview schedule and results can be very different from one participant to another: for example, a researcher may ask only one question in the first interview but many questions in the following interview. Unstructured interviews may range greatly in length, and provide wide latitude of information that can only be determined as useful, or not as the case may be, in the analytic stage of research due to the generality in focus (Bryman et al., 2009; Bailey, 2007; Morse and Richards, 2002). In contrast, for structured interviews, the questions asked are fixed, are asked in specific order, take place within a fixed time frame, and each interview has a similar duration. Structured interviews are very specific so as to allow for comparison of information among respondents. Bailey (2007) reports that for structured interviews, even the probing questions may be planned in advance and are typically asked of each interviewee.

For this research study, semi-structured interviews were employed as the primary method to address the second and third research objectives (see Figure 3.2). A semi-structured interview provides an interviewee with flexibility to reply to a question based on how they understand it and the issues brought up to them, however at the same time, an interview guide with specific questions (organized by topic but not necessarily asked in specific order) is used (Bryman et al., 2009; Bailey, 2007; Bryman, 2004). Probing questions are normally not included in the guide but rather evolve as the researcher picks up on what the interviewees have said (Bryman et al., 2009). The semi-structured interview then, allows an interviewee to offer an *in-depth* explanation based on what they view as important or relevant. Another unique characteristic of semi-structured interviews is that a dialogue rather than a question-and-answer session may evolve between the two parties. This can enrich the research study even further if the discussion remains focused on, and illuminates, the research topic (Bailey, 2007).

Of the three types of interviews, semi-structured interviews were deemed most appropriate for this research study given the fact that interview themes were already available based on the modified evaluative framework that emerged from the focus group process. The themes in the evaluative framework served as the basis for an interview schedule, which brought consistency to the lines of questioning pursued with each participant, but also offered some leeway for interviewees' opinions. Semi-structured interviews were especially appropriate given that W-CEA involves many professions, disciplines, and stakeholder groups. Some of the academic disciplines represented in the study include civil and environmental engineering, chemistry, biology, ecology, rural and urban planning, social work, ecology, economics, limnology, and others. Stakeholder groups in watershed management and therefore W-CEA include provincial and municipal government departments and agencies, watershed conservation authorities, water utilities, private industries such as aggregate mining, bottling companies, chemical processing, pulp milling, and ENGOs, which in the case of the Grand River watershed consisted of both environmental education groups and citizen monitoring groups. Such a diverse group of interest parties made it necessary to adopt a flexible interview schedule, and the qualitative data produced by the interviews was thought appropriate to best understand the decision patterns, management events, and other forms of collaborative behavior (Hearne, 2007; Scott and Imhoif, 2005) that together shape institutional relationships necessary to carry out and sustain W-CEA. In other words, semi-structured interviews, with their characteristic flexibility, allowed the full range of qualitative and quantitative disciplines, data sources, and perspectives to be adequately expressed.

In this particular research study, the potential interviewees were contacted right after the focus group took place in May 2010. They were also identified through the document review process, however given that not enough potential interviewees could be found through this process, interviewees of both the focus group and initial interviews were asked to identify other possible interviewees, a method known as 'snowball sampling' (Bryman et al., 2009; McIntyre, 2005). A total of 82 potential interviewees were identified and invited to join the study via email. Each received an introduction package consisting of: a letter of introduction to the study, a summary of the evaluative framework, and a participant consent form (see Appendix B for copies of these materials). Follow-up calls were made if no response was received within two weeks of the initial contact.

The potential interviewees that were targeted to participate in this research study consisted of a range of people who were either water experts or EA practitioners, or both, as well as those impacted by management decisions made in watershed (such as local community members). This latter group was important given that both watershed management and EA processes value public participation as an essential element of 'best management practices' (Canter and Ross, 2008; Genskow and Born, 2006). Furthermore, it is widely agreed that local communities can contribute a unique perspective to proposed management strategies given their lived knowledge of the regional or local environment (Agrawal and Gibson, 1999).

All interviews took place between June and October of 2010. A total of 29 interviews were conducted with a range of stakeholders from various sectors of government responsible for water resource management and/or EA; ENGOs; First Nations; academic researchers; EA consultants; and community members. The community members were individuals who volunteer with the various conservation programs available within the watershed. Their participation was important so as to provide a voice from the public. These are different from the ENGOs, which were considered to be independent researchers whose position is to provide further information to the government or other interested parties. Of the 29 individuals interviewed, nine are 'water experts' (defined based on their professional responsibilities or designations). Table 3.3 lists the types and numbers of stakeholders interviewed. Seventeen (17) interviews were carried out in person during a field visit to Southern Ontario, which took place in June 2010 for a period of two weeks. The rest of the interviews were conducted via telephone.

Semi-structured interviews were digitally recorded using a Sony digital recorder. According to Kvale (1996), recording interviews allow for the interviewer to concentrate on the topic and the dynamics of the interview at any stage of the research process. Listening to a taped interview multiple times also promotes sustained reflection upon the interview data. He argues although recording interviews results in de-contextulized contents, this method is much less subjective than relying on the researcher's memory (Kvale, 1996). Interview data were transcribed using a word processing program (Microsoft Word). The transcripts then served as the primary source of empirical data in the research study (Bryman et al., 2009; Kvale, 1996). In this research study, the semi-structured interviews provided rich and detailed answers, and became the primary building blocks for the major trends reported.

Table 3.3. Types and number of stakeholders interviewed from June to October 2010

Stakeholder type	Number of interviews carried out
Academia	4
Provincial Agencies	
• MNR	4
• OMAFRA	3
• MOE	2
Federal Government Agencies	1
Watershed Conservation Authority	
• GRCA	2
• TRCA	1
Municipal Government Officials	4
First Nations	1
Consultants and Private Proponents	3
ENGOs	
• Trout Unlimited	1
• Ducks Unlimited	1
• Community Members	2
(One interview per participant)	29

3.4 Data analysis

Qualitative data gathered in the focus group was manually coded, given the small number of focus group interviewees, however, interview transcripts were uploaded into NVivo 9.0© software which provides assistance with coding large data sets. Coding is a means of categorizing, or breaking down data into components and parts, and then giving labels or names to these parts of the transcripts statements (Bazeley, 2010;Bryman et al., Kvale, 1996). By reducing data to codes, data can be sorted by categories and sources (Bazeley, 2010). In this manner, a rigorous and detailed assessment of the relationships observed among codes is made possible (Bazeley, 2010). Coding software allows patterns and associations among data to become apparent and easily traceable (Bazeley, 2010; Bryman et al., 2009; Morse and Richards, 2002; Miles and Huberman, 1994). In the social sciences, NVivo9.0 © software is widely used as a coding aid (Bazeley, 2010; Johnston, 2006). Due to the large data set generated by 29 semi-structured interviews, computer-assisted analysis was deemed necessary, to allow the researcher to concentrate on meaningful and creative interpretations of what was said in the interviews (Kvale, 1996) and detect significant patterns among the data.

The first stage of coding employed in this research study was to formulate descriptive codes for data fragments known as ‘tree-nodes’—these were reflective of the themes contained

in the evaluative framework(lead agency; multi-stakeholder collaboration; CEA baselines, indicators and thresholds; multi-scaled monitoring; data management and coordination; vertical and horizontal policy and planning linkages; enabling legislation and financial resources. An additional tree-node was created to capture 'outlying' subject matter). All relevant components of the transcripts were then sorted using these tree-nodes.

Child-nodes (second level of coding) were then derived to further sort the data according to like themes. At this coding level, the conditions, interactions and points of convergence of the interview responses were noted. From this level of coding, it was easily to identify if a 'point of saturation' on a topic was reached, due to the replication of data. This level of coding also allowed for verification of incidents, cross-checking of facts, perceptions of interviewees to be compared, and points of disagreement to emerge (Bazeley, 2010; Morse and Richards, 2002). From this second level of coding, the actual interpretation of results could begin.

3.5 Research ethics and researcher bias

This study is part of a larger Social Sciences and Humanities Research Council of Canada (SSHRC) project to examine the potential for W–CEA in Canadian watersheds. The first phase of the parent project, initiated in the South Saskatchewan watershed (see Sheelanare, 2010), aimed to identify a generic list of institutional arrangements and capacity-building requirements necessary to develop and support watershed-based cumulative effects assessment and management (CEAM) in Canadian watersheds namely, the Lower Fraser (British Columbia); South Saskatchewan (Saskatchewan and Alberta); the Athabasca (Alberta); and the Grand River (Ontario). Overarching ethics approval for the parent project and the present research study was granted by the University of Saskatchewan in 2009, prior to the commencement of the Grand River watershed component, on which this thesis manuscript is based.

A qualitative research study is rarely value-free due to the inductive process associated with interpretivism and constructionism, which are fundamental components of all analytic strategies to generate meaning from research data and ultimately produce defensible conclusions. Moreover, various types of bias may influence earlier stages of research design and data collection. As a forewarning to readers of this particular research study, a few potential biases and research assumptions are discussed here.

In the research design stage, it is worthy to note that the focus group conducted was short of the 'ideal' participant sample size of 6-10, as discussed in qualitative research literature (McIntyre, 2005; Morse and Richards, 2002). Although the level of participation in the focus group was not as high as the researcher would have liked, best efforts were made to involve a variety of experts, and the goals of this portion of the study were ultimately achieved.

As well, with a broad interview schedule aimed at the sometimes very different types of disciplines and professions involved in both EIA and water resource management, not all the questions were answered by all the interviewees in each of the interviews carried out. Some interviewees clearly stated these were either not areas they dealt with on a day-to-day basis (and thus offered a very limited response) or clearly stated they are not familiar with the topic in question. For example, some municipal officials opted out of answering project-based EIA questions.

Since this is an exploratory study, a level of subjectivity was involved in selecting data trends to report on based: the researcher's prior knowledge, interests and urge to compare interviewees' experiences or perceptions shaped the data analysis and discussion. Furthermore, the interpretation of qualitative data relies upon an in-depth analysis by the researcher and may differ from investigator to investigator. Given this is human nature and there is no way to screen out such bias entirely (Bryman et al., 2009), the strategy used to minimize this bias was to maintain awareness of such phenomenon and try to minimize it. With regard to data analysis, it is common for qualitative research to rely on standardization of statements of the recorded interview (narrative structuring) to condense data into specific codes (Kvale, 1996). In order not to obscure data in this fashion, all transcripts in this study were typed verbatim. Although structured tactics for generation of meaning were later employed (Miles and Huberman, 1994), data was not condensed initially. Ad hoc tactics for generation of meaning were also applied in this research study.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

This research endeavors to advance understanding of the IAs necessary to support W-CEA. It employs an evaluative framework as a tool to appraise, on a macro-scale, the 'degree of readiness' of existing institutions in the GRW to undertake W-CEA. In other words, it attempts to gauge the institutional capacity to support W-CEA. Following a modified online focus group, semi–structured interviews were carried out in person as well as via telephone. The aim of the focus group was to customize an existing evaluative conceptual framework (Sheelanere, 2010) so as to render it more reflective of Ontario's context for both environmental assessment and water resources management. The refined framework (see Appendix B) then served as a basis for a semi-structured interview schedule (see Appendix A2), which was administered to experts on the GRW, CEA, and watershed management issues in Ontario more generally.

Primary topics of discussion with interviewees included: the presence or absence of a lead agency; multi-stakeholder collaboration; CEA baselines, indicators and thresholds; multi-scaled monitoring; data management and coordination; vertical and horizontal policy and planning linkages; enabling legislation; and financial resources, all of which were previously identified by Sheelanere (2010) as fundamental supporting elements for institutional arrangements necessary for developing and sustaining W-CEA. In addition to discussing these subjects, interviewees were also given an opportunity to describe any perceived barriers as well as catalysts to enabling and sustaining W-CEA in the GRW. The research results and related discussion are presented below.

4.2 Lead agency

Assessing and managing cumulative watershed effects requires a lead agency with the authority, the mandate and the capacity to do so. This means guiding the monitoring programs and having some influence over decisions about land-use and project development in a watershed. Sheelanere (2010) indicated that a lead agency is necessary to report, communicate

and harmonize the various types of information that may be needed for a regional CEA such as that for a watershed. Following from Sheelanere (2010), a series of questions were asked (see Appendix A2) of interviewees so as to determine whether there is such an authority, or approximation thereof, within the GRW.

Two schools of thought emerged when interviewees were asked whether a ministry or institutional structure exists within the GRW that has a specific mandate to coordinate development activities at the watershed-scale. This was due to differing thoughts on what a lead agency is. Some believed it was impossible to have a supra-agency put in place for the purpose of authorizing W-CEA, thus, there could be no lead agency in the true sense of one agency overlooking development activities or responsible for W-CEA. These interviewees suggested there is "fragmented authority" for W-CEA in the GRW. Others, however, suggested institutional structures are already in place to support W-CEA (albeit perhaps indirectly) and can be found "nested" within the various governance structures that exist in the GRW. These two views are now discussed in more depth.

4.2.1 Absence of a lead agency

Fourteen of 29 interviewees believe it is simply not feasible to have all the different water resource management authorities in Ontario "lumped" together for the purpose of enacting any specific form of watershed management, including W-CEA. This is reportedly the result of the fragmented nature of authority within the GRW, unwillingness of the provincial government to create such a centralized agency, and the policy implementation issues natural within a large watershed or other administrative regions. Fragmentation among the lead provincial agencies responsible for watershed management and planning was expressed by one interviewee this way: "You cannot have a lead agency because other agencies and the government in general is not going to go along with creating another, some kind of super-agency to oversee these things. It's not gonna happen." This indicates the perceived eminence of the provincial government in terms of dictating institutional arrangements in the GRW.

An academic interviewee who also perceived governmental unwillingness to establish a lead agency for W-CEA similarly commented by saying, "there is a problem with the way the system is constituted and the chances of changing that are nil." Not only was the government unwillingness to change an issue of concern to this group, but also the government's capacity to

conduct management on a watershed basis**.** One academic researcher noted that any 'unwillingness' is simply due to the fact that coordinating the many provincial, municipal and federal agencies is seen as an enormous job not easily accomplished by a single agency.

Fragmented authority also apparently results from the fact that there is no law to coordinate all the development activities that take place within the watershed, nor does existing legislation such as the *ON EA Act, 1990* and the *Planning Act, 1990* designate or require a lead agency to carry out W-CEA. Some interviewees saw this as a governmental philosophy of distributing responsibilities. Approximately four interviewees could not say, for example, where the authority of any particular agency might begin or end; nor did they know where such information could be found if an individual were to seek it. One interviewee simply stated: "Water management in Ontario is highly fragmented." A provincial agency employee reinforced this sentiment by explaining that:

> They (the agencies) are segmented by sectors - you have the environmental sector: the Ministry of Environment (MOE) and Ministry of Natural Resources (MNR) have authority. Around agriculture, you have Ontario Ministry of Agriculture and Rural Affairs (OMAFRA) that I am employed with. The municipalities, which have geographic scope, also have responsibility over a variety of local programs such as water supply and wastewater treatment. So it's distributed in that way but everyone has broader interests on the watershed and the province. There is no single super agency, which has sort of single power.

Interestingly, the fourteen interviewees who expressed this view were different types of stakeholders, not reflecting any specific government agency, or professional background, suggesting no polarization of views among water experts and non-water experts. In contrast with the above, a second group of interviewees went on to express quite a different opinion on the topic of a lead agency for W-CEA in the GRW.

4.2.2 Polycentric or "nested" water governance

A second school of thought was present among those who commented on the current water and resource governance structure within the GRW. This group of interviewees, approximately 11 of 29, perceived that various agencies currently take the lead on water resource management relevant to W-CEA and that, indirectly, such agencies address the interests of the watershed in their day-to-day operations and other undertakings. Interestingly, this group also

believes watershed management is 'about collaboration', whereby power, accountability and responsibility is shared. The following two statements made by a provincial agency employee and an academic, respectively, sum up the perceived nature of polycentric watershed management and governance within the GRW: "There is a different model here, different from what you are describing. It's more of a distributive governance model, not a centralized command-and-control model. " And: "The concept is of network governance…it's the only paradigm that I see working because it's covering the way in which different authorities are linked together." Together, these interviewees emphasize what is currently in practice within the GRW is an effective way of managing the water resources.

