

Lessons Learned, Best Practices and Critical Gaps in
Regional Environmental Assessment:
A Synthesis of Canadian and International Literature

Jill Blakley, PhD, University of Saskatchewan

Bram Noble, PhD, University of Saskatchewan

Karen Vella, PhD, Queensland University of Technology

Jérôme Marty, PhD, Council of Canadian Academies

Kelechi Nwanekezie, PhD Candidate, University of Saskatchewan

Katherine Fedoroff, MSc Candidate, University of Saskatchewan

Knowledge Synthesis Grant Final Report
Prepared for the Social Sciences and Humanities Research Council of Canada and
the Impact Assessment Agency of Canada

March 31, 2020

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Acknowledgments

We would like to acknowledge the Social Sciences and Humanities Research Council of Canada and the Impact Assessment Agency of Canada for supporting this research. Data collection and analysis would not have been possible without the enthusiastic and insightful contributions of three student research assistants at the University of Saskatchewan: Kelechi Nwanekezie (PhD candidate), Katherine Fedoroff (MSc candidate), and Cole Kowalchuk (BA student).

We are grateful to Alan Ehrlich, Manager, Environmental Impact Assessment, and Chuck Hubert, Senior Environmental Officer, of the Mackenzie Valley Environmental Impact Assessment Review Board for enhancing the dissemination of our research results. We also thank the following colleagues for contributing ideas and information that enriched the development of this report: Cheryl Chetkiewicz (Wildlife Conservation Society Canada); Paula Doucette (Transport Canada); Katherine Cumming (Parks Canada); Barry Wilson (CE Analytic); and Sarah Depoe (Government of Alberta).

Executive Summary

Background

Regional-scale environmental impact assessment is increasingly viewed by governments, industry, non-government organizations and the public as a viable means to better understand and proactively address cumulative environmental impact issues such as carbon emissions, biodiversity loss, habitat fragmentation, and watershed pollution in light of proposed development programmes. Regional assessment (RA) is now a discretionary component of project-based impact assessment (IA) legislation in Canada (GoC 2017, 2019). However, there is limited research on the scope of recent RA practice in Canada or elsewhere, or on identifying lessons to support RA implementation. The purpose of this Knowledge Synthesis (KS) project is therefore to characterize RA practice drawing on both academic and grey literature published between 2000 and 2020, and identify some of the emerging good practices that can render RA as helpful as possible to decision-making about natural resources development and conservation.

Objectives

Specifically, this project investigates:

- i. Key characteristics of RA practice (an inventory of initiatives; partnership models; impetus, and so on);
- ii. Promising methods, tools and approaches commonly used in RA practice; and
- iii. Lessons, opportunities and challenges, as well as critical knowledge gaps in RA research and practice.

Results

A total of 42 Canadian and 10 international cases of RA were analyzed. Regional assessment in Canada is not evenly spread: practice is concentrated in western and northern provinces and territories. Nearly three quarters of RA final reports were released within the last decade; nearly half within the last five years. The rising number of RA initiatives in Canada indicates increasing interest in this form of assessment, despite the lack of regulatory or legislative requirements to employ it. Of the 42 Canadian cases examined, 28 (67%) have a strategic component and 14 (33%) do not. Thirty-seven cases (88%) included a significant focus on cumulative environmental effects. Twenty-four cases (57%) contained both a strategic element and focused on cumulative effects assessment. Government is typically the lead proponent of RA initiatives in Canada while eight cases (20%) are Indigenous-led. Methodologically, RA is diverse: dozens of methods and tools are employed to assess impacts to a wide range of valued components. Public engagement and engagement with Traditional Knowledge are very commonly used in RA practice while scenario analysis is significantly less common. Internationally, RA practice appears to be widespread and very diverse in terms of motivations and goals ranging from facilitation of nationally important industries, to expedient approval of infrastructure investment programs, to establishment of science-policy advisory partnerships. Various arms of the United Nations are especially active in promoting strategic forms of RA.

We also analyzed 64 academic articles on RA published between 2000 and 2020. Of these, just 12 (19%) offer case specific evaluations of RA practice. Other themes in the literature include concept and framework development; integration of principles; integration of RA with planning and policy-making; promising methodologies, tools and techniques; and so on. It appears that the emphasis of regional-scale assessment has gradually shifted away from simply facilitating project approval toward also addressing key issues of governance, a focus on institutional capacity building including relationship building across institutions, socio-political dimensions, innovation and collaborative science and management.

Key Messages

1. In general, we find that the academic literature is quite divorced from the RA practice record and that there is a significant gap in reporting and analyzing case experiences, especially for early attempts at RA which were completed up to 20 years ago or more.
2. Regional assessment as a practice (not necessarily as a concept) is generally in an early stage of development. At present, it is likely possible to identify the inputs of an RA exercise (impetus, goals, scope, valued components, inputs/resources, assessment activities, assumptions and uncertainties, audience, and so on) for many cases, as well as immediate outputs in the form of case documentation and programs (including scoping reports, draft and final reports, action plans, public commentary on the reports, and so on). However, for the vast majority of cases it is likely too early to be able to verify predictions or determine outcomes (either mid-term or long-term, expressed as changes in knowledge, awareness, practices, or conditions).
3. Cumulative effects assessment is central to RA practice, although building in a strategic element to the assessment is not necessarily.
4. Very few academic papers on RA touch on topics considered important to the evolution of IA and future of IA in Canada such as: climate change; gender; equity and fairness; trade-offs; Indigenous and northern contexts.
5. It would be premature given the small number of in-depth cases analyses within academic literature and the early state of RA outcomes in many instances to attempt to judge what RA can or cannot realistically accomplish at present.
6. Clearly, the diversity, ambition, and momentum displayed among all RA cases examined, coupled with rising incidents of practice in Canada and elsewhere, is strongly indicative of widespread belief in substantive procedural and transactive benefits.

Methodology

The literature review was based on a qualitative content analysis of works published primarily in the last two decades (2000-2020), drawing on academic and grey domestic and international literature. The review cut across multiple development sectors (e.g. mining, forestry, energy, marine and coastal), jurisdictions (provincial, federal, territorial, Indigenous, international), and proponents (e.g., government, non-government, industry, Indigenous). In total, 124 documents were analyzed: 64 academic articles and 60 other documents representing 52 cases of RA. Data collection and preliminary content analysis were performed using NVivo 12 Plus, a software program commonly used to analyze large amounts of qualitative data. After an initial process to sort the documents and identify those most relevant to the study, coding and theme identification was performed using the study purpose and objectives as a guideline. They utilized a hybrid approach to coding involving both inductive and deductive approaches to build a common codebook (Fededay & Muir-Cochrane 2006). This led to the emergence of conceptual categories and a basis for subsequent explanation of the data (Babbie 2002; Gerring 2017). To focus the analysis, data were sorted according to key characteristics to ensure that the coding exercise captured both the state of 'tools/methodology' and 'lessons and knowledge gaps'.

The literature review activities were enhanced by informal communication with academic, public, private and not-for profit professionals with RA experience. These conversations helped shape some of the investigative themes in the literature analysis and identify some Canadian RA cases featuring exemplary practice. Many of these individuals, and others, will be engaged in future knowledge mobilization activities.