Within this second group, eight interviewees specifically identified the GRCA as a potential lead agency for W-CEA, given that it is legislated by the *CAs Act, 1946* to plan and manage water resources on a watershed basis, has interests in the ecological integrity of the Grand River watershed, and thus was seen as a 'natural' fit. Most of these interviewees were either directly employed by the GRCA itself or academics who perform watershed-based research. Although such perception exists, the GRCA is still lacking full legal authority for issues not mandated in the *CAs Act*, which exerts limitations on what it is allowed to do. Numerous concerns were expressed in the interviews about the actual institutional capacity of the GRCA to act as a leader. For example, several interviewees saw the GRCA as a robust leader in watershed studies, but not able to lead on issues related to private land development and other land-use planning activities. A seasoned GRW academic researcher observed that, "…when it comes to at least studies such as watershed studies, the GRCA tends to be the lead-agency. It's kind of an odd situation because you have the Ministry of Natural Resources and Ministry of Environment. They both deal with water issues." The same interviewee further observed: "There are multiple agencies who take the lead on different things but the only one that actually has the watershed mandate is the conservation authority (the GRCA), but they don't take a lead in all land-use planning and water management." As such, it was apparent that regardless of the water resources management network formed by the polycentric governance system, there are inefficiencies and sometimes fragmentation and the polycentric arrangement is perhaps not quite as functional as it might be.

In addition to the GRCA and the various provincial agencies, Ontario's polycentric water governance structure also includes municipalities. In general, terrestrial and water resources are

perceived as managed in a fragmented fashion except regarding small areas of overlap such as for riparian areas. There is a plethora of distinct management mandates and responsibilities, as explained by an aggregate operations permitting officer:

> It depends on the mandate, but none of the work is done on watershed basis, not really. Ministry of Natural Resource's mandate is to look at provincially significant wetlands for any impacts or anything to do with those. If there is impact is on water wells and large river systems, that's really Ministry of Environment. If it were to non-significant wetlands, then it would be the GRCA.

However, distinct examples of overlap as given by the above interviewee were rare to find among the interview data. Furthermore, an academic researcher explained how municipalities in the watershed work separately from the GRCA, saying: "…generally the management of water and other recreational activities, as well as management of land associated with water, has a lot of liaison with the municipalities and so on. This is sort of outside of the GRCA jurisdiction and they have to kind of sign off on some planning decisions to the municipalities." This segmentation of how the authority is divided among multiple agencies is not as clear as it ought to be. With such a distinctive dichotomy in the research results related to this important aspect of W-CEA, it was important to understand what might enable the polycentric governance structure described by the interviewees to work. Some interviewees did provide an extensive account of why they think polycentric governance for water resources could work. They pointed to the fact that the GRCA is uniquely positioned, and has a mandate to oversee issues on a watershed scale, which is viewed as a good starting point for conducting W-CEA. The fact that GRCA has been able to adapt to source water protection (SWP) planning is even more encouraging in terms of demonstrating the technical capacity that might be required to conduct the work related to W-CEA. This institution is seen as easily able to form links and networks with others that manage other aspects of water resources.

The most significant finding about a possible lead agency for W-CEA in the GRW, therefore, is that there are different opinions on whether there is an institution with the abilities needed to carry out the work of W-CEA. There is no strong consensus on whether watershed governance is indeed polycentric at present, or clearly led by a single institution. Although some interviewees were optimistic on the level of leadership provided by the GRCA at managing areas that the *CAs Act, 1946* mandates it to, questions still remain about the level of capacity (legal,

human, financial and technical) the GRCA has in terms of coordinating programs and initiatives that might be necessary for W-CEA. To shed further light on watershed governance in the GRW and the capacity for W-CEA, it is necessary to understand the roles and responsibilities of other parties involved in managing impacts to the watershed and development decision-making. The following section thus presents key findings related to stakeholder collaboration.

4.3 Multi-stakeholder collaboration

The management of cumulative watershed effects requires interdisciplinary teams consisting of multiple stakeholders, whose role and responsibilities are established and well defined. Stakeholders should be represented in impact assessment and in making decisions about development in the watershed (Noble, 2010b). They should be representative of multiple levels of government, as well as non-governmental agencies, interested individuals, and academics, and should come from multiple development sectors (e.g. resource management and conservation) (Elbakidze et al., 2010; O'Faircheallaigh, 2010; Agrawal and Gibson,1999).Congruent with Sheelanere (2010), who also illustrated the importance of having stakeholders whose backgrounds are diverse, the aim in this research investigation was to find out whether there is organized multi-stakeholder collaboration within the GRW.

Three clear messages on stakeholder collaboration in support of W-CEA emerged from the data. Some of the interviewees(9 out of 29) expressed the opinion that at present, no clear determination of roles and responsibilities among those collaborating on the watershed management activities could be made. Another eight of the 29 interviewed individuals identified and characterized specific challenges currently facing multi-stakeholder collaboration, and a third group, (12 of 29 interviewees) remarked on the existing capacity of GRW institutions to make collaborative decisions about watershed development, and capitalize on existing collaborative mechanisms for the purposes of W-CEA. Below, these trends are further elaborated on.

4.3.1 Roles and responsibilities of stakeholders

Several interviewees observed that stakeholder collaboration in the GRW is somewhat confusing when it comes to managing developmental impacts in the watershed, and in terms of making decisions about development activities in the watershed. When these interviewees were

asked if the roles and responsibilities for impact management were clearly defined, it was evident there is no watershed-based management strategy and therefore no cumulative effects consideration at the watershed scale. Reasons given to explain this include that: (i) the *Planning Act, 1990* dictates what kind of procedures to follow when considering development projects; (ii) monitoring for specific water parameters is not done vigorously throughout the GRW; (iii) communication among agencies responsible for water resources is not aligned to communicate impacts; and that (iv) watershed agencies face ongoing jurisdictional disputes and funding issues. All of these result in confusion among stakeholders and hampers effective collaboration. A provincial agency employee responsible for aggregate resource management explained it this way: "You know, if you strengthen the coordination component of cumulative environmental effects then you have something to respond to, but at this point, I don't know if there is a coordinated response." Overall, these types of comments were expressed by many interviewees who represented a variety of sectors and agencies currently responsible for management of diverse water parameters within the GRW.

About half of the interviewees (52%) agree that 'chaos' results from the number of legislative instruments currently governing water resources management and the lack of an impact management strategy based on the watershed. At the same time, legislative instruments such as acts and regulations are also seen to cause jurisdictional divide within the GRW. Specifically, water resources are managed in a fragmented fashion, leading to management gaps within the existing nested (polycentric) governance structure (see Folke et al., 2002). Both federal and provincial agencies manage some component of water resources. For instance, the MOE has authority over water withdrawal from the watershed and is the appropriate authority for issuing such permits, while the MNR is responsible for general ecosystem health (land and water), and includes the management of fisheries. Fisheries and Oceans Canada (DFO) may cross provincial jurisdiction if water resources on Crown land has been impacted. Thus, management activities may overlap but agencies involved do not necessarily work together all of the time.

In addition to provincial and federal government agencies, there is also the GRCA, which operates at arm's length from the provincial government itself when making decision in areas mandated by the *CAs Act*. These decisions may or may not coincide with the decisions made by municipalities (local government councils). Municipalities operate under the Ontario

Planning Act, 1990 and in accordance with the municipalities own official plan or the Waterloo regional 'Official Plan' and may not necessarily take the watershed boundary into account when taking decisions on development activities. Rather, is it more likely they refer to municipal boundaries instead. The municipal planning process is seen by a significant number of interviewees as not particularly inclusive of 'outside' stakeholder groups in decision-making processes. For example, one watershed agency representative recounted the following incident:

> We have a Provincial Planning Statement (2005), which is very general guidance around environmental expectations. That's usually the first stop, which developers and municipalities have to consider, but the directions are very general. A lot of decision on things like zoning and what's going to happen actually does happen at that stage (planning stage) where agencies like mine are not consulted. We are not part of the process. Part of the problem is, there is no requirement of looking at a large scheme of things and having everyone at the table, and that is because the planning process doesn't require it.

Such jurisdictional issues are further demonstrated in the following quotes from a non-governmental organization wetland manager and an interested citizen (and local researcher), respectively:

> Clearly defined? …If you could assemble and read all the appropriate legislations, I suppose they (jurisdictional responsibilities) would be set forth. I think there are areas of overlap, especially if you consider the formal government and non-formal. I think in a multi-stakeholder context it becomes much more confusing as to who is doing what.

> I think that's a very complicated question because there are all kinds of legislation, which impact the watershed. Whether it's the EA Act, Planning Act, the Conservation Authority Act, they have authority defined in each of the legislation and they kind of overlap and get fuzzy at the edges.

Based on statements like these and the overall analysis of interview data, it is evident that clarity in terms of the roles and responsibilities of stakeholders remains a "grey area" in the GRW. Furthermore, the decision-making process surrounding development activities seems to exclude some affected stakeholders who are clear that the current process is inadequate to address their concerns in relation to watershed management. The decision-making is entrenched in fragmented planning processes, which assumes the needs of all multi-stakeholders are the same. Without a clear understanding of how well multi-stakeholder collaboration is functioning in the GRW, false conclusions can be reached with regard to the effectiveness and success of

such partnerships (O'Faircheallaigh, 2010; Genskow and Born, 2006; Watson, 2004) and more importantly to this study, in support of W-CEA.

More than half of the interviewees identified the GRCA as a key forum to influence decisions on development and raise awareness about how to get involved with various committees: it was also thought to be in the best position to be the chief watershed steward. This institution is seen as an invaluable 'stepping stone' to effective stakeholder collaboration and it involves the interested citizens in many of its stewardship programs, asexemplified in the following statement by an interested citizen involved in some of the GRCA stewardship activities:

> I (participate) in the rural water quality program, so that's a group that's working with individual land owners offering financial incentives to do cattle fencing, to do better irrigation and liquid manure storage practices, so there are techniques. If you apply we can give you extra funds to offset that.

Although many others expressed a similar opinion, an antagonistic viewpoint was also expressed by a small group of interviewees. These interviewees were those who perceived that there is still lack of opportunity for GRCA to consider the watershed-wide scale and particularly issues of cumulative environmental effects as well as to enhance the technical capacity needs. One academic who works with the federal government explained the challenge by saying that: "I think we need a broader concern by such watershed managers in terms of the water quality and water quantity, using water chemistry, fish biology and fish responses to anthropogenic inputs into fisheries framework." Such statements are indicative of how different groups viewed multi-stakeholder collaboration. It also shows what they consider to be the minimum participation and inclusiveness in watershed management activities.

Overall, there are divergent views on what is working and what is not working in terms of multi-stakeholder collaboration within the GRW. It is clear the many stakeholders have different needs when it comes to being included in decision-making processes about development and watershed management. Some stakeholders see stewardship activities as sufficient, as discussed above, while others are seeking to participate in the management of the GRW beyond just 'citizen science'. This was also evident when investigating the status of watershed baselines, indicators, and other data needed to make a scientific evaluation of the state of the GRW.

4.4 CEA baselines, indicators and thresholds

Science is widely known as an important foundational element in doing 'good' W-CEA. The current state of any watershed needs to be understood: scientific indicators must be designated in order to facilitate impact assessment, and thresholds must be established to act as guideposts for monitoring and management. Rogers and Biggs (1999) argue that thresholds provide an inductive as well as strategic approach to the adaptive management of complex ecosystems. As such, the components for carrying out scientifically rigorous impact prediction as well as prepare monitoring plans, were investigated. These components include baseline data to be used in W-CEA, indicators for W-CEA, and thresholds for W-CEA. Current monitoring efforts related to projects-based EAs in the watershed were also a subject of inquiry, given that monitoring performed for project-based EAs may also inform appropriate baselines, indicators and thresholds for W-CEA.

4.4.1 Status of baseline data and indicators

There is consensus among interviewees that some baseline data for water related VECs is available within the GRW. Where viewpoints diverge is on the quality of these baseline data, as suggested by an EA consultant who said:

> I think there is certainly a good start and some pretty good agreement on what has to be collected…and it's a very large watershed so it's a very challenging task to cover all of that but I would say that in general, yes, certainly compared to other watersheds and other areas, I would say in the Grand we are in pretty good shape in terms of baseline (data).

This statement recalls Sheelanere (2010) who noted in a study of the South Saskatchewan River watershed that incomplete baseline data is not a new phenomenon in trying to coordinate water resources management activities for the purpose of conducting W-CEA. Apart from concern about the varied quality of scientific data that exists for the GRW, interviewees were concerned about data gaps, inconsistent and uncoordinated data sets, and irregularities in updating and reporting. One academic noted:

> There is probably good knowledge and good data collected. The problem with a lot of that (data) is, it has to be updated and has to be kept current. I don't know the extent to which that has been maintained…it's fashionable, so it comes and goes but it's not persistent. So 'yes' and 'no', some places there is probably very good baseline (data) for indication but in others not so good…it varies very much.

Despite such data gaps issues, the GRCA was specifically praised for being a leader in keeping water quality, quantity, and flow measure data, which is collected from 26 monitoring stations on tributaries of the Grand River. The GRCA also provides an interactive tool on their website (www.grandriver.ca), whereby interested parties can access data and build their own GRW map from selected data points. Their website allows monitoring data to be viewed on a real-time basis, as soon as it becomes available to the GRCA. However, maintaining a consolidated and centrally kept database in the GRW seemed to pose a challenge since not all data is housed by the GRCA. Some information is collected by other agencies, as explained in the following statement by an academic:

> That (aspect of data availability) is going to be highly variable. In some watersheds it might be centralized, current, and people may well know where to get it but in others, no. And it might be spread all over the place and stuffed in the cabinets in the offices of conservation authorities, MNR, MOE, Environment Canada…it's really hard to say, there is also a question of what exists in Burlington at Environment Canada, and how accessible that is to the proponents, let alone to the province.

A provincial agency representative also alluded to data problems by saying: "There is too much of it. Too much data and it's in a hundred different forms." He further explained: "Going back to the need for comparability of the data, the danger lies in the details such that if you combine data with different detection limits or different methods of analysis, you are not only not saying too much, but what you do say is going to be incorrect." Interviewees clearly emphasized the difficulties experienced in the GRW in terms of dispersed and sometimes unavailable data sets. Such difficulties emphasize the importance of efficient and effective stakeholder collaboration, as mentioned in section 4.3 above.

Another topic of concern to interviewees was the need for scientific indicators. Identifying specific, yet common science-based indicators for W-CEA will help avoid reactive management of impacts. They may also create a more coordinated, comprehensive approach and more comparable data, which may lead to more effective impact management. Rogers and Biggs

(1999) advocate for the use of common indicators to provide a scientific basis for management plans that in turn inform policies (and vice versa) and impact the many stakeholders in any given watershed.

In the case of the GRW, about a third of interviewees (11 of 29) believe no indicators currently exist. A GIS data specialist with one of the provincial agencies stated:

> To the best of my knowledge there is no dataset where they (MNR) have been able to get all the indicators they wanted. Many have come together and said these are the indicators we need; they went out and tried to get them. I know they didn't get all the indicators that they wanted because there is data they asked us for and we couldn't get.

However, a few interviewees (6 of 29) pointed out the beginning of commonality in indicator selection, as expressed in this statement by a GRCA official:

> I would say this area is a work in progress for us. The reason I say it's a work in progress is I think it's a little too narrow, and we are about to update that plan now…internally we are having a discussion around what are the indicators, how broad are they going to be, are we going to be picking ground water indicators, water quality indicators, flow indicators…so there is a little bit of work.

Thus, research data indicate there is recognition of important scientific precursors of W-CEA in the GRW such as the need for baseline data, indicators, and thresholds. This is encouraging because by diagnosing weaknesses in the way data is collected and managed, and obstacles affiliated with the selection of indicators of W-CEA, it will become easier to align IAs to fill any gaps. In time, it will be important to verify if existing data is sufficient for undertaking and sustaining W-CEA in the region. Currently, no such exercise has been initiated in the GRW for the purpose of assessing and managing cumulative watershed effects. Similar verification is also required in the case of another scientific precursor; environmental thresholds conducive for the purpose of W-CEA.

4.4.2 Thresholds for W-CEA

When interviewees were asked to comment on thresholds relevant to W-CEA and what these could look like, the answer most commonly received was " I am not sure", which suggests a significant amount of uncertainty on the subject. Interviewees advised they had no knowledge of existing thresholds related to W-CEA. A small number (5 of 29) of interviewees did consider

water quality objectives and standards to be 'W-CEA thresholds', but spoke of nothing further in this regard.

This uncertainty and lack of knowledge of thresholds is likely caused by the fact that linking water quality in a large watershed to each and every specific development activity (or project), which themselves might make up only a small part of a larger suite of point sources of pollution, is very challenging. As a result, at this time, not much is known about watershed thresholds in the GRW. What is monitored, for instance, is how closely projects meet water quality objectives in project EA, and how monitoring (if required) is done so as to meet these objectives. An EA consultant who noted this uncertainty said, "You know there are goals for those things, but in terms of them being implemented as thresholds and having some ability to stop or limit development because they are not met, I am not sure to be honest with you how that will work. You know, the proponent will always say it's not our fault, it's the overall watershed." A comment like this suggests it is important to devise a way to better link poor water quality to each individual project in the watershed. This might aid in guiding or limiting development.