1.0 Background

Regional-scale environmental impact assessment is increasingly viewed by governments, industry, non-government organizations and the public as a viable means to better understand and proactively address cumulative environmental impact issues such as carbon emissions, biodiversity loss, habitat fragmentation, and watershed pollution in light of proposed development programmes. Regional assessment (RA) is now a discretionary component of project-based impact assessment (IA) legislation in Canada (GoC 2017, 2019). However, there is limited research on the scope of recent RA practice in Canada or elsewhere, or on identifying lessons to support RA implementation.

Regional assessment is applied to understand the implications of major resource development projects and programs in areas of national and provincial importance, such as marine shipping areas, energy corridors, and northern environments. It is also seen as a strategic tool, to articulate a preferred course of action and set conditions for project proponents, including mitigations (CCA 2019; Noble et al. 2019; Chetkiewicz & Lintner 2014; CCME 2009). However, notwithstanding the interest in RA and its potential to contribute to evidence-based decisions, previous synthesis attempts are few, narrowly focused, and dated (see for e.g., Gunn and Noble 2009; Harriman and Noble 2008; Therivel and Partidario 1996). There is much to learn about emerging RA policies and practices in Canada and internationally, and from its potential connections to regional land use planning (CAC 2019), especially as perceptions of RA are diverse and there has been limited consolidation of lessons and promising practices (Noble et al. 2013; Vicente & Partidario 2006). Impact assessment research in general has been criticized for being too insular (Porter 2006) and divorced from the plan- and policy-making community it is intended to inform (Nitz and Brown 2001): RA may be able to change that. But because RA is inherently interdisciplinary, and emerged from a largely non-regulatory and grassroots context that blends IA, regional planning, and policy making (Olagunju & Gunn 2016 a,b), knowledge is often dispersed and a large share of knowledge is contained within multi-sectoral 'grey' literature. As Canada strengthens its commitment to RA under the *Impact Assessment Act 2019 (IAA 2019)*, it is time to take stock of RA research and experience to identify achievements and gaps and, in doing so, better understand what will make this practice as effective as possible.

This Knowledge Synthesis (KS) research project builds on the recent Council of Canadian Academies (CCA 2019) report on integrated natural resource management that positions RA as a key part of an integrated framework for natural resource management and decision making in Canada. Regional assessment is explicitly acknowledged in the new *IAA 2019* as a tool to inform baseline trends and mitigation plans and examine alternative scenarios – with the focus on improving proposed or likely projects. Increasingly, project proponents, environmental non-government organizations, and Indigenous communities are engaging in and promoting RA in some of the largest, most significant resource-rich development zones in Canada, including Alberta's Athabasca oil sands (Johnson et al. 2011); Ontario's Ring of Fire (Chetkiewicz & Lintner 2014; 2019); Manitoba's Nelson River hydro-electric complex (Noble & Gunn 2013); and the Beaufort Sea hydrocarbon region (BSStRPA 2008). However, few initiatives have come full circle from conceptualization to implementation to informing and influencing evidence-based decisions. Further, international initiatives such as the United Nations calls for strategic assessment of World Heritage Areas, including of the Great Barrier reef, have resulted in the development long-term regional sustainability plans (CoA 2018) – yet, the practices and lessons learned are not well-documented or known to the wider RA policy and practice communities. According to Vella (2019): "...a [Knowledge Synthesis] project like this would be internationally...very helpful to understand what works or offers promise to help decision makers take to action..." In Canada, defining best practices for RA is essential as the Impact Assessment Agency of Canada, other governments, and

Indigenous groups across Canada pursue RA pilot projects in the north and elsewhere. By consolidating current scholarship and drawing on the applied experience of Canadian and international jurisdictions, the KS project will address a critical gap in current RA scholarship and provide guidance to RA interests (e.g. policy makers, planners, Indigenous governments, industry proponents) on next steps to strengthen both research and practice.

2.0 Objectives

The purpose of this project is to characterize RA practice in Canada, with select international examples, and identify some of the emerging good practices that can render RA as helpful as possible to decision-making about natural resources development and conservation. Based on analysis of academic scholarship and grey literature, this project investigates:

- i. Key characteristics of RA practice (an inventory of initiatives; partnership models; impetus, and so on);
- ii. Promising methods, tools and approaches commonly used in RA practice; and
- iii. Lessons, opportunities and challenges, as well as critical knowledge gaps in RA research and practice.

The scope of this research does not include regional-scale project impact assessments¹.

3.0 Methods

3.1 Search Methods

This project utilized a multi-jurisdictional literature analysis involving both academic and grey literature from multiple development sectors and proponents. The literature search targeted works published in the last two decades (2000-2020), drawing on domestic and international literature. Source materials were derived from multiple development sectors (e.g. land use planning, oil and gas, mining, forestry, energy, marine and coastal), jurisdictions (provincial, federal, territorial, Indigenous, international), and proponents (e.g., government, non-government, industry, Indigenous). A structured literature search was performed using four databases: Scopus; Web of Science, Academic Science Complete, and Google Scholar. We also performed a scan of the 'grey literature' (e.g. known RA reports and frameworks) using broad web searches. Standard search terms were used: 'regional assessment'; 'regional environmental assessment'; 'regional impact assessment'; and 'regional strategic environmental assessment'; and 'strategic regional plan' (and combinations thereof). Additional documents were accessed with assistance from various colleagues involved or interested in RA.

3.2 Selection Criteria

Our literature search and selection process is detailed in Figure 1. The literature search activities returned several hundred potential documents for review across all of the search platforms. In a two-stage screening process, first, the titles and keywords of each document were used to gauge potential

¹ Many project-based IAs required by law either federally or provincially in Canada are regional in scale. For example, the Bipole III transmission line project in Manitoba is a hydro-electric transmission line corridor extending more than 1400 km from the proposed Keeyask Hydroelectric Generating Station (on the Nelson River) to Winnipeg. This is clearly a regional-scale assessment. However, this study focuses on RA initiatives at the policy, plan, and programme level occurring outside regulatory project-based IA in Canada and abroad.

relevance to the study. Next, the abstract or executive summary of each document was read to confirm actual relevance to the study. Identification of ‘cases’ of RA was based on the following criteria: that the initiative was (i) empirical or applied; (ii) policy, plan, or programme focused; (iii) regional in geographic scope; (iv) possessed an ‘impact assessment’ component (retrospective and/or prospective analysis). The case selection criteria were adapted from Gunn and Noble (2009). From the initial sample of hundreds of documents, 124 were included in our in-depth literature analysis. Of these, 64 documents were academic articles and 60 were grey literature documents representing 52 cases of RA in Canada and internationally. The case documents were analyzed separately from the academic literature. The case documents provided information about ‘what’ RA consists of, ‘how’ RA is done and by ‘whom’ and ‘why’, whereas the academic literature primarily provided information about research progress and gaps, and lessons that may have subsequently been derived from practice (following the public release of case documents).

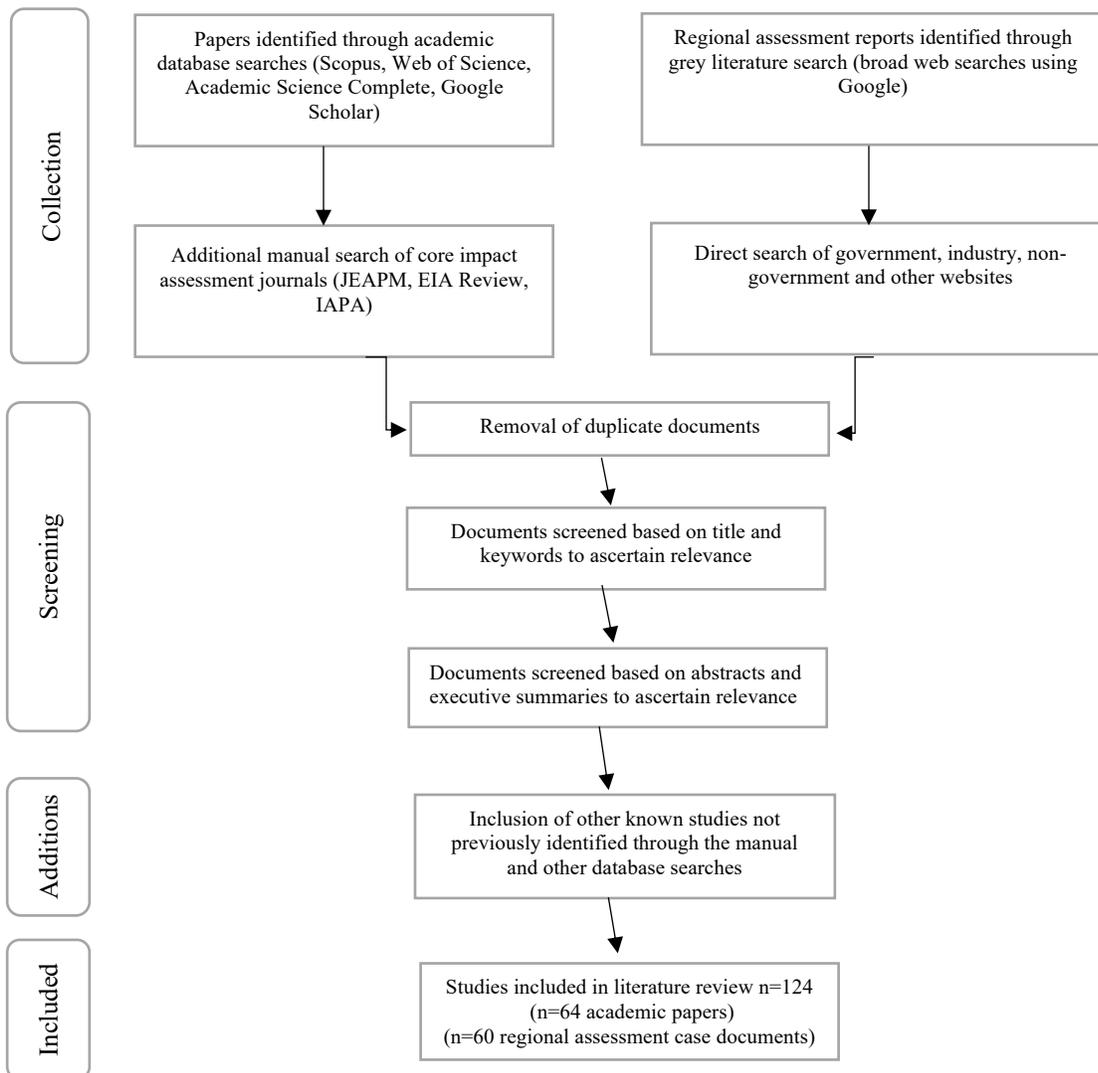


Figure 1. Literature search and selection process

3.3 Data Collection

Data collection and preliminary content analysis were performed by student research assistants at the University of Saskatchewan. All of the documents in our sample were uploaded to NVivo 12 Plus, a software program commonly used to analyze large amounts of qualitative data. Using NVivo 12 Plus, the students performed coding and theme identification using the study purpose and objectives as a guideline. A hybrid approach to coding was utilized, which involves both inductive and deductive approaches to build a common codebook suitable for team use (Fededay & Muir-Cochrane 2006). This led to the emergence of conceptual categories and a basis for subsequent explanation of the data (Gerring 2017; Babbie 2002).

3.4 Data Analysis

To focus the analysis, data were organized according to key characteristics. More specifically, the data were organized to capture the state of 'tools/methodology' featured in cases of RA, and 'lessons and knowledge gaps' discussed in the broader literature, among other broad themes. For the RA case analyses, 'parent nodes' (codes) included: 'purpose'; 'rationale'; 'type of assessment'; 'methodology'; and 'partnership model'. The analysis of academic literature focused on 'lessons learned', 'research gaps', and so on. Many 'child nodes' (sub-codes) were developed within all parent nodes. For example, for the parent node 'lessons learned' child nodes included: 'best practices'; 'barriers and challenges'; 'opportunities'; 'recommended future research', etc. Coded data were then examined within their categories to identify emergent themes and key trends, while also identifying illustrative outlying information (nonconforming to dominant trends).

The literature review activities were enhanced by informal, unstructured communication with academic, public, private and not-for profit professionals with RA experience. These conversations helped shape some of the investigative themes in the literature analysis, guide the data analysis, and identify some Canadian RA cases for analysis. Many of these individuals, and others, will be engaged in future knowledge mobilization activities.

4.0 Results and Discussion

In this section, we first discuss broad trends among the Canadian cases with respect to: (i) geographic scope and temporal concentration of practice; (ii) the prevalence of strategic assessment and cumulative effects assessment as core components of RA; (iii) partnership models and sectors of application; and (iv) methodology. We then provide a brief profile of the 10 international cases of RA. Next, we summarize trends apparent in the academic literature on RA. Section 4 ends with a summary of research strength and gaps.

4.1 Analysis of Regional Assessment Cases

A total of 42 cases of RA in Canada (completed between 2000 and 2020) were identified for review via the literature search and through informal conversations with colleagues. A further 10 international cases of RA were selected for review completed by various organizations. Table 1 lists all cases by jurisdiction and summarizes their broad characteristics including: year of public release of final report; proponent or partnership model; sector of application; impetus; methodology/approach; and some of the most common methods used.