Despite widespread uncertainty, there were a number of interviewees (11 of 29) who suggested there are perhaps thresholds not stringent enough to have stopped development, but that could suffice for W-CEA. This group of interviewees mainly consisted of academics, ENGO representatives, and EA practitioners and consultants. It could be that this group was in agreement given that they utilize many of the same documents and literature given the nature of their professions. In general, this group viewed current provincial water quality standards as sufficient enough to diagnose the status of the watershed health and thus could be considered thresholds for assessing the cumulative watershed effects, believe there is a low possibility of finding such standards within other legislated water resources management requirements. An academic researcher for example noted: "I think you have to go back to regulations of particular substance and you may find that, yes, there are maximum allowable effects." Such a suggestion exemplifies how uncommon specific thresholds are. Even though CEA is not a common practice in Ontario at present (Lindgren and Dunn, 2010), project-based EA if done properly can inform watershed-scale initiatives. Thus, capitalizing on monitoring done for project-based EA may be necessary as a building block for W-CEA.

4.4.3 Monitoring in project-based EA

Interviewees were asked to elaborate on their understanding of monitoring requirements for project-based EA to see if there are standard monitoring indicators or requirements across project EAs. It is important to note that in Ontario, the *Planning Act, 1990* governs most private proponents' activities The *Act* specifies that all land acquired by a municipality will be cleared, graded or otherwise prepared for the purpose for which it has been acquired by the municipality. Land developers must then apply for development permits and abide by any 'official plans' as well as any set environmental controls. Private undertakings are subject to the *EA Act,1990,* only if they are specifically designated in regulations or are requested by interested parties to undergo an EA (Lindgren and Dunn, 2010; Sinclair and Doelle, 2010; Graci, 2009). As such, one academic researcher suggested the private developer plays a limited role in managing the project process and thereby monitoring due to limited subjectivity to the *EA Act, 1990*. The researcher said: "Mostly, they (proponents) are in the business of developing infrastructure based on the municipal standards, then handing them over to the municipality for implementation." Therefore, a large divide exists because of this distinction of how project undertakings are managed based on different legislation. The opinion of many interviewees is that a proponent has to be concerned with very little regarding cumulative environmental effects under the Ontario's provincial EA process. It seems however, there is a significant role for private proponents to play specifically in multi-scaled monitoring activities that capture different levels of impacts. Researchers of cumulative effects in watersheds believe (see Seitz et al., 2011; Sheelanere, 2010) that for W-CEA to be successful, all stakeholders need to monitor the same parameters (Noble, 2010b). This would create more useful and useable data sets for deducing environmental change to a river system and its host watershed.

4.5 Multi-scaled monitoring

Interviewees were asked to comment on the status of monitoring for project-based EA, monitoring at a broader watershed scale, as well as monitoring related to the general health of terrestrial and aquatic environments in the GRW in order to determine whether multi-scaled monitoring is being undertaken at this time. Multi-scaled monitoring is monitoring of impacts on a hierarchy of spatial scales that correspond to the perturbations and processes both within and outside the watershed (Noble, 2010b; MacDonald, 2000). Multi-scaled monitoring is essential to

W-CEA because it helps us to understand environmental change in VECs. Such monitoring can better reflect true impacts to the watershed system because each spatial scale produces baseline data for impact prediction and mitigation.

Lines of questioning on multi-scaled monitoring were closely linked with those on CEA baselines, indicators and thresholds (as reported on in Section 4.4). Both themes investigate the status of important scientific precursors for W-CEA, however, here the emphasis is on pinpointing what is done to monitor impacts across multiple scales and more specifically, whether project-based EA has been contributing monitoring data for watershed-scale initiatives.

4.5.1 Monitoring for permit approvals

The interview data reveal in order to obtain a permit to operate, some large scale development projects or projects that are considered to have significant impacts may require ex-post monitoring, as specified in the environmental impact statement (EIS). Moreover, a monitoring component is part of the follow-up process in a good practice EA/CEA (Noble, 2010a; Hegmann et al., 1999, Abraham, 1998). Interviewees reported that monitoring is done to satisfy the approvals process for various permits needed for operations. These monitoring activities are largely short term, uncoordinated, and produce data that are often incomparable.

In fact, it appears short-term monitoring initiatives do not seem to be coordinated among more than a few development projects within the watershed, if any. Moreover, data collected in such monitoring initiatives might not be compatible with other levels/types of monitoring ongoing in the watershed. Reporting systems are separate for permit-directed monitoring because the 'responsible authority' changes from one project to another. For instance, as per the *Aggregate Resources Act, 1990* for aggregate mining operations, the MNR would require impact monitoring only if extraction is below the water table or if it was determined that there are significant impacts to provincially significant wetlands (PSWs) from a pit or quarry nearby. For impacts to non-PSWs, the need for monitoring activities is determined through municipal initiatives. A mayor from a small township heavily engaged in aggregate mining explains: "Even (with) simple things, like when you compare one monitoring activity with another, we have found a great deal of difficulty to coordinate those few operators in one sub-watershed, the data just wasn't comparable." Such disparities influence the quality of multi-scale monitoring outcomes.

There is also evidence that monitoring is performed with different levels of intensity, depending on the size of a project. Large-scale projects with significant implications for water quality or quantity normally have rigorous monitoring requirements with reasonable compliance (Mulvihill and Ali, 2007) while smaller projects are normally neglected post-approval stage (Hanna, personal communication, 2010). An EA consultant explained that, "…some of the smaller projects would have standards or best management practices (but) once they have implemented these, there is no requirement for further monitoring." Such discrepancies in the monitoring programs make it difficult to improve monitoring beyond current status quo. Overall, monitoring programs now operational in the GRW are highly variable and they appear largely uncoordinated. For successful W-CEA, monitoring would ideally consist of long-term practices and reporting and allow for comparison among project-based EAs. This approach would allow a clearer understanding of environmental changes occurring within the watershed, which could then better inform overall watershed management goals.

4.6 Data management and coordination

Interviewees were asked to provide their understanding of the status of data management and coordination within the GRW, and whether they were aware of any stakeholders who might be warehousing data collected in this region. Opinions on the capacity to capture, share and manage the data were also sought so as to shed light on the 'data gap' problem spoken of earlier in Sec. 4.4. Scattered data and incomplete monitoring data were core topics for interviewees not only in the present study of the GRW, but also in a related study recently carried out in the SSW by Sheelanere (2010). Below are the two trends, which emerged the most in this theme of data management and coordination.

4.6.1 Data accessibility to watershed stakeholders

In the GRW, centralized watershed databases have been compiled by the Canadian federal and Ontario provincial governments, as well as by conservation authorities belonging to Conservation Ontario (CO). Conservation Ontario is a coalition of 36 conservation authorities that partner on specific projects, and may jointly create data sets for common use. However, not all data are shared with minimal restrictions. One researcher stated that, "Some of the data that are collected are available and well-shared, like the basic physical data, stream flows, and

reservoir levels. Those all are publically available on the website. Some of the other monitoring data, which is site specific stuff, is not readily available." Existing governmental and conservation authorities' databases include: Land Information Ontario (LIO), Southern Ontario Stream Monitoring and Research Team (SO-SMART) database, and Ontario Geospatial Data Exchange (OGDE), just to mention a few. Interviewees reported that some of these data sets are quite detailed and contain anything from survey data to soil classifications, vegetation cover, and more. Water quality data collected by the federal government tends to be retained in their own databases, although it may be shared with conservation authorities and the MOE quite freely. Municipalities also keep databases particularly on infrastructure and water services supply.

However, despite efforts in Ontario to centralize and share some data sets, it is evident that databases are still fragmented in the sense that they are scattered in various locations and managed by various organizations/institutions. One interviewee, an interested citizen who is a scholar within the GRW and an ENGO researcher, commented: "You don't always know which people you have to ask for (data). It's very spotty. One engineer may give you all you want and the other would be holding it to their chest. It seems almost to be an individual decision. It's very arbitrary." Apart from the fact that data are scattered, other phenomenon worthy of note include incompleteness of existing data, and extensive time lags between baselines data collection and reporting, which often renders data unhelpful. The time lag is tied to the spark of interest a studied phenomenon may generate at first, often followed by a lack of funds to support ongoing data collection and reporting initiatives. This combination of data accessibility problems is highlighted by an ENGO representative, who spoke of data incompleteness and time lags as follows:

> As of today, the most recent assessment of wetland cover in Ontario is dated 2000-2002. That's when the data was captured. That's almost 10 years ago. That's a concern. The problem in Southern Ontario, and by that I mean south and east of the Canadian Shield, is that only thirty-four percent of that area has been identified as Provincially Significant Wetlands (PSW). That means two-thirds have not. And the reason two-thirds has not been identified as provincially significant is that they haven't been evaluated.

This type of sentiment raises concern with regard to both data incompleteness and time lags. The data accessibility problem for watershed stakeholders is exacerbated by the fact that there are different detection limits applied in the collection of both baseline and monitoring data, rarely

are ‘raw’ rather than manipulated data made available. In fact, data are normally shared only after a level of ‘interference’, meaning that data sets are manipulated (subject to calculations or editing) by the owner prior to release to others. This type of activity naturally limits the full potential of data to be useful and paint an unbiased picture of watershed health.

About a third of interviewees (11 of 29) mentioned data gaps exist because of the proprietary nature of certain data being collected. Some interviewees felt this was an obstacle to data sharing in that data sharing agreements normally put in place and often mean a waiting period before access to the data is given to others. An example of the latter is when datasets are produced by university researchers: such data is often considered ‘public’ and widely shared, however academics tend to wait until peer-reviewed journal articles have been published before releasing their data. This means delayed analysis of environmental change for those stakeholders who might need to have (more immediate) access to different types of raw data to draw their own conclusions.

Seven of 29 interviewees believe data sharing agreements are working well in the GRW and they see no obstacles to sharing any centrally gathered data at all. This is especially the view of the provincial agencies that have worked together on different projects and are aware of the various memoranda of understanding (MOU) in effect among government divisions. The perceptions and experiences of the interviewees with regard to data sharing and accessibility illustrate that not everyone has had the same experience. The research results point to the need to improve all phases of collecting, sharing and storing data. These aspects of data management and coordination underscore even further the need to build institutional capacity in support of W-CEA.

4.6.2 Technical capacity for data capture and management

Lack of technical capacity has often been referred to in the literature as an impediment to water resources management (Nicholson, 2010; Ivey et al., 2006; Watson, 2004). To understand if any technical capacity challenges exist in the GRW with respect to data management and coordination, interviewees were asked to comment on data capture, managing and sharing mechanisms and arrangements. Responses suggest that overall, data capture does not play a major role in capacity constrains to perform W-CEA. Rather, management and sharing of data were named as greater challenges in the GRW and were thought to require further capacity

building. A significant number of interviewees again named the GRCA as a leader in the region in terms of data capture and sharing on real time basis (see www.grandriver.ca).

Despite this vote of confidence, however, interviewees reported the GRCA is still behind in terms of managing data collected, especially analyzing and reporting the findings derived from monitoring efforts. A manager for the GRCA explained it this way:

> I think we can easily, all of us, collect data, but data is useless until it's actually summarized, investigated, analyzed, inspected and then reported on. If you don't report on it then there is no need to actually collect it, that's my mantra. From the capacity perspective point of view, in our agency we don't have the bench strength, if you will, to keep on top of that analysis and reporting process.

Notwithstanding the GRCA's attempts, it is evident that accessibility to data that provide meaningful information that can create new knowledge is still an on-going challenge for institutions working together within the GRW.

In addition to lagging capacity in data analysis and reporting, there is concern about comparability among data sets. Currently, there are attempts towards centralization of water parameters and land spatial data by both the provincial and federal government agencies; by creating further ease access to existing databases. However, database fragmentation is still an issue of concern. This is illustrated by a municipal water quality manager who said, "I think sharing is one aspect but there is a need to have consistency in approach. Again, going back to the protocols and standard operating procedures, the comparability of different data is important." Inconsistent data can lead to capacity issues for W-CEA by limiting how easily information can be shared and how impact predictions and mitigation can be ill informed.

Finally, one other contentious issue in the GRW with regard to data management capacity is funding. This is not new in terms of managing water resources or performing CEA as noted by the literature (Seitz et al., 2011; Squires et al., 2009). In the case of the GRW, interviewees consistently reported that the long-term planning commitment required to execute W-CEA successfully would not likely be matched by a long-term financial commitment from stakeholders due to ongoing financial constraints. This is also not new: Plummer et al., (2010), Kilgour et al. (2006) and Leadlay and Kreutzwiser (1999) all have previously noted financial constraint as a barrier to effective natural resources and environmental management. Financial resources required to support W-CEA are discussed at greater length in Section 4.9.

4.7 Vertical and horizontal policy and planning linkage

As suggested in the evaluative framework for the IAs applied in this research, effective W-CEA requires some linkage between watershed management and project-based EA. Such linkages may be 'vertical' meaning there are interconnections among the various mechanisms of planning and assessment (policies, plans, programs, projects), while some linkages may be 'horizontal' meaning there is a relationship among mechanisms operating on the same ecological scale. Thus, EA can provide important information for consideration in watershed planning and decision-making (Noble, 2010b; Buckley, 1998) and vice versa. Hunsaker (1998) explains that in order to be effective, the assessment and management of cumulative effects has to be interactive and ongoing at a local, regional, and eventually national level. This is especially important given administrative management boundaries (no matter what the level) and those necessary to address cumulative impacts may be mismatched (Rogers and Biggs, 1999; Hunsaker, 1998).

Based on the importance of vertical and horizontal policy and planning linkages, the main focus of inquiry under this theme of investigation was to find out the level at which there is association among the parameters measured 'up and down' the assessment scale or 'horizontally'. At present, there is little documented information that sheds light on the level of interconnectivity that may exist in the GRW across or among scales of assessment and management. The interview results provide an initial glimpse into this important issue.

4.7.1 Interconnectivity 'up and down' the assessment scale

There are two views of vertical and horizontal policy linkages in the GRW. The first view is that there is already some sort of 'rolling' of data and information into the 'next' level of assessment. There is agreement among a few interviewees (10 of 29) that some effort is being made towards using, for example, sub-watershed plans to inform project-based EA within the GRW. However, this group of interviewees is not representative of a particular stakeholder type. That is to say, there was no pattern of opinions based on whether interviewees are water or non-water experts, or work with government agencies, in academia, or otherwise. The view that 'rolling' of data and information already occurs is encapsulated in the following statement by an academic researcher:

> Municipalities look at Conservation Authorities' watershed plans, sub-watershed plans and tertiary plans to receive input about whether a development should proceed or not, and how they should be designed. So the structure is there to look at cumulative environmental effects…the vertical and horizontal linkages are there, definitely.

The above statement is evidence of at least some interconnectivity among different scales of planning and assessment. The same interviewees also pointed out there is sufficient water policy guidance available to proponents who conduct project-based EA, for example, as found in municipal and Region of Waterloo official plans, sub-watershed plans, and the *Grand Strategy,* (which attempts to illustrate impacts at a watershed scale).

A second viewpoint expressed by interviewees is that vertical and horizontal policy and planning linkages are in fact 'non-existent'. This group of interviewees (13 of 29) explained this is due, once again, to a 'disconnect' between the formal project-based EA, informally practiced regional CEA (W-CEA would fall into this category), and the municipal planning processes in Ontario (see Lindgren and Dunn, 2010; Baker and Shoemaker, 1993). This group feels minimal guidance is provided by regional plans and corresponding policies to project proponents to help link management initiatives across the various scales. Available municipal and regional official plans and the *Grand Strategy/Grand River Basin Water Management Plan* were deemed not specific enough to provide any real guidance to project proponents engaged in project-based EA. One academic researcher said, "There is no single plan or policy at the watershed scale that other plans must adhere to". Another explained that a major problem is the stagnant nature of these documents. For example the *Grand River Basin Water Management Plan* is relatively outdated, having been published in 1982. Thus, there are poor linkages among project-based EAs and this formerly important GRW plan. Another reason given for lack of policy and plan integration is that are ambiguous about what directions project proponents might follow or support. Interestingly, all conservation authority representatives that were interviewed agreed to the need to update the plan. However, EA consultants did not all share the same view. This could possibly be an indication that little watershed policy and planning information is linked to the work of the EA consultants in the Grand River watershed.

Contradictory mandates also seem to contribute to the lack of vertical and horizontal integration. A chief planner from one of the smaller communities within the GRW stated:

> We do have competing interests from different ministries and we have a ministry that competes within itself. The MNR is responsible for protection of natural resources and it's also responsible for…exploitation of those resources, such as gravel. So what we have done in our official plan, as an example, is prohibit aggregate mining pits close to the wellheads protection areas. The MNR is concerned that we are doing that, and they want us to allow it, but we have other policies that want us to protect our wellheads.