Table 1. Regional assessment case features

	PROFILE		PROPONENT			SECTOR						IMPETUS			METHODOLOGY			COMMON METHODS										
	Final Report Released	Cumulative Effects Focused? Strategic/Proactive?	Government-led	Non-government led	Industry-led	Terrestrial/Land Use Planning	Marine or Coastal	Forestry	Transportation/Roads	Mining	Oil and Gas/Energy	Multi-sector Sustainability	Legislation/Regulation	Government Policy-Related	Voluntary	United Nations Prompted	Quantitative	Qualitative	Mixed Methods	Primarily reviews existing studies	Methodology not detailed	Modelling	Scenario Comparison	GIS	Heuristic frameworks/Expert Knowledge	Remote Sensing	Traditional Knowledge	Public Engagement
British Columbia																												
An Assessment of the Cumulative Effects of Land Use and Management in SSN	2016	N Y		X		X								X		X	X				X	X	X				X	X
The Baynes Sound Coastal Plan for Shellfish Aquaculture	2002	N N	X				X					X				X	X							X				X
A Broad Scale CIA Framework for the Cariboo-Chilcotin	2015	N Y	X			X							X					X					X					
Cortes Island Coastal Plan for Shellfish Aquaculture	2003	Y N	X				X					X				X	X										X	X
Cumulative Effects Assessment for the Merritt Operational Trial	2015	N Y	X					X					X			X	X				X	X					X	
Current Condition Report for Grizzly Bear in the Northeast Region	2018	N Y	X			X							X			X					X			X		X	X	X
Eight Peaks Winter Recreation Sustainable Resource Management	n.d.	Y N	X			X							X							X								X
Elk Valley Cumulative Effects Assessment and Management	2018	Y Y		X	X	X								X		X					X			X		X	X	X
Howe Sound Cumulative Effects Project	2018	N Y	X				X						X			X							X					
The Johnstone-Bute Coastal Plan	2004	Y Y	X				X						X			X	X											X
The Kyuquot Sound Coastal Plan	2003	Y Y	X				X						X			X		X									X	X
Metlakatla Cumulative Effects Management Program	2019	Y Y		X							X		X					X					X	X		X	X	X
Robson Valley Enhanced Forest Management Pilot Plan	2003	Y Y	X			X		X					X			X					X	X						X
Alberta																												
Chief Mountain Cumulative Effects Study	2011	Y Y				X					X		X		X	X					X	X						X
Cumulative Effects Assessment of the North Saskatchewan River Watershed	2009	N Y		X			X						X		X	X					X	X	X					X
Lower Athabasca Regional Plan	2012	Y Y	X			X							X				X	X						X			X	X
South Saskatchewan Regional Plan	2018	Y Y	X			X							X							X	X			X			X	X
Terrestrial Ecosystem Management Framework for the RM of Wood Buffalo	2008	Y Y		X		X					X			X				X			X	X					X	X
Wood Buffalo Strategic Environmental Assessment	2018	Y Y	X	X		X								X		X	X	X	X		X						X	X
Saskatchewan																												
Assessment of the CEs of Climate Change and Land Use to the Trans Mountain Pipeline and Wildlife Habitat i	2019	N Y		X		X							X		X	X					X	X		X				
The Great Sand Hills Regional Environmental Study	2007	Y Y	X			X							X		X	X	X				X	X	X	X	X	X	X	X
Manitoba																												
Manitoba Hydro Regional Cumulative Effects Assessment - Phase II Report	2014	N Y	X							X			X					X			X	X		X	X		X	X
Nova Scotia																												
Eastern Scotian Shelf and Slope - Middle and Sable Island Bank	2012	Y Y	X							X			X					X						X				X
Eastern Scotian Slope (Eastern Portion) and Laurentian Fan (Western Portion)	2013	Y Y	X							X			X					X						X				X
Easten Scotian Slope Strategic Environmental Assessment	2012	Y Y	X							X			X					X						X				X
Fundy Tidal Energy Strategic Environmental Assessment	2008	Y Y	X		X		X					X						X			X			X				X
Middle Scotian Shelf and Slope Strategic Environmental Assessment	2019	Y Y	X							X			X					X						X				
Misaine and Banquereau Banks (draft report)	2013	Y Y	X							X			X					X						X				X
Sydney Basin and Orpheus Graben Offshore Cape Breton	2016	Y Y	X							X			X					X			X							X
Western Scotian Shelf	2014	Y Y	X							X			X					X						X				X

Table 1. Regional assessment case features (continued)

	PROFILE		PROPONENT			SECTOR					IMPETUS		METHODOLOGY			COMMON METHODS												
	Final Report Released	Cumulative Effects Focused? Strategic/Proactive?	Government-led	Industry-led	Non-government led	Terrestrial/Land Use Planning	Marine or Coastal Watershed-focused	Forestry	Transportation/Roads	Mining	Oil and Gas/Energy	Multi-sector Sustainability Legislation/Regulation	Government Policy-Related	Voluntary	United Nations Prompted	Quantitative	Qualitative	Mixed Methods	Primarily reviews existing studies	Methodology not detailed	Modelling	Scenario Comparison	GIS	Heuristic Frameworks/Expert Knowledge	Remote Sensing	Traditional Knowledge	Public Engagement	
Newfoundland and Labrador																												
Regional Assessment of Offshore Oil and Gas Exploratory Drilling	2020	Y Y	X		X					X		X			X								X			X	X	
Northwest Territories																												
Thcho Wenek'e Land Use Plan	2013	Y Y		X		X						X			X	X				X		X			X	X		
Northwest Territories Cumulative Impact Monitoring Program 2016-2020 Action Plan	2015	N Y			X						X	X				X										X		
Nunuvut																												
Keewatin Regional Land Use Plan	2000	Y N	X		X	X							X			X	X								X	X		
Strategic Environmental Assessment in Baffin Bay and Davis Strait	2019	Y Y		X	X			X				X							X							X	X	
Yukon Territory																												
Beaufort Regional Environmental Assessment	2016	N Y	X		X					X		X		X	X	X			X		X	X	X	X	X	X	X	
North Yukon Regional Land Use Plan	2009	Y Y	X		X	X						X				X							X			X		
Peel Watershed Regional Land Use Plan	2019	Y Y	X		X	X						X			X								X	X		X		
Canadian Arctic																												
IRIS 1 An Integrated Regional Impact Study of Climate Change and Modernization in the Western and Central Arctic	2015	N Y			X						X		X		X	X	X					X		X	X	X	X	
IRIS 2 An Integrated Regional Impact Study of Climate Change and Modernization in the Eastern Arctic	2018	N Y			X						X		X		X	X	X			X		X		X	X	X	X	
IRIS 3 An Integrated Regional Impact Study of Climate Change and Modernization in Hudson's Bay	2019	N Y			X		X					X			X	X	X			X				X	X	X	X	
IRIS 4 An Integrated Regional Impact Study of Climate Change and Modernization in the Eastern Sub-Arctic	2012	N Y			X						X		X		X	X	X			X	X	X		X	X	X	X	
International																												
Anatec Navigation Impacts Review, Thames Estuary Dredging Areas (UK)	2009	Y Y		X				X					X		X	X				X	X	X		X		X		
GEO-6 Regional Assessment for North America (United Nations Environment Programme)	2016	Y Y	X							X			X				X										X	
Great Barrier Reef 2050 Long-Term Sustainability Plan (AUS)	2015	Y Y	X					X					X		X		X								X	X		
Great Barrier Reef 2050 Water Quality Improvement Plan (AUS)	2018	Y Y	X					X				X			X	X				X						X	X	
The IPBES Regional Assessment Report on Biodiversity and Ecosystem Services for Africa	2018	Y Y	X							X		X			X	X	X			X	X	X	X	X	X	X	X	
Programmatic Environmental Assessment Rural Energy Program in Georgia (USA)	2006	Y N	X							X		X				X											X	
Scientific Inquiry Into Hydraulic Fracturing in the Northern Territory (AUS)	2018	N Y	X							X		X			X		X			X					X	X	X	
Strategic Environmental Assessment of the Selous Game Reserve (Tanzania)	2019	N N	X				X							X						X						X	X	
Third Regional Development Project (World Bank)	2016	Y Y		X		X							X			X	X					X		X			X	
The Western Greenland Sea Strategic Environmental Assessment (Denmark, Greenland)	2012	Y Y	X			X				X		X			X	X	X			X							X	

4.1.1 Canadian Cases

Geographic Scope and Temporal Concentration of Practice

Based on the cases we identified and analyzed, RA practice within Canada is not evenly spread (see Figure 2). Of the 42 Canadian cases, 13 (31%) are focused on regions in British Columbia and a further 11 (26%) on regions in the Northwest Territories, Yukon Territory, Nunavut, and the Canadian Arctic. Nine RA initiatives (21%) were found in prairie provinces (Alberta, Saskatchewan, Manitoba) and eight (19%) on the east coast (Newfoundland and Labrador, Nova Scotia). Notably, no RA initiatives were identified for Ontario, Quebec, New Brunswick or Prince Edward Island, though it is possible some may exist.