This interviewee went on to express the frustration caused by contradictory mandates, and said, "OMAFRA are concerned that we are prohibiting intensive livestock operations in the wellheads protection areas, yet at the Provincial Policy Statement (2005) level, it says we need to protect our water resources. So even though the overall policy comes from the province, there are competing interests between ministries. We have to think what we want to achieve here." It is therefore difficult to have smooth operations with such conflicted and fragmented policies, which are incoherent, and which cause unclear reporting authority.

4.7.2 Monitoring results of project-based EA

An important aspect of vertical and horizontal linkages has to do with monitoring. Monitoring is important in EA for a number of reasons, as mentioned above in Sec. 4.5. It shows whether agencies are implementing promised mitigation measures, and whether these measures are effective. Monitoring also compares the actual effects of a project to its predicted effects, and it typically improves project outcomes through adaptive environmental management (Shepherd, 1998). In the previous section, it was revealed that the monitoring results of an individual project-based EA can inform regional land-use planning and water resource management initiatives (such as through W-CEA).

Despite the importance of monitoring, relatively little attention is paid to the actual use of project-based EA monitoring data in the GRW. A majority of interviewees expressed that the GRW is behind in terms of incorporating EA monitoring data into watershed management objectives. This lag is due in part, they say, to the large amount of information that results from assessing physical undertakings within the GRW. It is also possibly due to the "success" of current monitoring programs in the watershed: the more successful the program, the more data generated. Both ideas are captured in the following statement:

> I think the link that was there, is definitely not as strong as it should be. It's just because again, so many small projects are going on in the watershed. There is a lot of material being generated and it's very difficult to incorporate all of it.

Overall, the comments on monitoring suggest a weak connection between current watershed management practices and project-based EA, which may be compromising to the GRW's ecological integrity.

A First Nations interviewee advocated for the need to look at the watershed in a more holistic manner. This individual sees holism as one of the core directions of the new watershed management plan currently being drafted for the GRW. The interviewee said:

> I think again with the drafting of the new watershed management plan, there is potential there and that's the direction I would like to see the plan go. Take some of these concerns, and maybe they are not absolute policies but they are concerns of the citizens near the watershed here. Then the onus would be on the developers and proponents to comply recognize and implement the best they can. That would be an enhancement over what is in place now.

However, it seems there isn't a clear impetus (regulatory or otherwise) for most stakeholders in the GRW to expand the use of monitoring data at present or adopt a more integrated approach to assessment and management. Part of the challenge in implementing W-CEA then is the regulatory regime, and whether W-CEA could gain legal standing as a watershed management and decision-making process.

4.8 Enabling legislation

Currently in Ontario, there is no legislation that requires any responsible authority in EA to perform CEA (Lindgren and Dunn, 20101; Graci, 2009).To find out more information about the existing legal framework, interviewees were asked (1) their opinions on what should be the legislative means by which to implement W-CEA; (2) whether there is a need to form new legislation for W-CEA to progress; and (3) whether there are any legislative means at present in the GRW to ensure the results of watershed-based programs (e.g. monitoring, planning, assessment) are integrated into individual project developments.

Interestingly, interviewees suggested that concepts related to W-CEA have long been developed and pursued in the GRW, although they might not have been called W-CEA. There is a strong sense that these types of initiatives are directed by existing legislation, regulations and

policies. As noted in the statement below, interviewees strongly emphasized that initiatives and practices resembling W-CEA exist informally, if not in the letter of the law:

> I think sometimes you might see W-CEA exists in other processes but (it is) not called that. Like we sometimes observe EA at work in other policies and programs although it's not called EA, but it's still assessing the impact and coming up with mitigations and so forth. So sometimes that quality (W-CEA) is being achieved in other regulations.

It was evident in the interviews, based on opinions such as this, that there is understanding of the need for W-CEA and some supporting legislative instruments do exist within the watershed in some form or another. Two of the most important and influential legislative acts in this regard are the *Clean Water Act, 2006* and *Lake Simcoe Act, 2007*.

4.8.1 Clean Water Act of 2006 and Lake Simcoe Act of 2007

Interviewees clearly see the need to have enabling legislation specific to W-CEA. These interviewees supported the *Lake Simcoe Act, 2007*, for example, whose regulations requires ecosystem based management (adopts the whole Lake Simcoe basin as a unit of assessment) as well as the *Clean Water Act, 2006*,which directs Source Water Protection (SWP) planning. These two pieces of legislation are a departure from the piecemeal-based legislation that is more common in the GRW and divides environmental management into many separate components (e.g. looking at water quality and quantity separately). An ENGO researcher commented on the comprehensiveness of Lake Simcoe Act by stating that, "If there was enabling legislation that would support a standardized approach to cumulative effects assessment, it would be within the Lake Simcoe watershed through the Lake Simcoe Plan." Therefore it shows that some interviewees prefer such legislation and believe if W-CEA is to take roots in the GRW such legislation should also be established for this watershed region.

Although the *Clean Water Act, 2006* is viewed as an important step toward ecologically-based drinking water management, a number of interviewees were not sure what parts of the watershed would be 'zoned' to include protection for SWP under this Act. This was because the preliminary planning and background studies done for SWP are still ongoing. Despite the work that still needs to be done, the designation of SWP zones is considered to be an indication of moving towards legislative and administrative instruments that reflect ecological units and a more holistic approach to watershed management.

At the present time, watershed management in the GRW consists of a complex regulatory and legislative environment involving five levels of government: municipal and regional, provincial, federal, the GRCA, and/or sometimes First Nations. With this division of responsibilities, there is an ongoing need to put in place clear memoranda of understanding (MOU) and maintain effective collaboration among the many and varied kinds of water resources managers. It is also important to understand the degree to which the results of watershed-based programs are implemented at the individual project-based EA level, namely what sort of compliance exists with respect to watershed-scale initiatives. One academic researcher observed: "One of the biggest challenges in Ontario is that there is no single way in which all this (project-based EA and watershed initiatives) occurs, so then you get into fragmented, multi-jurisdictional issues." This researcher also believes fragmented jurisdictional issues mean there is no effective way to deal with cumulative watershed effects at this point in time.

In sum, although there appears to be a strong awareness of the need for W-CEA in the GRW, and although there is some agreement that there is a sufficient legislative and regulatory framework for W-CEA, it is also evident that project-based EA and larger watershed-scale initiatives occur in highly fragmented fashion. The biggest obstacle at the moment might be the need to link the two scales of assessment: the watershed scale and the project-based EA, so as to protect the watershed ecological integrity. Environmental assessment experts readily admit that EA has not merged successfully into the other more traditional way of managing natural resources (Duinker and Greig, 2006).

4.9 Financial Resources

It is important to establish the financial feasibility of developing and sustaining W-CEA in the GRW, given the historical budgetary cuts that have limited the financial capacity in other watershed management initiatives (see Plummer et al., 2010; Veale, 2007; Fitzgibbon et al., 2006; Plummer et al., 2005). Realigning IAs to make W-CEA possible would likely be a very expensive endeavor and thus, a clear understanding of what such realignment may entail is crucial at this point. Although an initiative such as W-CEA may be seen as expensive, far greater costs may be incurred by not undertaking it. Such costs include the potential loss of ecosystem services, as a result of ignoring the cumulative environmental effects altogether. These losses

may be irreversible and thus become great opportunity cost to the communities in the GRW. Below are the key messages relayed by interviewees on financial resources to support W-CEA.

4.9.1 Municipality property levies

The financial dependence of CAs (such as the GRCA) upon municipalities was seen to have direct consequences on how CAs determine their activities, including potentially advancing W-CEA in the GRW. The municipalities fund conservation authorities based on population size and property levies received (Government of Ontario, 2000). About a third of interviewees (10 of 29) acknowledged that this dependence and funding structure does not adequately serve the purpose and needs of the CAs, even at this time. The concern is that this funding structure does not enable the GRCA to initiate programs such as W-CEA, mainly because the distributed funding model creates insufficient funds to support a major initiative like W-CEA. One academic researcher explains:

> The conservation authority's mandate really is to do watershed studies like cumulative studies. They are dependent financially on the municipal property levies. Because of the financial status of the municipalities, it's very unlikely that the council would approve a significant increase in levies for the conservation authorities; it would be political suicide for the council and therefore suicide for the conservation authorities.

As indicated in the above statement, the property levy and distribution formula does not seem to provide the financial resources needed to cover watershed wide programming at present. The interview data further suggest that there is not much "wiggle" room to encompass an initiative like W-CEA in the future either. With such limited financial resources, limited institutional capacity is therefore inevitable. Shortages in funds to support long-term initiatives in water resources management is not a new phenomenon and has been discussed extensively in literature within the Canadian context (see for example: Plummer et al., 2010; Ferreyra et al., 2008; Timmer et al., 2007; Ivey et al., 2006; Mitchell, 2005; Plummer et al., 2005; Ivey et al., 2004).

Some interviewees critiqued the financial operations of the GRCA. They observed that with anticipated population growth and of the fact that most of the GRW lies within the Greater Golden Horseshoe (GGH) designated growth plan area (OMPIR, 2006), the GRCA has a great opportunity to reform the way it manages water resources. Specifically, there is opportunity to garner further financial resources from member municipalities if the GRCA can be able to

present to these member municipalities a better case of how to effectively manage the water resources to meet this future expansion. A knowledgeable ENGO researcher stressed that the GRCA would be in a better financial position if they had strategically identified their long-term goals. Had they done so, the GRCA may have been able to include W-CEA in the new watershed management plan that is currently being prepared. The researcher said: "They have not made a very good case to the members of their (sponsoring) municipalities to request for financial support; they have been running on the momentum they created through the 1990s." In comparison, the Credit Valley Conservation Authority and the Toronto and Region Conservation Authority (TRCA), which also operate within the GGH Designated Growth Plan area, have advanced a very powerful argument about their strategic regional sub-watershed planning needs to the point that the region of Peel (consists of the municipalities of Brampton, Caledon and Mississauga) has increased their budget to develop their long term monitoring program by more than $5 million over the next 5 years (Imhoif, personal communication, 2010). This will provide the TRCA with a new source of financial resources to possibly implement W-CEA and related monitoring.

Therefore, financial constraints at present can be turned into an opportunity to progress toward W-CEA if the GRCA can capitalize on the need to plan for future water resource management, as has been done by other CAs. But ongoing financial constraint—as noted by the interviewees—is also a debilitating obstacle in that it limits support available to build any kind of institutional capacity. Financial support for W-CEA in the GRW strongly depends upon the visions and creative approaches taken by the CAs and other decision-makers, both now and in the future.

4.9.2Funding for W-CEA

Almost all interviewees agreed that there would likely never be enough funds available to do 'good' W-CEA. However, a majority of them (11 of 29) view ongoing data collection and attempts to coordinate activities as an encouraging starting point for W-CEA, when coupled with an appropriate vision developed as part of a strategic long-term watershed plan (as discussed in Section 4.3). Monitoring programs were also seen as important financial priority in advancing W-CEA.

Despite that there is a fairly clear sense of the financial priorities related to W-CEA, interviewees cautioned that there is competition for available funds. One competing initiative that is concurrent to watershed planning exercises, which causes a diversion of resources that could perhaps support W-CEA, is the SWP program initiated under the *Clean Water Act, 2006*. This is a 'new' and 'imposed' planning exercise that has been passed from the province to the GRCA related municipalities. Given this is ongoing, there will not be much room left in planning budgets to meet W-CEA priorities, unless perhaps new sources of funds are identified. An academic researcher explains:

> For instance, with the Clean Waters Act, the province will pay for the planning exercise but not for the implementation, and so in 2012 provincial funding for clean water officially seizes and the cost are going to be transferred to the municipalities. With the $25 billion deficit, they are not looking for places to spend money. So if there is going to be funding for CEA, it would have to come out of local government. But they are so close to bankruptcy, it's not going to happen.

This statement suggests that financially, it might be quite difficult to develop and sustain W-CEA in the GRW at this time.

Notwithstanding the initiatives such as SWP, the current regional planning process especially for the urban municipalities within the GRW was seen as a reactive process and somewhat wasteful of financial resources. Given that, as stated in Section 4.9.3, the GRCA lies within the GGH Growth Plan area; the population of which is expected to increase by 6.6% over the next decade (GRCA, 2009; Olewiler, 2004) planning for this future expansion is necessary. This is also an important exercise because pressure upon water resources within the GRW will likely increase significantly with such population growth. As such, the provincial government has been busy preparing for this change. However, based on the interview results, this same planning process is seen as uncoordinated and not considerate to the limited financial resources available. An example of such sentiments is given below:

> Right now, they (municipalities, region of Waterloo, and GRCA) tend to be reactive, so basically they are managing the decline of the watershed. If you don't know where you want to go, it's hard to change the direction. People just assume that's the trajectory and they manage it. So if you say, 'this is where we prefer to go', then it forces the plans and the approvals to push for that direction.

This quote highlights the reactive nature of this planning process and the current environmental management goals in the GRW. It has been argued in the literature that for 'good' CEA (in this case W-CEA) to take place, there has to be integration of regional planning with science and

management activities (Noble 2010b; Harriman and Noble, 2008). Such an approach is currently missing in the GRW.

4.10 'Bridges' and 'barriers' toward the development of W-CEA

During the interviews, a number of common reflections emerged in addition to the themes of the evaluative framework. These are termed here as 'bridges' and 'barriers' to W-CEA in the GRW. These reflections were generally made in response to the final question in the interview schedule (see Appendix A2), which asked each interviewee to relay any further observations they might like to make. The 'bridges' noted by interviewees are unique to the context of the GRW and could represent excellent opportunities to both streamline current watershed management approaches and possibly strengthen aspects of IAs in support of W-CEA. The barriers on the other hand, are the obstacles to a more proactive, streamlined, and effective watershed management process. These are also very context-based on the GRW condition. Table 4.1 summarizes the 'bridges' and 'barriers' to W-CEA identified by the 29 interviewees.

One of the primary 'bridges' to W-CEA is the fact that, there are good professional relationships in the GRCA. This is seen as a great start in terms of the human resources needed to undertake W-CEA effectively. The individuals that work for the GRCA have long been at the forefront of influencing change in the watershed, and have made many intelligent decisions about water resources despite the vagueness of certain water resource management policies. These individuals tend to remain with the institution for longer terms, resulting low turnover rates and store the consolidated institutional memories. They also are active members of communities, who spread stewardship awareness within the watershed. Moreover, their commitment to the GRCA mandate and involving citizens in various 'citizen science' programs contributes community capacity building, as defined by Honadle (1981).

The existence of the three research institutions (University of Waterloo, Wilfrid Laurier University, and the University of Guelph) within the watershed is also seen by study participants as a significant 'bridge' to W-CEA. The capacity of these universities to contribute to watershed and W-CEA studies means there is great potential for the GRW to adopt W-CEA. Each of these universities has extensively researched many aspects of water resources management and could contributed to W-CEA. The universities have also lobbied for ongoing watershed programs such as the GRFMP and the Exceptional Water Program (Plummer et al., 2010). It has been argued in

literature that the users of a given resource know more about that particular resource than anyone else, and their interest in safeguarding the same resources is often strong and unwavering (Agrawal and Gibson, 1999; Rogers and Biggs, 1999). This observation might also apply to universities such as those in the GRW that although are not stakeholders in the traditional sense, do typically express a strong interest in responsible natural resources management. The universities will continue to generate new knowledge of contextual relevance to the GRW that could further inform W-CEA management goals.

Table 4.1 Summary of 'bridges and barriers' for advancing and sustaining W-CEA in the GRW

Bridges for W-CEA in the GRW	Barriers for W-CEA in the GRW
Professional relationships: there are good working relationships within the GRCA based on their history	Lack of: provincial support and commitment beyond Clean Water Act and of integrated view of water resources
Established leadership: strong role played by the GRCA at present	Unclear contribution of Source Water Protection in the future
Public participation: strength of the community involvement in watershed management	Unknown watershed carrying capacity and set limit of development
Research support: three universities contribute to water-centered research	Missing: Harmonization of jurisdictional responsibilities.
Watershed programs: ongoing programming allows for long term-monitoring data collection and build complete databases(E.g. Exceptional Water Program, GRFMP)	Lack of political will and creativity among leaders. Barriers of communications within the research community
CEA practice: good examples of CEA in project-based EIA exist within the watershed	Lack of evaluation along the lines of property and development rights
	Culture of risk aversion Immature science and lack of attention to the science of CEA

Another 'bridge' to W-CEA is the citizenry of the GRW, who are relatively aware of watershed management issues and quite involved in planning and management efforts (Plummer et al., 2010; Region of Waterloo, 2010; Baker and Shoemaker, 1993). For example, various communities within the GRW are often involved in 'citizen science': collecting samples of flora and fauna; conducting restoration for streams, rivers and riparian zones; and participating in the awareness programs of different ENGOs, the GRCA, provincial agencies and municipalities. This involvement strengthens relations among the many stakeholders involved in water resources

management. Cavaye (2000) indicated that an involved civic community and an open-minded governance structure brings about community social capital, which he defined as the ability, organization, attitudes, skills and resources needed by the communities to improve their economic and social situation. An active, involved citizenry also often leads to a shared vision of the future among stakeholders, and management goals more reflective of the community's values (Veale, 2003).

In contrast to the 'bridges' discussed above, interviewees also identified a number of barriers to W-CEA in the GRW. These are viewed as pressing issues in the GRW and they include: lack of provincial support; unclear watershed carrying capacity; lack of political will; communications breakdown; unclear contribution of SWP; lack of jurisdictional harmonization (legal framework); property rights litigations; and risk aversion in terms of trying new approaches to the management of complex environmental problems such as cumulative watershed effects. The withdrawal of provincial support in sub-watershed planning as well as budgetary decreases in environmental management (both MOE and MNR), was seen by many as a step backwards along the path of management at a watershed scale (Fitzgibbon et al., 2006; Veale, 2003; Shrubsole, 1996), especially given the strong evidence that an ecological unit such as a watershed must be adopted to address important ecosystem-wide relationships and processes of environmental change (Noble, 2010b; Heathcote, 2009).

Communication breakdown come about from the problem of fragmentation of management mandates and convoluted requirements by the many stakeholders involved in the water parameters management. Lack of jurisdictional harmonization (legal frameworks) also compounds the indistinctiveness of roles of the stakeholders involved in water resources management. The risk aversion in terms of trying new approaches to the management of complex environmental problems such as cumulative environmental effects was seen as an obstacle for W-CEA in the GRW. Such views were of those interviewees who saw that the ecologically based legislation like the *Lake Simcoe Act, 2007,* provided a new way of looking at cumulative watershed effects and signify a leap towards new ways of viewing old problems In addition to this view, property rights were of concern especially in relation to zoning and re-zoning of residential, protection areas and commercial areas. This was a concern for interviewees who mentioned how other ecosystem management approaches had to undergo a clear analysis of

land allocation for ecosystem-based approach such as the case of the Greenbelt and the Niagara escarpment being identified as protected areas.

Biophysical and environmental barriers may also affect the technical (and scientific) aspects of W-CEA in the GRW. Interviewees explained that the biological carrying capacity of the GRW is still unknown despite the volume of studies completed over the years. This is a legitimate barrier especially in light of the expected population growth, which will inevitably increase pressure on water resources and result conflicts among water users (Leadlay and Kreutzwiser, 1999). For W-CEA advancement this means it will be difficult to set the limits of acceptable change, especially if the rivers systems fluctuate with water use. Such acceptance levels of changes are normally proposed by the communities within the watershed because they reflect their values of what is seen as acceptable level of change (O' Faircheallaigh, 2010; Rogers and Biggs 1999).

The final 'barrier' to W-CEA emphasized by interviewees is the science of prediction and assessing environmental effects on a large spatiotemporal scale. A few believe the state of watershed science is too immature to support an undertaking like W-CEA, or even to stop unwanted development from happening in the GRW. The concern is it's difficult to pinpoint the 'culprit' if impacts experienced are due to non-point sources of anthropogenic pollution. It's difficult to prove causality when examining environmental impacts (Dixon and Montz, 1995; Reid, 1993). However, it is also safe to argue that such a view is due to lack of attention to the science of CEA. There has been great progress in terms of the supporting science needed for 'good' W-CEA in the past two decades, especially in Canada (Seitz t al., 2011; Squires et al., 2010; Dubé et al., 2006; Dubé 2003; Hegmann et al., 1999; Abraham, 1998).

In order to progress towards W-CEA, there is a need to break down some of these barriers. The most significant barrier to overcome is the lack of harmonization among jurisdictional mandates. In order to provide clarity and achieve the common goal of watershed health and sustainability, these mandates must operate in unison or at least unfold in a synergetic fashion. It is counterproductive to have one provincial government agency operating under a conservation paradigm while another operates under a development paradigm with regard to the same water resources (i.e one conserves and constructs new wetlands while another operates aggregate mining in the same vicinity). Adopting an environmental assessment framework (upon which W-CEA is based), rather than continuing to rely on the current uncoordinated mesh of

policies, would help to illuminate the antagonistic nature of certain jurisdictional mandates and perhaps bring the goal harmonization a little closer.

The second most significant barrier that needs to be overcome is 'immaturity' of the science of CEA (also applicable to W-CEA). Some interviewees believe existing science is simply too immature at present to solve the complex problems experienced in the GRW. However, despite this viewpoint there actually is considerable literature on W-CEA and on what can be done to protect watersheds using this framework. Furthermore, there are a number of examples good watershed management with Canadian context, which is unsurprising given that the phenomenon of water resources management fragmentation is experienced nation-wide (see Seitz et al., 2011, Nobel, 2010b, Sheelanere, 2010; Dubè et al., 2006). Perhaps what is needed is further dissemination of studies and information that would help improve the science of CEA in the GRW.

Finally, the lack of political will and lack of creativity among leaders in the GRW must be addressed. Political will is generated by elected officials by appreciating fully the science and concern of those living within the watershed regardless of the political mandate the respective official has for the term he occupies the office. Furthermore, creativity results from applying new ways of solving problems that have been attempted in the same traditions. Creativity may be defined as: "the ability to transcend traditional ideas, rules, patterns, relationships, or the like, and to create meaningful new ideas, forms, methods, interpretations, etc." (Keeney, 1992). Both political will and creativity can aid the eight investigated themes. However, these two components are contextual and are tied to the current institutional arrangements in the Grand River watershed. A more in-depth discussion of how creative insight and political will can influence water resources management and help W-CEA to take root in the GRW is contained in Chapter 5.

4.11 Conclusion

The intent of this research was to explore the IAs necessary to develop and advance W-CEA in the GRW using an evaluative framework originally developed in a similar study in the SSW (see Sheelanere, 2010). The investigation has revealed a rich tapestry of IAs in the GRW which, to a large extent, could form a solid basis for W-CEA should it be pursued in the future. However, all indications are that W-CEA is still a concept largely in its infancy in the GRW.

Exisiting IAs—those that are ‘tangible’ (see Chapter 2 of this thesis)—can be said to possess some of the necessary ingredients for W-CEA, but the ‘recipe’ is quite incomplete at the moment. For instance, institutions such as the provincial agencies, the municipal councils and even the GRCA have not yet identified cumulative watershed effects specifically as a concern at this time, and manage such effects within the existing EA framework. In terms of ‘intangible’ IAs (also see Chapter 2), there isn’t any reference to cumulative watershed effects reflected in the language of existing watershed management plans. There is little evidence to suggest anyone has envisioned or undertaken an assessment or management approach similar to W-CEA, despite the opinions of some of the interviewees who suggested this was so earlier in this previous chapter. What can be said about the current status of the IAs in the GRW is that they are in a transitional stage in terms of watershed management approaches. Given this scenario, there exists an opportunity to include W-CEA if there are options for reforming the approaches currently implemented in water resources management in the watershed. The GRW can be identified as a watershed that is very ‘organic’ in that it has a high rate of both development and population growth, and it is in a state of rapid change. Thus, new and creative approaches to watershed management can possibly be implemented and IAs remolded as needed.

The most unexpected findings in this study relate to the concept of a ‘lead agency’ for W-CEA in the watershed. With the long-standing and well-known existence of the GRCA, it was expected there would be a consensus view that this institution could and should be entrusted as the responsible authority. However, there were clearly divergent opinions on who might lead a W-CEA initiative. Water resources management in Ontario and the GRW appears to be a highly fragmented process with a number of ongoing concerns that need clarifying before IAs can support W-CEA goals. There is a degree of ambiguity that still lingers around ‘who does what’, and how many MOUs exist for a particular action to be taken in relation to water resources management. Therefore, it is difficult to identify a specific lead authority among the many different levels of governance.

Another surprising and interesting finding was in relation to the importance of political will. The political will of local government representatives as well as provincial ones can influence either the creation or hindrance of the information availability for the political decisions makers to use for the purpose of creating changes in the administrative and legal systems. For instance, it was noted by many interviewees throughout the research that the

decisions of provincial government are tied to political will and how the views of political leaders on the environmental management fluctuated the funds availability in 1990s. Such political will heavily impacts the financial resources made available for an initiative like W-CEA. Ongoing financial support is incredibly important in initiating and subsequently supporting environmental protection programs, and thus if there is no political will to influence the commitment of financial resources, it becomes very difficult to expand the mandates to include W-CEA. It is important to stress the importance of contextual relevance that is provided by the GRCA since Ontario is a vibrant and diverse province with varying wealth and various ways of implementing similar policies. A good example is how each municipality; regional government and CAs interpret what the Provincial Policy Statement (2005) requires them to do.

The following chapter presents major conclusions drawn from the results presented in Chapter 4 and interprets these in light of the study's goals and objectives. In particular, Chapter 5 comments on the overall 'degree of readiness' of institutions in the GRW to carry out and sustaining W-CEA via existing institutional arrangements. Later in Chapter 5, opportunities to advance W-CEA in the GRW are summarized and some reflections are made on the evaluative framework that served as a basis for the investigation. Finally, policy recommendations and directions for future research stemming from this project are discussed.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

In light of the current emphasis on regional-scale approaches in the field of EA and the need to advance watershed management and protection in southern Ontario, this research investigates the institutional potential to implement W-CEA in the GRW. The study adopted an evaluative framework as a tool to appraise, on a macro-scale, the 'degree of readiness' of existing institutional arrangements to undertake W-CEA. Qualifying the 'degree of readiness' is a coarse way of gauging the institutional capacity to support W-CEA. As noted earlier in Chapter 4, institutional capacity consists of a combination of technical and human resources, as well as administrative and financial capacity, which together allow an envisioned goal to be attained.

In light of the established components of the evaluative framework used in this thesis, technical capacity is gauged based on knowledge gaps, institutional knowledge and communication, as well as the maturity of science available to support W-CEA. Human resources capacity includes elements such as knowledgeable people, citizen participation, and ability to engage in knowledge sharing among various institutions. Administrative capacity includes policy development and implementation (including clear mandates, directives and goals for water resources), and the limitations of laws and regulations in relation to environmental impact assessment and management. Financial capacity is assessed based on the ability to initiate and fund new watershed initiatives (such as W-CEA), flexibility of funding structures, and the ability to pursue watershed planning and management goals beyond source water protection. Gauging the overall institutional capacity is an important advancement towards W-CEA because lack of institutional capacity often poses the most significant barrier to improved regional-scale EA (Genskow and Born, 2006; Watson, 2004; Canter, 1999; Buckley, 1992).

Given that no two watersheds are exactly alike in terms of their biophysical and socio-economic parameters (Nicholson, 2011; Reid, 1998), the GRW is a case unto itself, although the conclusions drawn in Chapter 5 can contribute general knowledge toward the growth and expansion of the W-CEA concept. To reiterate, the specific research objectives of this research study were to: (1) develop an evaluative framework of institutional arrangements to support W-

CEA; (2) employ the evaluative framework in context of the Grand River watershed to identify the presence or lack thereof of supportive institutional arrangements for W-CEA and the region's overall 'degree of readiness' to practice it; and (3) identify opportunities for advancement of W-CEA in the Grand River watershed, and watersheds elsewhere, based on the application of the evaluative framework. All of these objectives were accomplished.

The sections that follow draw broad conclusions for the entire research study, based on the results and discussion presented in Chapter 4. Conclusions are drawn about the institutional 'degree of readiness' to undertake W-CEA in the GRW, as well as what can be achieved at this point in terms of moving W-CEA forward. This chapter also draws conclusions on the current status of the IAs in the GRW. Broad policy recommendations are offered in Section 5.5, and finally, areas for future research are identified at the end of the chapter.

5.2 'Degree of readiness' to assess and manage cumulative watershed effects in the Grand River watershed: Nativity for W-CEA

Currently the IAs within the GRW are not well set up to facilitate the assessment and management of cumulative watershed effects and related impacts. The management of cumulative watershed effects will depend on improvements in all eight areas investigated via the evaluative framework, which is broadly reflective of the necessary ingredients for 'good' W-CEA (Sheelanere 2010) and specifically reflective of Ontario's institutional context. If progress is made on these many fronts, however, it is possible to attempt W-CEA. Even if progress lacks or lags in one or more of the eight institutional themes investigated, W-CEA could probably still be attempted, however, it would likely continue to portray the shortcomings currently experienced in EA practice, including inconsistencies in how CEA is practiced (Noble, 2010a,b,c; Hegmann et al., 1999; Canter, 1999; Contant, 1993). It is therefore crucial to make progress in all aspects of IAs which form the institutional template for W-CEA, and build the necessary institutional capacity to prepare the GRW to develop and eventually carry out W-CEA.

The identification of a lead agency; clarity of stakeholder roles and responsibilities; data management and coordination; and strong compliance requirements guided by enabling legislation, regulations, and policies, are the four themes of the evaluative framework which together comprise the *managerialism ethos* important in creating opportunities and impetus for CEA, as well as ensuring process efficiency. The financial aspects of an on-going watershed-

scale initiative such as W-CEA are also part of the *managerialism ethos*, as shown in Figure 5.1 below. The *scientific ethos*, which is also critically important in realizing W-CEA, consists of the following framework themes: CEA baselines, indicators and thresholds; multi-scaled monitoring; and vertical and horizontal linkages. The eight foundational aspects of 'good' W-CEA captured in the evaluative framework can therefore be explained metaphorically as 'two sides of the same coin', as depicted in Figure 5.1.

Figure 5.1 The 'managerialism ethos' and 'scientific ethos' as two sides of the same 'coin' of W-CEA

Scientific and management approaches should inform each other at all stages of CEA as well as in the process of addressing identified impacts. The scientific ethos provides understanding of the causes of current watershed conditions and helps to determine the physical nature of environmental problems (see Figure 5.2). The management ethos can then be utilized at various scales (project or watershed) to generate management goals to address regional-scale effects. As suggest by MacDonald (2000), a nested series of separate but cross-referenced project-and policy-scale assessments are the most effective means to address cumulative effects over the full range of spatial and temporal scales. If there is clear understanding of current cumulative watershed effects, this knowledge can be used to adjust existing policies and improve planning at the watershed scale (Noble, 2010b; MacDonald, 2000). Figure 5.2 indicates how the

scientific and management approaches inform each other in the process of evaluating complex environmental problems such as cumulative watershed effects.

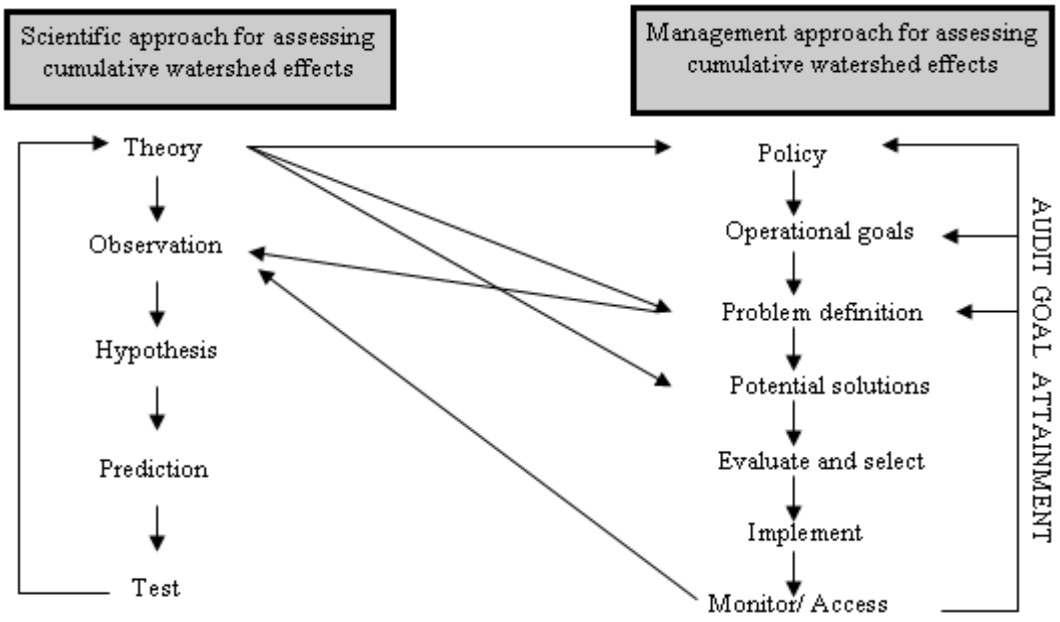

Figure 5.2 Linkages among the scientific approach and the management approach in the process of evaluating cumulative watershed effects. Adapted from Rogers and Biggs, 1999.