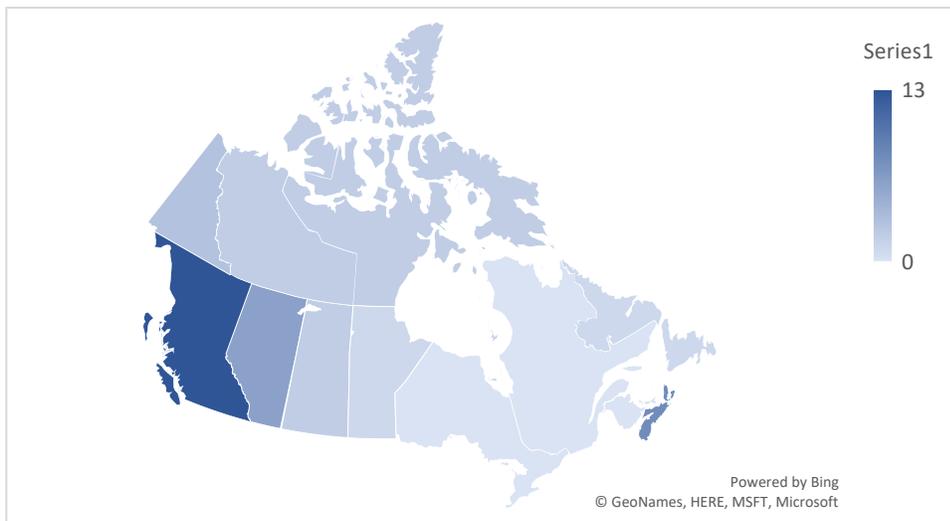


Figure 2. Geographic concentration of RA practice in Canada

Figure 3 shows the number of the RAs completed in Canada between 2000 and 2020, by province. The concentration of RA practice in British Columbia and northern parts of Canada could possibly reflect the more advanced state of Indigenous land claims processes and self-governance systems in those areas. It is likely also reflective of the geographic concentration of valuable timber, mineral, oil and natural gas resources in western and northern Canada.

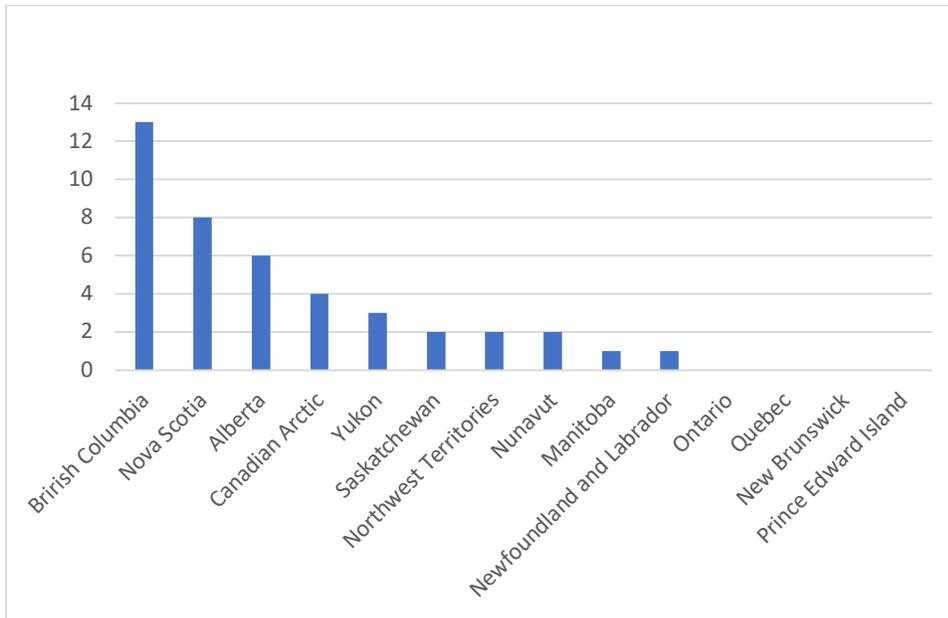


Figure 3. Regional assessments completed in Canada between 2000 and 2020, by province or territory

Of the 42 Canadian cases, 30 (71%) had final reports publicly released within the last decade. Twenty (48%) of the final reports were released within the last five years. Figure 4 depicts the rising trend of RA practice over the last two decades which indicates increasing interest in this form of assessment despite the lack of regulatory or legislative requirements to employ it.

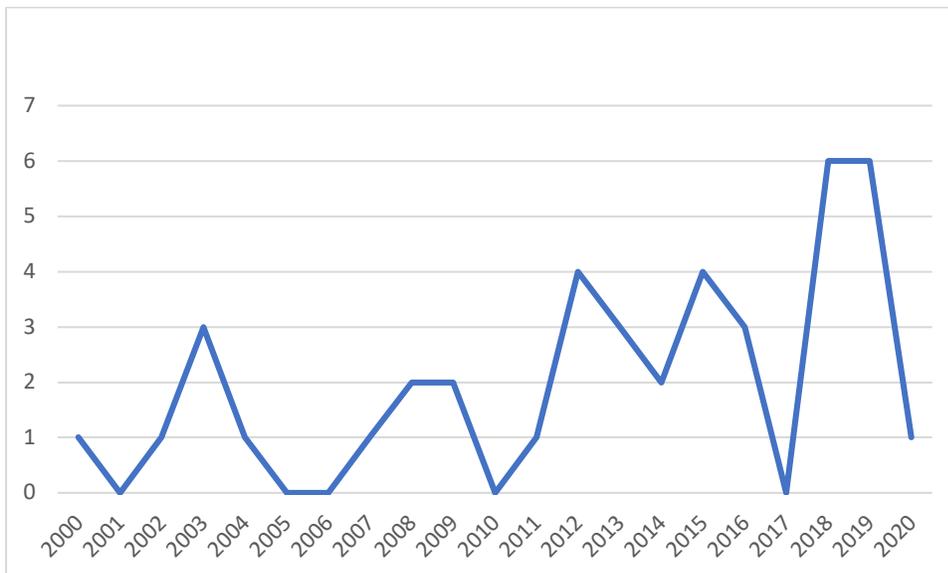


Figure 4. Rising trend in regional assessment practice in Canada, 2000-2020

It is also apparent that RA as a practice (not necessarily as a concept) is still very much in its infancy, given that nearly three quarters of the RA initiatives sampled are concentrated within the last 5-10 years (see Figure 5). This trend has important implications for deriving best practice information about RA

practice in Canada and abroad. At present, it may be possible to identify the inputs of an RA exercise (impetus, goals, scope, valued components, inputs/resources, assessment activities, assumptions and uncertainties, audience, and so on), as well as immediate outputs in the form of case documentation and programs (including scoping reports, draft and final reports, action plans, public commentary on the reports, and so on), but for a strong majority of cases it is likely too early to be able to verify predictions or determine outcomes (either mid-term or long-term, expressed as changes in knowledge, awareness, practices, or conditions). It is also too early in the majority of cases to determine what key external factors, if any, will ultimately facilitate or hinder the implementation of a given RA initiative.