5.2.1 Managerialism ethos: Administrative template for W-CEA

As noted above, successful W-CEA will include attention to both the managerialism ethos and the scientific ethos in the GRW. The managerialism ethos provides the template by which to set administrative and management goals better aligned with watershed spatiotemporal scales and to address cumulative watershed effects. The research results clearly demonstrate there are administrative complexities and impediments in all aspects of planning, reporting and implementation related to W-CEA goals, as well as ongoing tension and marked differences in professional opinions among water resources management agencies within the GRW. Points of contention arise from the fact there is inconsistency in water resources policies when viewed using the watershed as the unit of administration. Each of the agencies manages resources according to their own specific mandates, with little or no communication or coordination with the others. None of the existing agencies can be identified as a lead agency for all aspects of water resources management at all times. For example, at the provincial government level, the MOE and MNR, who are responsible for water quantity and water quality respectively, do not

always coordinate their mandates with the GRCA which is legislated by both the provincial and municipal governments to operate on a watershed scale.

Furthermore, based on the research results, federal government agencies such as Environment Canada and DFO appear to be almost non-influential in the GRW when decisions about water resources and development are taken, given that water is a provincial jurisdiction and so are the problems affiliated with it on a watershed scale. The exception is if a water issue is of a trans-boundary nature (involves more than one province by spanning borders). Due to this fragmentation of authority, it would be difficult to assign the responsibility of W-CEA to any one of the agencies found within the GRW at this point. For W-CEA to be undertaken and for it to be sustained, there has to be coordination of policies among all agencies responsible for water resources and landscape management within the watershed. Their mandates must also contain explicit objectives which aim to prevent, mitigate, or manage sources and pathways of cumulative watershed effects and their impacts. There must exist a functional lead agency at each level of governance whose mandate is W-CEA. At present, this type of leadership is lacking at all levels.

Coupled with the challenges of identifying a lead agency and developing appropriate policies to support W-CEA, is the challenge of setting unified, coordinated watershed-wide management goals. At the moment, such goals are lacking due to varied opinions on the most efficient and effective means to manage landscape and aquatic environments; how to include all stakeholders in development decision-making and conservation initiatives; and best management practices to ensure water quality and quantity in the Grand River. Currently, there is no lead agency charged with setting management goals that could support W-CEA. In fact, there are already many leadership ambiguities arising from trying to balance water use within watershed boundaries.Administratively, the coordination of water users is one of the major obstacles in addressing watershed-scale cumulative effects because each development sector (resource development agencies versus those that are responsible for conservation) tends to defend their particular interests. This phenomenon has been noted in many other watersheds management studies (see for example: Nicholson, 2010; Blackstock, 2009; Hooper and Lant, 2007; Genskow and Born, 2006).

At the present time, the GRCA is perceived to be a lead agency without full legal authority or complete decision-making power, but with watershed ecological integrity at the core

of its operations. The provincial agencies are perceived to have the power to make decisions about water resources use and restrictions, while the municipalities are perceived to control development activities. For the W-CEA concept to take root and to ensure synchronicity, the research suggests sectoral development goals should be linked at both operational (landscape) and strategic (planning) levels. By employing this approach, there should be better coordination in the management of cumulative watershed effects and there will be less confusion about what effects are being managed on a watershed scale. Watershed management goals should be tracked through watershed planning processes, watershed monitoring programs, and/or using state-of-the-watershed report cards (Veale, 2003). With this kind of administrative structure in place, project-based EA could very easily become an integral tool in the watershed management toolkit (it could be integrated within the broader W-CEA process). Baseline data collection efforts might become more fluid if management goals are compatible at project and watershed scales. A project's contribution to the overall degradation or enhancement of the watershed could be more easily deciphered, which would inform follow-up and monitoring efforts at both scales.

Furthermore, in the GRW, IAs are inherently that of a polycentric (nested) nature. The many stakeholders involved have not assumed clear roles and responsibilities in terms of contributing to watershed-scale management goals, and especially when considering the participatory approach that is followed in the management of all aspects of the watershed. The main cause of confusion among interviewees, is how stakeholders fit into development and decision-making processes for the watershed. Multi-stakeholder collaboration—which in essence should allow those affecting and affected by a decision to prepare, facilitate, and implement watershed-scale decisions—seems to be sorely lacking in the majority of established IAs within the GRW. There is awareness of the need for impact management in existing multi-stakeholder collaboration mechanisms such as the GRCA committees, but there is also a great divide between this awareness and the implementation of impact management 'on the ground', especially with regard to those impacts that are cumulative in nature.

It is possible to capitalize on a polycentric governance structure for the purpose of managing watershed cumulative effects, but there is little or no movement in that direction as yet. The watershed stewardship provided by the GRCA for example, will remain insufficient to steer decisions about development activities that could result cumulative watershed effects if its legal authority is limited and constantly overridden by other provincial or municipal agencies, as

it is currently. Given that strategic and community planning are important components of W-CEA, significant involvement of stakeholders beyond opportunities offered through formal governance structures (including NGOs and the scientific community) will be necessary.

A clear mandate to carry out W-CEA must also exist. However, the research results show strong differences of opinion on how to make progress in this area. Some interviewees want to see new and enabling legislation specific to W-CEA that is system- (ecologically-) based, whereas others believe W-CEA can be enacted under the current network of environmental and planning legislation, regulations, and policies. The latter may be more feasible considering the polycentric (nested) water governance structure that is observed in the GRW. However, given that the *ON EA Act, 1990*does not require CEA (Lindgren and Dunn, 2010; Graci, 2009), and nor does any other legislative or legal instrument in Ontario, it will be difficult to move W-CEA forward. The legal 'assignment' of W-CEA to a lead agency is likely necessary before any agency will assume responsibility for it. The 'lead agency' does not have to be a single institution, however, especially as W-CEA-type goals are already enmeshed in some other pieces of legislation such as the *Nutrients Management Act, 2002; Environmental Protection Act, 1990;* and *Water Resources Act, 1990*. Instead of one 'supra-agency', it may be possible to designate a responsible agency at each level of governance to direct all stakeholders involved at that particular level, leading to a 'tiered' or 'nested' management structure for the entire watershed.

5.2.2 Scientific ethos: The technical underpinning of W-CEA

The transfer of knowledge gained through scientific assessment and monitoring activities undertaken in many Canadian watersheds has not been without hiccups. There has not been enough implementation of policies that carry forward the knowledge obtained from such assessments and monitoring activities. It was clearly agreed by the interviewees that there are some gaps in translating knowledge towards more applied forms, so as to institutionally enable the practice of W-CEA in a more formal process. This observation reinforces similar observations in the literature on CEA, that more regionally-based CEA have remained within the informal EA realm that exist as academic investigations (Seitz et al., 2011; Noble, 2008; Dubé et al., 2006; Brown et al., 2001; Culp et al., 2000 a,b,c). Specifically, in order to progress W-CEA, IAs should reflect the need to establish CEA baselines, indicators and thresholds; multi-

scaled monitoring; and vertical and horizontal linkages between project-based EA and the watershed wide initiatives.

There is evidence that science in support of W-CEA, especially related to monitoring, has progressed quite considerably in the past two decades (see Reid, 2010; Seitz et al., 2011; Squires et al., 2009; Dubé et al., 2006; Kilgour et al., 2006; Dubé, 2003; Canter, 1999; Hegmann et al., 1999; Reid, 1993; Buckley, 1992). In particular, the literature is clear in advocating for management of cumulative effects on an ecosystem basis and that it is necessary to link various scales of assessments together (Noble, 2010b; Harriman and Noble, 2008; Dubé, 2003**;** Canter, 1999). These scales could include, for example, a river reach, a river tributary and finally a whole watershed. Linking scales of assessment theoretically should allow for impacts to be detected on a system-wide basis; and this in turn should lead to more meaningful management practices (Ramachandra et al., 2006; Seitz et al., 2011). This approach is lacking at the present time in the GRW. Consideration of the negative watershed-scale impacts of development activities within the GRW (e.g. resulting from aggregate mining; agricultural activities; flood control and electricity damming; sewage treatment; and urban development), as explained in depth in Section 2.4.2, are not unified in the sense that institutions do not appear to consider all the horizontal and vertical linkages of impacts. No emphasis is placed on understanding the nature of cumulative effects (i.e. pathways of accumulation and/or whether originating on- or off-site). What is focused on in the GRW is the static "state" of the watershed and ad hoc management initiatives that are not designed based on the assessment or monitoring of cumulative effects. The various watershed-planning processes do not employ a rigorous methodological approach that could lead to a watershed management plan with explicit cumulative effects management goals.

There appears to be a minimal sense of urgency in the GRW to act on cumulative environmental effects issues, in comparison with other Canadian watersheds such as the Athabasca River watershed (see Seitz et al., 2011; Squires et al., 2009). In the Athabasca watershed, cumulative watershed effects have reached a more critical and visible level. Some of the visible cumulative effects in this region include decreased water quality due to increased effluent and discharge of complex chemicals for the Oil Sands operations; and decrease water quality due to excessive withdraw for these operations as well (Squires et al., 2009). It is an opportune time to support W-CEA in the GRW so as to avoid similar issues now experienced in

the Athabasca River watershed, but without the sense of public urgency created by visible crises, a W-CEA agenda in the GRW may unfortunately remain a low priority item on political agendas.

In terms of monitoring, which could provide the necessary CEA baseline for the watershed; incompatibility occurs often between that done for project-based EA and that done at a watershed-scale. Monitoring initiatives are largely uncoordinated and rarely do they inform the overall watershed management plan for the Grand River. Such inconsistencies have led to many data gaps and incompatibility issues over the years. Furthermore, monitoring done for project-based EA is done for the sole purpose of a development approval process, and there is a strong difference between what is required for private development activities versus requirements for government undertakings. The differences in the processes are exacerbated by the fact that the majority of government development undertakings fall under 'class' EA, while private ones are considered under the *Planning Act,1990.* This division propagates a phenomenon known as the 'tyranny of small decisions'[2] (Noble, 2010b; Abraham, 1998; Spaling and Smit, 1993) which in this case, further reduces the chances of conducting W-CEA in the near future. Divided legislative and jurisdictional trajectories impede attempts to improve the watershed environment from the perspective of managing cumulative watershed effects. This type of division obscures even further knowledge generated through monitoring efforts because the authorities responsible for private and public undertaking might not cross paths in their decision-making. To chart an alternative course, legislation and regulations must be either integrated or linked in some fashion, and should address watershed-wide indicators and thresholds to standardize the monitoring for the GRW.

However, the weakest area in terms of the science needed to support W-CEA in the GRW is the identification of indicators and thresholds relevant to W- CEA goals. Despite recent progress on how to do W-CEA (Reid, 2010; Seitz et al., 2011; Squares et al., 2009), there is still no agreement among the research community and practitioners as to a 'best set' of set indicators

[2] Noble (2010b:8) writes: "The first issue concerns the scope of current EA practice and what *doesn't* get assessed. Cumulative effects are often characterized as 'death by a thousand cuts', or the 'tyranny of small decisions'; but cumulative effects are rarely recognized as such in practice. For many small projects (e.g., access roads, culverts, oil exploration blocks), assessments are too restricted in both time and resources to effectively integrate CEA science – if such projects are assessed at all". Abraham (1998) also describes the environmental degradation from cumulative effects as 'the tyranny of small decision'. Spaling and Smit (1993) have referred to the term when explaining how each decision made by an individual actor about the environment may result in an increment of environmental change that is individually insignificant but repeatedly over time and dispersed over space by many actors may accumulate and contribute to significant environmental change.

or accompanying thresholds. This was also found to be the case in the GRW. Specific indicators of land-use change that impact watershed processes and products have to be agreed upon if they are to be used to predict and measure cumulative effects in a meaningful way. Agreement on these parameters is necessary to develop standard, required management goals that are 'fit-for-purpose', rather than continuing to rely on general, suggestive guidelines which are just recommended rather than mandated.

Thresholds indicate the limit of acceptable environmental change (Canter, 1999), and by standardizing these for use at all the scales of impact assessment in the watershed new knowledge of threats to ecological integrity could be generated and ecological resilience could be better estimated as well. By identifying watershed relevant indicators and thresholds, there is better potential to assess impact significance overall.

In terms of the *scientific ethos* of W-CEA then, the results show there is considerable understanding in the GRW of which areas of current watershed management practices need to be improved. Currently, however, there is no clear understanding on how to move forward to achieve any W-CEA proposals that may be made. Institutional arrangements are not aligned with the scope, principles or components of 'good' W-CEA as defined by Sheelanere (2010). As shown in Figure 5.3, this study demonstrates that the establishment of IAs reflective of W-CEA goals should essentially compliment the scientific input so as to reach the desired condition of a healthy and sustainable watershed. When IAs are aligned to reflect W-CEA goals, these elements may more likely to be linked to the project-based EA and even subsequent higher management and monitoring initiatives such as provincial monitoring activities. Data generated in the project-based EA will help to enhance and refine W-CEA goals and IAs as the process continues on because W-CEA should be an iterative and adaptive process

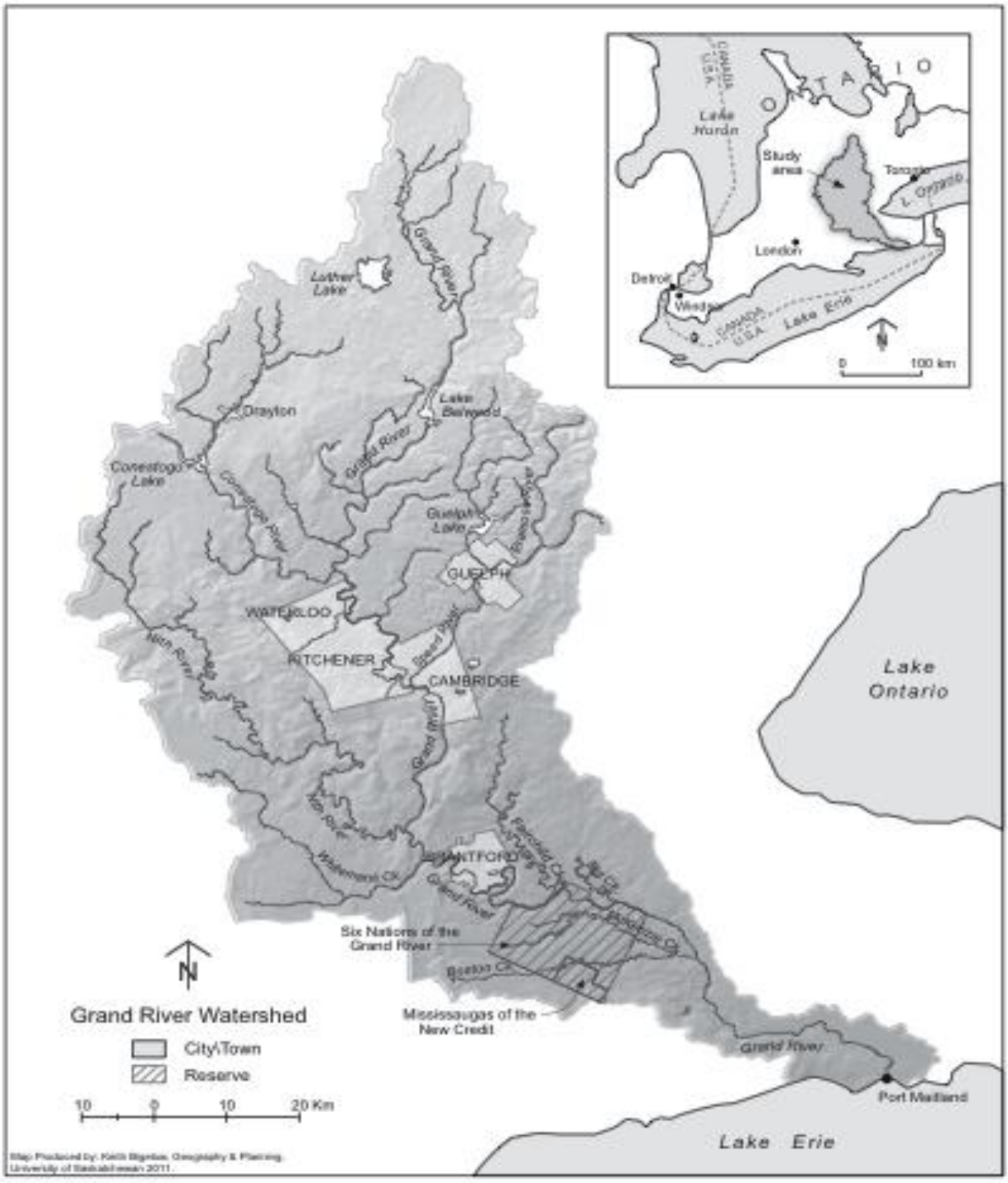

Figure 3.1. The Grand River with its major tributaries, cities and towns, and First Nations reserves.
Map source: Keith Bigelow, Cartographer, Department of Geography and Planning, University of Saskatchewan.