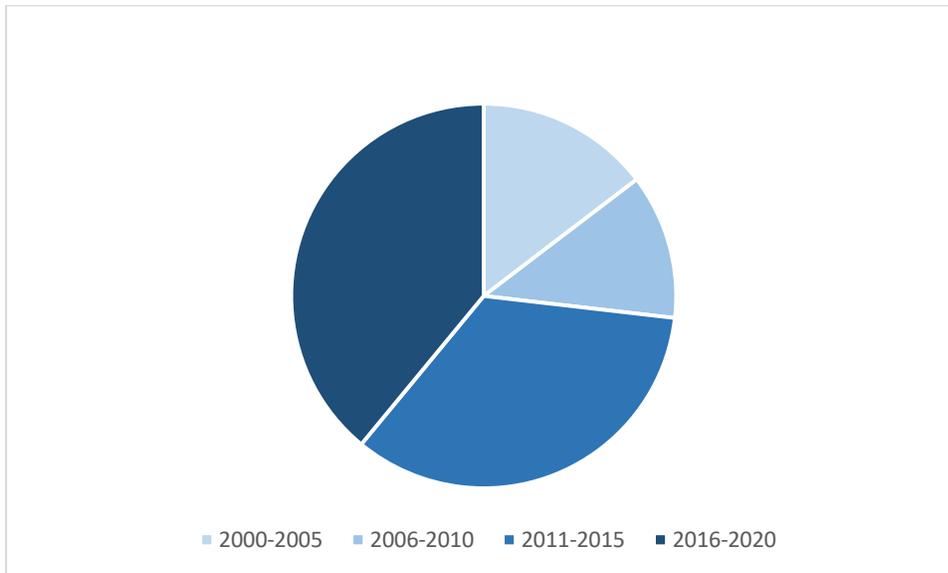


Figure 5. Temporal concentration of RA initiatives in Canada, 2000-2020

To begin to derive insight into outcomes and best practices for RA, in-depth case investigations of several earlier completed cases such as the Kyoquot Sound Coastal Plan (2003) and the Johnstone-Bute Coastal Plan (2004) in British Columbia; the Cumulative Effects Assessment of the North Saskatchewan River Watershed (2009) in Saskatchewan; the North Yukon Regional Land Use Plan (2009) in Yukon Territory; and the Keewatin Regional Land Use Plan (2000) in Nunuvut may yield some insights, given the length of time that has passed to allow for implementation and action plans to take shape. Cross-case synthesis and meta-analysis of lessons will be important in addition to single case studies.

In Canada, many more RA initiatives are on the horizon. In the course of this research, the following RA initiatives were identified as in progress or imminent:

- The province of British Columbia is leading RAs including the Marine Area Planning Partnership (MAPP) initiative (split into sub-regions) and the Environmental Stewardship Initiative (ESI) focused mainly on the Prince Rupert area;
- The Ontario Ring of Fire Regional Strategic Environmental Assessment was recently authorized by the provincial and federal governments;
- The federal government is initiating a series of pilot RAs under the *Impact Assessment Act, 2019*;
- Transport Canada is currently conducting six pilot cases of regional cumulative effects assessment (South Coast, British Columbia; North Coast, British Columbia; Cambridge Bay, Nunuvut; St. Lawrence, Quebec; Bay of Fundy, Nova Scotia/New Brunswick; and Palcentia Bay, Newfoundland);

- The Canada-Nova Scotia Offshore Petroleum Board (CNSOPB) recently announced it will update its SEA for the Western Scotian Shelf and Slope region; and
- The Tseil Wau-Tuth Nation commissioned the State of Port of Vancouver Estuary study in 2019. This coastal environmental baseline project is supported by Fisheries and Oceans Canada.

Other known RA initiatives have been completed in Canada within the past 20 years but were not included in this study. Many of these RAs are either internal government reports, not yet publicly released, or proprietary reports produced for private clients. For example, Parks Canada performs strategic assessment for many national parks that are regional in scope and focused on cumulative environmental effects: these are used internally to guide production of park plans and inform subsequent project-based IAs. The Alberta Government completed the South Athabasca Oil Sands Regional Strategic Environmental Assessment though it has not yet been publicly released. Some long-running RA initiatives are very complex and not possible to assess as a ‘single’ assessment. For example, the trans-boundary Crown of the Continent Managers Partnership is a multi-jurisdictional partnership amongst federal, state, provincial, tribal and First Nation agency managers and universities in Alberta, British Columbia and the state of Montana, USA. It was established in 2001 and has been active since. It involves a diverse group of science and resource management agencies acting at varying levels of government to collaboratively investigate and address environmental management issues identified in the Crown of the Continent ecosystem. The initiative is both strategic and focused on cumulative environmental effects and has resulted in dozens of collaborative research reports and management plans/directives since its inception. Research and management agendas of the partner stakeholders are currently guided by the *Strategic Conservation Framework (2016-2020)*, though this document is not itself a RA.

Strategic Assessment and Cumulative Effects Assessment as Core Components of RA

Regional assessment initiatives may or may not have a strategic component, meaning a component that is future-focused and analyzes the relative desirability of multiple future state options (Noble 2000). The strategic component of a RA would be used for prospective impact analysis; to determine the most desirable, practicable option or scenario; and, ideally, recommend a course of action to achieve that desired state. In this research, an RA initiative was also considered strategic if one of its chief aims was to influence the nature of future development in the area and/or related environmental management programs and decision-making, including subsequent policy and plan formulation and project approval. This is known in impact assessment literature as ‘tiering’ (Fischer 2003). Of the 42 Canadian cases examined, 28 (67%) have a strategic component and 14 (33%) do not. For example, the Cortes Island Coastal Plan for Shellfish Aquaculture and the Eight Peaks Winter Recreation Sustainable Resource Management plan in British Columbia and the Keewatin Regional Land Use Plan in Nunuvut are strategic in different ways. The Cortes Island Coastal Plan for Shellfish Aquaculture is meant to:

...assist LWBC [Land and Water British Columbia Inc.] and other provincial agencies when considering applications for shellfish tenure. It also assists the local community and First Nations by identifying opportunities for future development, including conservation and recreation areas...[additionally] it will prove a useful tool for individual development proponents...by identifying in advance the opportunities, constraints and limitations to...aquaculture...around Cortes Island. (BC MSRM 2003: p.v).

The Eight Peaks Winter Recreation Sustainable Resource Management plan is centered around a “Desired Future Condition” statement according to which resource management objectives are established for 44,500 hectares of mountain slopes near the community of Blue River. The Keewatin

Regional Land Use Plan provides a framework for communities, government, and industry within which to work, guiding development where it might occur and establishing limits and concerns, while also ensuring the protection of the land and resources. It is not meant to apply directly to individual project proposals (Nunavut Planning Commission 2000).

In IA, it is widely agreed that cumulative environmental effects are best understood by adopting a regional scale of analysis (GoC 2016; CCME 2009). Of the 42 Canadian cases, 37 (88%) included a significant focus on cumulative environmental effects. Again, the approaches taken to cumulative effects assessment is diverse. To cite a few examples, the Cumulative Effects Assessment of the North Saskatchewan River Watershed was an ALCES based modelling exercise undertaken by the Government of Alberta “intended to simulate the effects of major land uses in the watershed (agriculture, forestry, urban, and petrochemical industry) on watershed values (i.e., biodiversity, landscape integrity, water quality and water quantity) over a 100 year time span” under four different development scenarios (NSWA 2009). The Manitoba Hydro Regional Cumulative Effects Assessment was an effort to collate the results of past studies in the region and perform novel retrospective analyses of the data where possible in order to characterize the total effects to select ‘regional study components’ since the onset of hydro-electric development in northern Manitoba (Manitoba Hydro 2014). A series of Integrated Regional Impact Studies of Climate Change and Modernization were undertaken between 2012 and 2019 for four regions of the Arctic: Western and Central, Eastern, Hudson’s Bay, and Eastern Sub-Arctic. These studies, coordinated by the research consortium ArcticNet, attempt to synthesize and assess the accumulated state of knowledge for each region with respect to climate variability; terrestrial and freshwater systems; marine ecosystems and contaminants; Inuit health, food and cultural security; resource development; and so on. The goal is to unite scientists and Northerners in a joint effort to mobilize and translate existing science into policy including climate adaptation plans, attenuate negative impacts and maximize positive outcomes for the Arctic (Stern and Gaden 2015).

Twenty-four of the 42 Canadian cases (57%) were both strategic and focused on cumulative effects assessment – these initiatives could be termed ‘regional strategic environmental assessment’ (RSEA) as defined by the Canadian Council of Ministers of the Environment (2009). For example, the Robson Valley Enhanced Forest Management Pilot Plan in British Columbia utilized a scenario analysis process to consider “what’s possible for forest management in an uncertain future” (Teserra Systems, Inc. 2003: p. 1). The goal was to cooperatively define a desired future forest condition for the Robson Valley Timber Supply Area and develop strategies to achieve it based on how well different assemblages of forest management strategies met expectations for an array of social, economic and ecological objectives. The approach to cumulative effects assessment in this case was to estimate the impacts to forest function and productivity of the various assemblages of management strategies. The Terrestrial Ecosystem Management Framework for the Rural Municipality of Wood Buffalo in Alberta similarly evaluates the cumulative impacts of three hypothetical management scenarios over a 100-year time frame. It recommends broad regional strategies and the application of specific management measures and monitoring at a sub-regional scale (CEMA 2008).

Partnership Model and Sector of Application

Regional assessments are led by various proponents, including federal, provincial and territorial governments; non-government groups; Indigenous groups; and other conglomerates (i.e., research consortiums, multi-agency partnerships that share power and authority, or similar). It appears that most often, government is the lead proponent of RA initiatives in Canada. Of the 42 Canadian cases, 27 (64%) can be characterized as government-led (including initiatives such as the Canada-Nova Scotia Offshore

Petroleum Board that are government-led and serve both public and industry needs). It is apparently not typical for RA to be industry-led in Canada based on the sample of cases reviewed. It appears that none of the initiatives are spearheaded by private corporations, though at times, they are contributing partners in RA or perform RA (typically modelling exercises) as a fee-for-service. Six initiatives (14%) are led by non-government organizations and a further 11 initiatives (26%) are led by conglomerate (multi-stakeholder) partnerships.

In several cases, RAs are initially led or spear-headed by government but ultimately performed via a multi-stakeholder partnership. For example, the 2008 Fundy Tidal Energy Strategic Environmental Assessment was initiated by the Government of Nova Scotia in response to new legislation requiring the addition of 500 MW of new renewable energy capacity be added to the provincial system by 2013. The government commissioned a research conglomerate made up of universities and the Nova Scotia Department of Energy to undertake the SEA, which then engaged Jacques Whitford as a sub-consultant and a stakeholder advisory group of community leaders including an Indigenous Mi' kmaq Chief.

Interestingly, eight of the 42 RAs (19%) are Indigenous-initiated:

- An Assessment of the Cumulative Effects of Land Use and Management in the St'kemlupsemc Te Secwepemc Nation (SSN) – an ALCES modelling exercise to estimate impacts of the Ajax mining project to SSN traditional territory;
- the Assessment of the Cumulative Effects of Climate Change and Land Use to the Trans Mountain Pipeline and Wildlife Habitat in the North Thompson Watershed – another ALCES modelling exercise requested by the Adams Lake Indian Band and Trans Mountain Corporation to estimate impacts of the Trans Mountain Pipeline System and/or Trans Mountain Expansion Project to the North Thompson watershed in British Columbia;
- the Elk Valley Cumulative Effects Assessment and Management Report – the Ktunaxa Nation Council and other groups advocated for the establishment of a cumulative effects assessment and management process for the Elk Valley focused on five valued components (old and mature forests; riparian habitat; Westslope Cutthroat Trout; Grizzly Bear; and Bighorn Sheep). Leadership later passed to the British Columbia provincial government;
- the Metlakatla Cumulative Effects Management Program – developed in response to the Liquefied Natural Gas 'gold rush' on British Columbia's North Coast and focused both on assessment and ongoing management activities to support planning and decision-making efforts;
- the Wood Buffalo Strategic Environmental Assessment – Parks Canada commissioned an assessment of cumulative impacts of surrounding industrial land uses to the Outstanding Universal Values of the park;
- the North Yukon Regional Plan – the Yukon's first regional plan completed under a First Nation Final Agreement, this strategic RA was a joint effort of the Vuntut Gwitchin and Yukon governments;
- the Thcho Wenenk'e Land Use Plan – a guide for land use management of approximately 39,000km of Thcho lands with the goal of protecting Thcho culture, heritage and traditional way of life; and
- the Strategic Environmental Assessment in Baffin Bay and Davis Strait – the Nunavut Impact Review Board, an Indigenous independent institution of public government, assessed the potential for oil and gas development in Baffin Bay and Davis Strait during a moratorium on oil and gas exploration in the waters of the Canadian Arctic.

The earliest completed Indigenous-led RA in our sample was the North Yukon Regional Land Use Plan in 2009 but six of the others were completed within the past five years.

In terms of what is driving RA, typically the initiatives are voluntary (20 cases, 48%). Fifteen initiatives (36%) have been undertaken in response to existing governmental policy and/or a desire to be able to better respond to the regulatory environment surrounding regional development. Six initiatives are connected with regulatory triggers of some kind. The drivers behind each RA initiative are complex, however, and often do not neatly fit within one category. For example, in 2014, the Mikisew Cree petitioned the UNESCO World Heritage Committee to place Wood Buffalo National Park World Heritage Site on the list of World Heritage in Danger (Government of Canada 2019). The World Heritage Committee subsequently called for a strategic environmental assessment of the park. Parks Canada was the lead proponent of the Wood Buffalo SEA but it worked very closely with multiple Indigenous partners on the assessment.