The Grand River has many smaller tributaries, but its main tributaries are the Conestogo, Nith, Eramosa and Speed Rivers (Lake Erie Region Source Protection Committee, 2010; Veale, 2004; Mitchell and Shrubsole, 1992). The watershed consists of (in whole or in part) 49

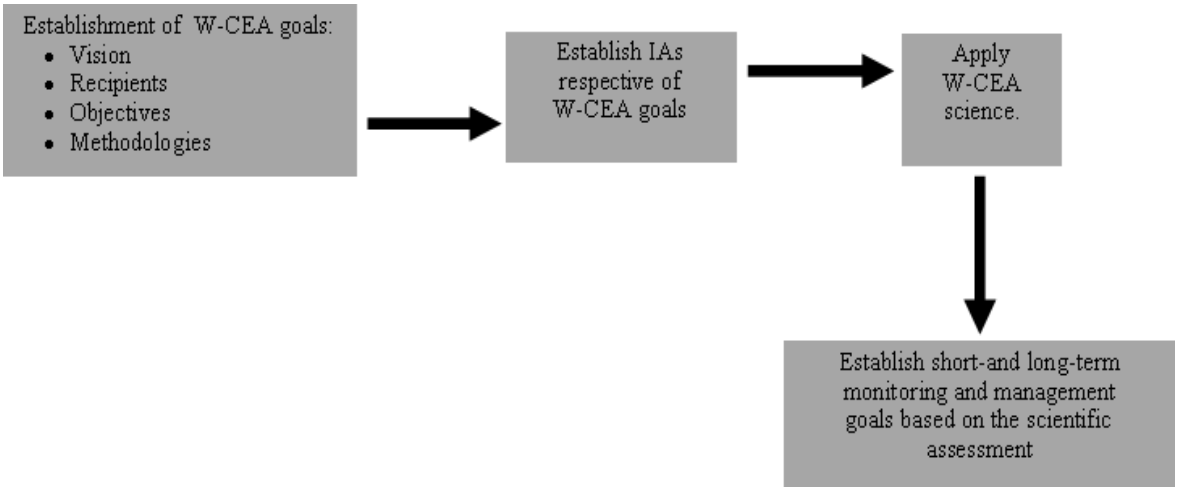

Figure 5.3The relationship of institutional arrangements to the science of W-CEA

Therefore W-CEA should not be a one-time assessment but a living process that is carried out to establish the broad watershed priorities and targets identify thresholds and making decisions about developments. These aspects demonstrate the importance of the scientific ethos and are the fundamental aspects of the evaluative framework used in this thesis.

5.3 Reflections on the evaluative framework

This research study is part of a multi-phased, Canada wide-study. It follows from an earlier study of the SSW and confirms the finding that "… 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 the watershed" (Sheelanere, 2010: 84). Furthermore, this study confirms the findings of Leadlay and Kreutzwiser (1999) that sufficient data, communication, understanding, and education are the main ingredients for success in building strong environmental policies for water resources management. An established W-CEA framework, such as the one refined in this study, can ease institutional coordination and communications, which ultimately enable the transfer of institutional knowledge. This framework has defined components, making it easier to diagnose where problems may lie within existing institutional arrangements. The W-CEA framework can be viewed as a way to operationalize IWRM and perhaps overcome the negative legacies associated with it such ambiguity, inertness, and a heavy focus on context rather than procedure (Watson, 2004). Through W-CEA, there will be legitimate policy basis for application, another

way this concept is different from the current approached under IWRM. This is due to the fact that W-CEA under the Canadian EA process in it can be legislated and follow systematic set steps that can be audited for compliance. Below is the explanation of what the analysis of the evaluative framework means in terms of the capacity to undertake W-CEA in the GRW.

5.3.1 Institutional capacity to undertake W-CEA

Although the evaluative framework first developed for the SSW did 'hold true' in the GRW in that all eight key elements of W-CEA that were established in the Saskatchewan study were in fact relevant in the Ontario context, the results of this study strongly suggest there are two further key components of 'good' W-CEA. These are *political will* and *innovation and creativity*; directly derived from the list of barriers to W-CEA in the GRW (see Table 4.1 in Chapter 4). It was observed that increased *political will* could significantly influence the IAs and thus W-CEA within the GRW. This is because political decisions to allocate funds toward any aspect of watershed management depend upon such will. It may be said that to a large degree, political will is what sparks the realignment of institutions to reflect newly desired management frameworks such as W-CEA. It often takes an incredible amount of energy, perseverance, and scientific and financial investment—fueled by sustained political will—to adapt 'business as usual' to a more ecologically sensitive model of environmental management.

Lack of emphasis on innovation and creativity as a means to solve complex environmental problems was identified as another possible barrier to W-CEA in the GRW. Both innovation and creativity challenge the traditional way problems of cumulative watershed effects have been viewed and result in new and revolutionary ways of solving enduring issues. Both Noble (2010c) and Hunsaker (1993) have concluded that there is a strong need for innovative solutions to deal with the uncertainty in resource management problems and that various experimental approaches are required. Shown below in Figure 5.4 is a conceptual framework indicating how *political will* and *innovation and creativity* can influence the execution of W-CEA.

Innovation and creativity are common qualities transferable to W-CEA frameworks adopted in other watersheds: they are not specific to the GRW context. Shannon (1998) notes it is through interactions and relationships building among multiple stakeholders and institutions that innovations often arise. Therefore the IAs to support and sustain W-CEA, might potentially

facilitate the creation of new institutions or consolidation and reform the existing ones if incompatibilities are observed (Shannon, 1998). Creativity also stems directly from the involvement of multiple stakeholders. Creativity may be defined as: "The ability to transcend traditional ideas, rules, patterns, relationships, or the like, and to create meaningful new ideas, forms, methods, interpretations, etc." (Keeney, 1992). The key process in creative thinking is to establish strategic, clearly stated objectives that can guide the decision making process (Keeney, 1992). Applying creativity in solving cumulative watershed effects is definitely essential to generate new or improved solutions to these problems.

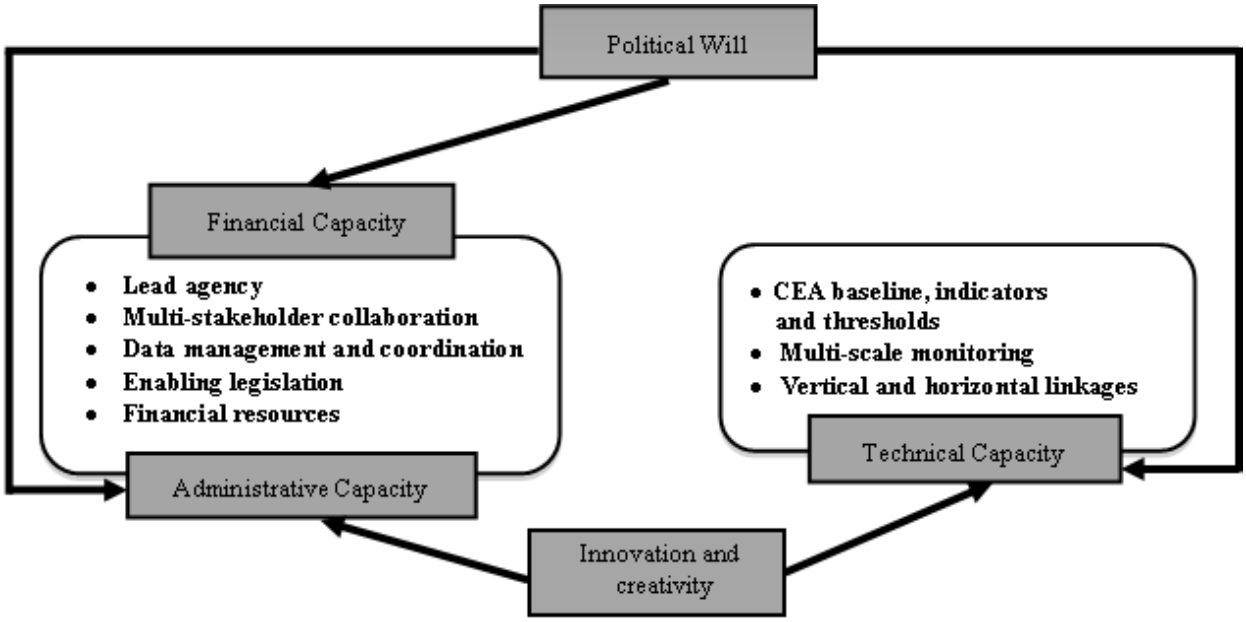

Figure 5.4 How 'political will' influences the financial, administrative, and technical capacity to conduct W-CEA. Political will precedes investment in institutions and institutional arrangements, as well as investment in technical capacity.

5.4. Addressing the research gap

This research was successful in providing further information on the identified gaps in literature, which briefly were to (i) generate more knowledge on the nature of IAs necessary to support W-CEA; (ii) build on the results of the SSW research study (Sheelanere, 2010); and (iii) investigate the potential for W-CEA in an Ontario watershed. All the stakeholders interviewed in the study saw the importance of thinking of impacts beyond a project-based EA, however the institutions are currently not ready to undertake the assessment and evaluation of cumulative

watershed effects. The re-orientation of IAs to align with a W-CEA framework would show where knowledge overlaps, contradicts, or is scarce and could thus redefine the way a sustainable watershed environment is achieved. We now know that IAs must be realigned before the practice of W-CEA can flourish in the GRW at this point.

5.4.1 Research contributions and transferability

The findings of this research study make a valuable contribution to the field of both CEA and watershed management and should be of broad interest to both Canadian and international practitioners of CEA and W-CEA respectively. The introduction of *political will* and *creativity and innovation* as key elements of W-CEA may help to improve future application and interpretation of this conceptual framework in other watersheds. The customized framework for evaluating IAs in Ontario, which is one of the main contributions of this research study, may be of benefit to future decision-making about cumulative effects that result from future development when there is a political will to try new approaches as well as innovative and creativity emphasis put in the way policies are formulated. Another beneficial outcome of this research study is that it reinforces the need for public participation and stakeholder involvement in issues concerning environmental decision-making. Given that the focus group opportunity included members of the larger Grand River community, as well as practitioners and other key informants. W-CEA provides opportunities to share ideas among a collective (defined in this case by the watershed), which stimulates social learning, occurs, and build up social capital in the region area. Finally, the research study results showed there is a need to find better ways of translating scientific findings into the policy and legislation realm.

With respect to transferability, by including both watershed CAs and other watershed resource managers in the research design and dissemination, there is an opportunity for direct knowledge transfer from academic discovery to applied watershed management. This may help to propagate solutions to long-standing management problems in complex environments. Shannon (1998) notes that it is through creative interactions and relationships that innovations arise and eventually become institutionalized; this interaction and relationship is very important for institutional capacity building. Therefore, having specialized knowledge of the ‘degree of readiness’ of Ontario’s institutions to support and sustain W-CEA might potentially facilitate the

creation of new institutions or the consolidation and reform of existing ones as needed (Shannon, 1998).

Perhaps the key contribution of the research in an international context is that it is one of the only studies on the subject of W-CEA that enquires into the interactions, philosophies and relationships of water management institutions. Many international water management institutions especially in developing countries are only evaluated in relations to the aid agencies (see Agrawal and Gibson, 1999) and rarely these studies consider W-CEA in the view presented in this study.

5.4.2 Future research

This research study demonstrates that IAs cognizant of W-CEA goals must exist in order to assess and manage cumulative effects properly. However, the evaluative framework employed herein offers only a crude measure to gauge institutional capacity to carry out and sustain W-CEA. Further research is needed to expand the knowledge of IAs in the GRW, and more specifically, formulate explicit criteria to measure each component of institutional capacity (administrative, human, technical and financial) discussed. Such criteria would provide an incisive means by which to pinpoint institutional capacity and developmental needs in the GRW and possibly other, comparable watersheds.

Further research is also needed on water resource management policy, specifically how to integrate both the management and scientific ethos of W-CEA in water policy formulation. For the case of the GRW, the research should concentrate on stakeholder analysis as well as understanding institutional knowledge (institutional memory) related to managing complex environmental problems such as cumulative watershed effects. The carrying capacity of the river system should be established so as to gauge current effects level of development activities to ensure land-use can be sustained without pushing the system to a point of no return.

Further research of a biophysical and ecological nature is also needed. Supplemental quantitative studies would be especially beneficial if they could provide further insight into cumulative effects assessment and management issues in the GRW. The need for these kinds of studies has also been acknowledged by the Canadian Water Network (CWN), which recently issued a call for research proposals to develop a regional monitoring framework to support CEA (www.cwn-rce.ca/news-and-events/cwrc-rfp-grwrc/). The aim of this research will be to

determine biotic ‘endpoints’ for the Grand River system, integrate biotic ‘endpoints’ and physical/biochemical river processes, as well as development of tools or approaches for predicting changes in biotic endpoints. If successful, such biophysical studies would help to strengthen the scientific ethos discussed in this chapter earlier on.

Furthermore, as is the case for most qualitative research, there is never enough opportunity to truly canvass the public over an extended time frame to gather views on watershed management and of course concepts like W-CEA. If a broader level of involvement of the public was possible in this study, the investigation might have revealed other opportunities to progress W-CEA in the GRW.

Lastly, research must be done to help establish a generic institutional design for W-CEA so that an ‘institutional model’ of W-CEA exists. This would allow the concept to be more easily integrated into existing watershed plans across Canada and internationally. This research could focus on policy analysis, business management studies, and operational management studies, which are also important components of successful W-CEA practice. In addition to the development of such theory, next steps may include further development of W-CEA on contextual basis by applying it to different sizes of watershed.

5.5. Recommendations and concluding remarks

There is great opportunity in the GRW to address the management of cumulative effects through a W-CEA framework. To begin to move forward in this regard, there is first a need to designate a ’responsible authority’ for W-CEA at each level of government. Over the years, water resources management fragmentation among the federal, provincial, regional, municipal governments, as well as the various watershed conservation authorities, has led to significant management gaps and environmental stress in the GRW (Veale, 2007; Fitzgibbon et al., 2006; Mitchell, 2005; Plummer et al., 2005; Leadlay and Kreutzwiser, 1999; Shrubsole, 1996). Despite entrusting the management of watershed-scale issues to the GRCA, there are serious questions about how much authority this organization really has. Therefore, the authority should be spread at each level of governance as suggested in Section 5.2 and Section 5.2.1, respectively.

This is readily apparent when it comes to decision-making about development activities within the watershed. On this front, the hands of the GRCA are ‘tied’: municipalities make most of the key decisions and their ability to control development supersedes any power vested in the

GRCA. As a result, many well-intentioned attempts at watershed management by the GRCA are often ineffectual. Therefore, it might be appropriate for the provincial government to truly strengthen the legal powers and legitimize the decision making-ability of this key conservation authority. Given the dichotomy of views on the lead agency, it seems fitting for the authority to be mandated along the lines of current governance but be stated unambiguously on how to carry out the authorization of development activities within each level of the polycentric governance hierarchy. Such mechanism will also avoid duplicity of roles and responsibilities. Clarifying the responsibilities of the many stakeholders will also act to minimize 'turf politics'.

Next, provincial agencies should attempt to further align their databases to more easily allow agencies to share monitoring data. The fewer restrictions imposed on data sharing, the easier it should be to achieve the desired horizontal and vertical linkages among scales of assessment. Enhanced databases and data sharing may also lead to a greater degree of innovation and progress in developing watershed-appropriate indicators and thresholds. Furthermore, this kind of coordination may aid in the establishment of common management goals that clear and attainable to stakeholders within the watershed.

Another key recommendation to the regional and municipal governments is to better coordinate regional planning processes. The various philosophy that underlay decisions made by officials in such processes should be closely link at various planning level (municipal and regional) so as to reduce confrontational outcomes. This will allow for the development of short, medium and long-term development goals cognizant of watershed sustainability and not political jurisdictional boundaries alone. There is a need for government leaders to reform the public consultation process as well, to more clearly specify who should be included at discussion tables, and at what stage of the planning process. Moreover, if the municipal planning process becomes more collaborative, it will also present opportunities to better envision conservation strategies and public participation, which both are necessary strategies for addressing impacts to the water resources within the GRW as well as build further awareness of the management goals established by the respective responsible authorities.

It is recommended that watershed institutions in the GRW adopt a W-CEA mandate, because thus far there has been continuous degradation of the watershed proving, that current methods lack integrative and system oriented approaches that are iterative and operates on a more 'active' adaptive management principles (see Noble, 2010c on a discussion about active

adaptive management). Water resources, which are a primary product of the watershed, are already scarce in Ontario and thus need to be protected for the benefit of current society and for future generations.

Moreover, W-CEA can be formulated to reflect EA systematic stages throughout its vision, objectives, principles and methodologies (refer to Figure 5.3). This approach may help to ensure watershed protection, given the current failures of forms of IWRM, as described in the literature review (see Chapter 2). It is important to pinpoint the importance of formalizing the W-CEA process so that once required by law, litigation and compliance can be demanded. Such an approach can then achieve the highest watershed protection. With clearly defined and established W-CEA process, there will be no confusion on what ought to be achieved, little systematic and random redundancies, which cause inefficiency in watershed management practices, and ultimately, achieve watershed sustainability. The adoption of W-CEA can therefore contribute to the growth of EA field in Canada.

In sum, W-CEA is fairly well conceived and the need to attempt it is broadly understood, but the concept may be effectively hobbled by the giant implementation gap that looms. The success or failure of the concept probably depends more upon the institutional fragmentation (in addressing environmental problems) that has persisted over much of the last century, than any specific flaw in the concept itself. At the same time, successful W-CEA clearly depends upon the clear and singular vision each institution and their ability to make a unique and lasting contribution to the tapestry of watershed management. The simultaneous push-pull between the need for both integration and autonomy of the various institutions is perhaps the seminal challenge of both W-CEA and cumulative effects assessment and management, and will continue to define research agendas on these and related topics well into the future.

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APPENDIX A1

FOCUS GROUP DISCUSSION QUESTIONS

1. Are the requisites/ principles complete in terms of what is required to implement and sustain a framework/ system for assessing and managing cumulative effects at the watershed scale? If not, what is missing?
2. If one is assessing the capacity to deliver and implement W-CEA, are there other types of capacity issues or needs that are important to look for or to consider?
3. Are there any issues that are specific to the Grand River watershed context?
4. Are you aware of any CEA-type initiatives being conducted in this watershed?
5. Are these requisites/ principles complementary to any existing regional land use plans? (i.e. are there specific plans or programs that I should be looking to?)
6. What do you see as the most significant challenges/ or opportunities to WCEA?
7. Who are some of the key people or agencies that I should be talking to?

APPENDIX A2

INTERVIEW SCHEDULE

Introduce each theme to the participant:	**Interview questions:**
Lead agency • Assessing and managing watershed cumulative effects require a lead agency with the authority, the mandate, and the capacity to do so. This means guiding monitoring programs, and having some influence over decisions about land use and project development in a watershed.	1. Is there a lead agency, ministry, or institutional structure in the watershed or province mandated to coordinate development activities (including monitoring and assessment) at a watershed scale? (Probe for explanation with follow-up questions such as, *"what do you mean by …? Can you explain your use of..?Might there be any other reasons for …"* .Probing requires some tactfulness so as not to become annoying, if an answer sounds open, vague, some probing is usually helpful. a) If NO, is there anything that approximates such a structure (perhaps at a sub-watershed scale, in certain economic regions, etc.)? Please explain. Is there adequate capacity? Is there a potential/perceived need to expand? (Probe for explanation) b) If YES, does this organization have the adequate capacity (legal, financial, technical) to coordinate watershed scale programs and initiatives required for WCEA (e.g. monitoring, data sharing, coordinate stakeholders, etc)? (Probe for explanation)
Multi stakeholder collaboration • Watershed CEA also requires that the roles and responsibilities of various stakeholders are well defined and represented in impact assessment and decision making about development in the watershed.	2. At the watershed scale, is there a mechanism or forum for facilitating multi stakeholder collaboration, such as a stakeholder panel, committee, or council, in watershed planning, monitoring, making decisions about development, etc.? (Probe for explanation) 3. Are the roles of government, watershed agencies, project developers, and so on clearly defined in terms of managing impacts to the watershed and in making decisions about development in the watershed and water use? (Probe for explanation)
CEA baselines, indicators and thresholds • There is also an important science side to doing good WCEA. The current state of the watershed needs to be known, and agreed upon indicators are needed for impact assessment and monitoring purposes.	4. Is there a formal and accessible data set (e.g. a state of the watershed report) that provides a baseline on such things as surface and ground water quantity, quality, and usage, as well as on various land uses affecting water resources? (Probe for explanation) 5. Are there common science-based indicators for assessing the cumulative effects on the landscape or to water resources at the watershed scale? (Probe for explanation) 6. Are there standard monitoring indicators or requirements across project EIA? (Probe for explanation) 7. Are there thresholds for development in the watershed or maximum allowable effects levels established for various water quality parameters? (Probe for explanation)

Multi-scaled monitoring • Monitoring is of course essential to understanding and managing cumulative effects, and should be done at both the project and the watershed scale.	8. Is monitoring required in project EIAs or for certain developments? Is it being done? (Probe for explanation) 10. Are there monitoring programs operating at the broader watershed scale? (Probe for explanation) a) If YES, do they include landscape (e.g. land use change/disturbance) as well as aquatic monitoring? (Probe for explanation) 11. IfNO, is the monitoring done for projects (e.g. EIAs) compatible with what is being collected at the watershed scale? (Probe for explanation). (Probe for explanation)
Data management and coordination • When monitoring is done, it is important that there be some mechanism in place to share that data and make it available.	12. For those data that are collected in the watershed, is it accessible to all watershed stakeholders (e.g. project proponents, watershed agencies, etc)? (Probe for explanation) 13. Is there adequate technical capacity for data capture, management, and sharing? (For spatial/land use data and for water use/quality data). (Probe for explanation)
Vertical and horizontal linkages • Effective WCEA requires that there is come linkage between watershed and project-based initiatives.	14. Are project-based EIAs guided by other regional or watershed-scale plans and policies? (Probe for explanation) 15. Are the results of project-based EIAs and monitoring used in any way to support broader watershed initiatives (e.g. watershed monitoring, planning, etc)? (Probe for explanation) 16. Are other land use and water policy plans and programs consistent with broader watershed-scale plans? (Probe for explanation)
Enabling legislation • Regardless of the data and the linkages, there must be some means to implement WCEA type initiatives/	17. Does there exist legislation or any regulatory or policy-based support for CEA initiatives at the watershed scale? (e.g. for monitoring, planning, assessment) (Probe for explanation) 18. Is there any means to ensure that the results of watershed-based programs (e.g. monitoring, planning, and assessment) are implemented at the individual project level? (Probe for explanation)
Financial resources • None of this, of course, is possible without resources to make it happen.	19. Currently, in this watershed, does there exist sufficient resources to initiate and sustain the types of broad scale and long terms initiatives required to support watershed-based CEA? (e.g. financial and/ or human resources for monitoring, coordination, planning, reporting, and so on) (Probe for explanation)

20. One last question (should time permit): We've discussed a number of factors concerning W-CEA. What, in your view, are the most significant barriers and bridges in this watershed to advancing (and sustaining) CEA at the watershed scale? (Probe for explanation)

APPENDIX B

RESEARCH STUDY INTRODUCTION PACKAGE TO INTERVIEWEES:
INTRODUCTION LETTER, CONSENT FORM AND EVALUATIVE FRAMEWORK

Dear _____:

My name is Jania Chilima, and I am a Masters' student at the University of Saskatchewan, School of Environment and Sustainability. As part of my masters' thesis, I am working on a project titled, 'Evaluating Institutional Arrangements to Support Watershed Cumulative Effects Assessment in the Grand River Watershed, Canada' under the supervision of Dr. Jill Gunn, Department of Geography and Planning &School of Environment and Sustainability, University of Saskatchewan. My project is part of a national research parent project titled 'Watershed cumulative effects assessment and management.' Drs. Bram Noble and Robert Patrick, Department of Geography and Planning, University of Saskatchewan leads this parent project. I am writing to request your participation in this research project.

By way of background, cumulative effects are effects of an additive, interactive, or synergistic nature, caused by often individually minor, but collectively significant actions that accumulate over space and time. The need to better assess and manage cumulative effects on Canada's watersheds is well argued, but there are constant and consistent messages that Cumulative Effects Assessment and Management (CEAM) in its current form is simply not working.

This research will attempt to identify the institutional arrangements and capacity-building requirements necessary to develop and support watershed-based CEAM. The research is guided by four objectives: i) to describe the current institutional environment, regulatory and non-regulatory, for CEAM in Canadian watersheds; ii) to identify the necessary institutional and capacity requirements to do 'good' watershed-based CEAM; iii) to evaluate the current state of institutional arrangements and capacity to effectively implement and sustain watershed-based CEAM; iv) to derive lessons across watersheds to advance knowledge and understanding of best-practices. This research will occur in four Canadian watersheds: Lower Fraser, BC; South Saskatchewan, SK and AB; Athabasca, AB; Grand River, ON. The Social Sciences and Humanities Research Council of Canada fund the research.

Specifically, at this stage, I am working on objective (iii) of this study as part of my masters' thesis, and I am inviting you to participate in a semi-structured interview (either in-person or via telephone). You were identified as a potential participant based on your organization's involvement/ interest in watershed management and/ or cumulative effects assessment, or other study interviewees provided your contact information. You need not be an expert in cumulative effects assessment. Rather, I am interested in your views about the current capacity to implement and sustain a framework for watershed CEAM in the Grand River Watershed.

I am attaching a standard University of Saskatchewan 'participant consent form' for your review. I will follow-up with you via telephone in the upcoming weeks to determine your interest in participating in this research, to schedule an interview and a time and location of your convenience, and to send you in advance a list of discussion topics for the interview. The tentative period for in-person interviews is the month of June. Meanwhile, should you have any questions, please do not hesitate to contact me at 306-262-6920 (cell) and 306-966-1017 (office), or the project's lead researcher, Dr. Bram Noble, at 306-966-1899 (b.noble@usask.ca).

Sincerely,

Jania Chilima

PARTICIPANT CONSENT FORM

"Watershed cumulative effects assessment and management"

Please read this letter carefully, and feel free to ask any questions you might have. I will review this information with you at the time of the interview.

Principle/Lead Investigators: Dr. Bram Noble, Department of Geography, University of Saskatchewan, Saskatoon, SK, S7N 5A5, Tel: 306-966-1899, E-mail: b.noble@usask.ca
Dr. Robert Patrick, Department of Geography, University of Saskatchewan, Saskatoon, SK, S7N 5A5, Tel: 306-966-6653, E-mail: robert.patrick@usask.ca

Student Direct Supervisor: Dr. Jill Gunn, Department of Geography, University of Saskatchewan, Saskatoon, SK, S7N 5A5, Tel: 306-966-1944, E-mail: jill.gunn@usask.ca

Student: Jania Chilima, University of Saskatchewan, SK, Tel: 306-966-1017 and Cell: 306-262-6920, E-mail: Jania.chilima@usask.ca

Purpose and Procedure: The purpose of this research is to evaluate the current institutional arrangements and capacity-building requirements to implement and sustain watershed-based CEAM. To achieve this, in part, you are invited to participate in an interview to discuss you views on the current capacity to assess and manage cumulative environmental effects in the Grand River Watershed beyond the scope and scale of the individual project, at the watershed scale.

The interview will take approximately 1 to ½ hours, and will be audio taped so as to facilitate data analysis. Similar interviews are taking place with government representatives, watershed agencies, project proponents, and academic/ scientific experts across three other Canadian watersheds. Results of the interviews will be aggregated and used to evaluate the current capacity in Canada's watersheds to advance cumulative effects assessment and management from the project to the watershed scale. Overall, this study will contribute to a greater understanding of the institutional arrangements necessary to develop and support a more watershed-based approach to cumulative effects assessment and management and, to that end, may be of benefit to your organization when planning, regulating, or assessing the implications of development activities.

Potential Risks: There are no personal risks to participating in this study. Your affiliation, but not your name, may be identified in research reports in order to lend credibility to the research. Given the limited number of interviewees in each watershed, it may be possible to identify specific individuals based solely on organizational affiliation. However, you are being asked to provide your professional judgment and, as such, there is minimal personal risk. All data collected for this study will be reported in aggregate form only. Individual responses will not be revealed.

Potential Benefits: There are no direct benefits to you personally to participating in this study. The results will be used as part of a graduate thesis in the Masters' program, and shared with various provincial and federal agencies, industries, and academics in order to advance institutional arrangements in support of watershed-based CEA.

Storage of Data: Interview tapes, notes and transcriptions will be stored temporarily on a hard drive (dedicated solely to this study) in the office of the lead researcher, and in the long term on CDs in a locked cabinet of the lead researcher for a minimum of five years and until all publications, conference papers, and research theses have been produced and disseminated. The lead researcher will be responsible for all data storage and management. The lead researchers will have access to all data.

Confidentiality: The information you provide to this study will be aggregated with information provided by other interviewees in this watershed and in three other watersheds, and used as the basis of discussion for a focus group to develop a normative model for watershed cumulative effects assessment. In addition, the information will be used to produce reports for publication in scientific journals and may be presented at conferences and workshops/meetings. Your personal identity will be kept confidential at all times. You will be identified only by your position or professional affiliation (e.g. 'organization x'). However, because the interviewees for this study have been selected from a relatively small group of people, some of whom may be known to each other, it is possible that you may be identifiable to other people on the basis of the information you provide. In other words, only aggregate data will be presented in the research results, but confidentiality of your involvement as a participant is this study cannot be guaranteed. If, within 30 days following completion of your interview, you have any second thoughts about your responses, you can contact me or one of the lead researchers, who will immediately remove your information from the data set and provide you with an opportunity to review your responses to determine whether you would like to withdraw it from the research. After 30 days, it is likely that some form of research dissemination will already have occurred.

Right to Withdraw: Your participation is voluntary; and you may withdraw from the study for any reason, at any time, without penalty of any sort, up to 30 days following completion of the interview. You may also refuse to answer specific questions. If you withdraw from the research project, any information that you have contributed will be destroyed or returned at your request. Before and after your interview, you will be reminded of your right to withdraw.

Questions: If you have any questions concerning the study, please feel free to ask at any point. You are also free to contact me or one of the lead researchers at the numbers provided above if you have questions at a later time. This study has been approved on ethical grounds by the University of Saskatchewan

Behavioral Research Ethics Board on 15 June 2009. Any questions regarding your rights as a participant may be addressed to that committee through the Ethics Office (966-2084). Out of town interviewees may call collect. When the study is complete, all interviewees will receive a short report that outlines significant research findings.

Consent to Participate: I have read and understood the description provided above. I have been provided with an opportunity to ask questions and my questions have been answered satisfactorily. I consent to participate in the study described above; understanding that I may withdraw this consent under the terms outlined above.

_____ _____

(Name of the participant) Date

_____

(Signature of the participant) Signature of Research student

UNIVERSITY OF SASKATCHEWAN

Requisites for Watershed Cumulative Effects Assessment

- Themes for Discussion -

Please find below a number of themes to guide our discussion. These themes are proposed as 'requisites for watershed cumulative effects assessment' (WCEA). They were compiled based on experience with WCEA elsewhere, based on the academic literature, and were reviewed by various experts in the field. Our discussion will focus on the extent to which these characteristics or factors are present in your watershed, so as to understand the 'degree of readiness' to advance WCEA and the needed capacity building to do so.

1. Lead agency

- Assessing and managing watershed cumulative effects require a lead agency with the authority, the mandate, and the capacity to do so. This means guiding monitoring programs, and having some influence over decisions about land use and project development in a watershed.

2. Multi stakeholder collaboration

- Watershed CEA also requires that the roles and responsibilities of various stakeholders are well defined and represented in impact assessment and decision making about development in the watershed.

3. CEAbaselines, indicators and thresholds

- There is an important science side to doing good WCEA. The current state of the watershed needs to be known, and agreed upon indicators are needed for impact assessment and monitoring purposes.

4. Multi-scaled monitoring

- Monitoring is essential to understanding and managing cumulative effects, and should be done at both the project and the watershed scale.

5. Data management and coordination

- When monitoring is done, it is important that there be some mechanism in place to share that data and make it available to end users.

6. Vertical and horizontal linkages

- Effective WCEA requires linkages between watershed and project-based assessment, monitoring and decision-making initiatives.

7. Enabling legislation

- There must be some means to implement WCEA type initiatives, and ensure influence over development decisions.

8. Financial resources

- Sufficient financial and human resources must be available to implement and sustain, over the long term, WCEA programs and requirements (e.g. monitoring programs, landscape modeling, reporting, communication, data management and coordination)