Regional assessment initiatives in Canada are primarily concentrated in the following sectors: land use planning (12 cases, 29%); oil and gas (10 cases, 24%); marine/coastal area planning (9 cases, 21%); and watershed planning or management (3 cases, 7%). In Canada, RA does not seem to be taken up within the mining or transportation sectors as yet. Seven of the Canadian RA cases (17%) were not sector specific but rather cross-cutting, focusing broadly on regional sustainability. Figure 6 illustrates the distribution of RA cases by sector.

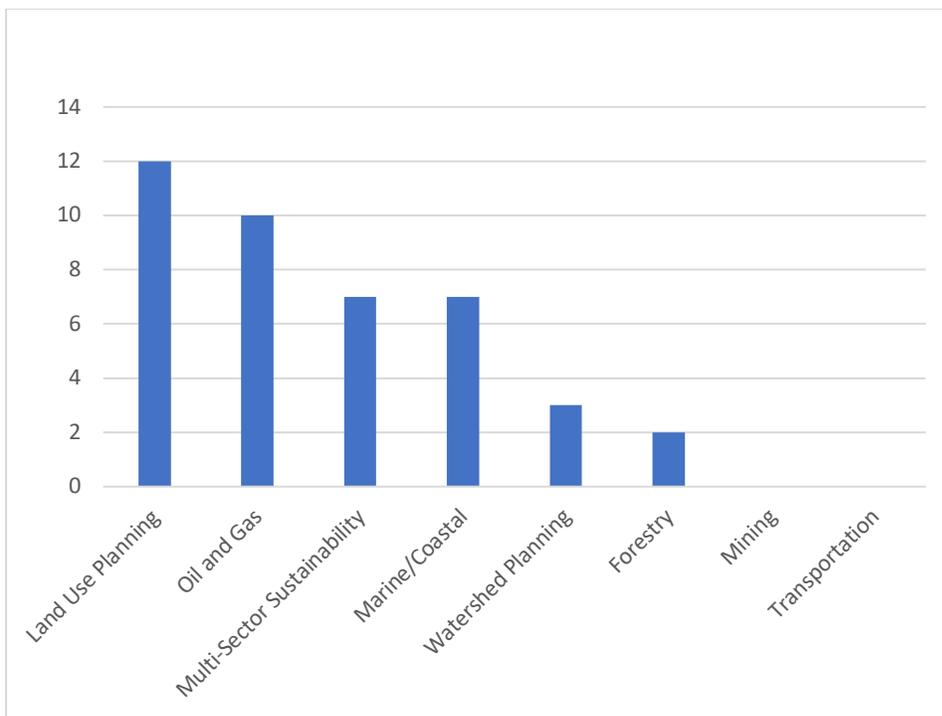


Figure 6. Regional assessment cases by sector

Methodological Approach and Common Methods

Methodologically, the 42 cases are diverse. The RA final reports are typically lengthy documents and most cases explore many potential impact possibilities in the course of the assessment. The reports usually feature multiple in-depth analyses performed for numerous valued environmental, social, cultural, economic and other components. Accordingly, a variety of methodological approaches are demonstrated ranging from primarily quantitative to primarily qualitative, but mixed methods approaches are also common, and often all three approaches are employed within the same RA initiative (see Table 1). In some cases, we found that the methodological approach was a retrospective compilation and review of existing information, meaning that either no new data were collected and/or no new analysis was performed. In three of the cases, the methodology description was not sufficiently detailed to be able to discern either the methodological approach or the methods used.

Dozens of methods, tools and techniques were employed in our sample of cases. We gathered data about the frequency of use of some of the most common methods used in IA, namely: modelling; scenario analysis; geographic information systems (GIS); remote sensing; use of heuristic models and expert judgment; Traditional Knowledge (sometimes also referred to as Traditional Ecological Knowledge, Native Science, and so on); and public engagement. Due to the length and complexity of the documents, we focused on identifying prominent instances of application of these methods. Figure 7 summarizes how many of the RA cases employed these methods.

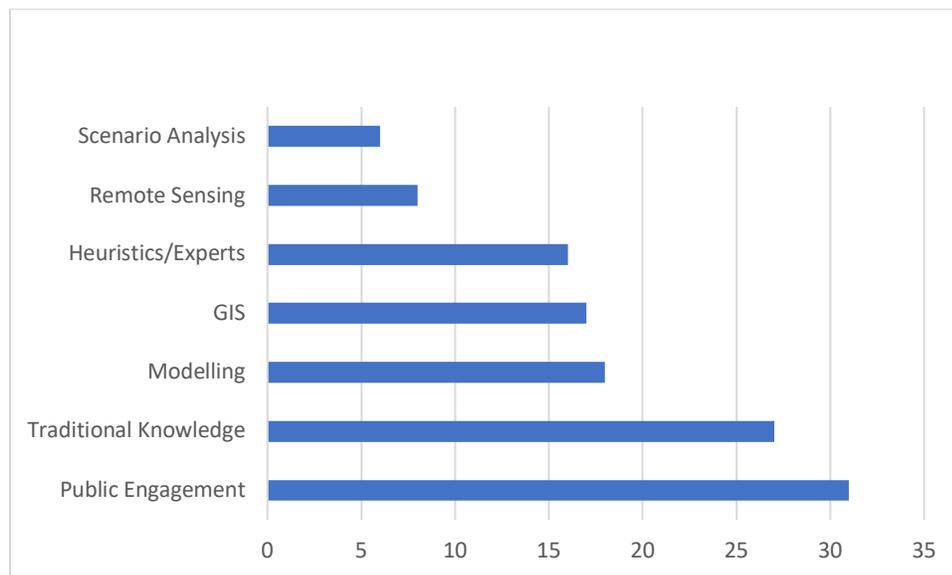


Figure 7. Frequency of use of common impact assessment methods in Canadian regional assessment

Figure 7 suggests that public engagement and engagement with Traditional Knowledge are both seen as highly beneficial to RA practice across all sectors and jurisdictions in Canada. Many RAs employ some form of modelling, GIS, and expert evaluation, though these methods are featured in less than half of the cases reviewed. Interestingly, scenario analysis is not often used even though it is believed by many to be a core element of good practice cumulative and strategic environmental assessment (CCME 2009). According to the Expert Panel (2007: 78), “the assessment of scenarios as discussed in the CCME [Canadian Council of Ministers of Environment] approach, is the key way for parties to discuss how they would like the region to look in the future.” The broad trends illustrated in Table 7 are alone not enough

to allow the identification of promising methods, tools, and approaches in RA. There are many fruitful tools such as the ‘critical loads and levels’ approach that have been used successfully for years to assess cumulative effects. Critical loads and levels are commonly used to estimate the acidification risks of sulphur emissions to fish (Hunsaker 1989; Kuylenstierna et al. 2001) and the risk of air pollution impacts to ecosystems (PBL 2003), for example. However, it was beyond the scope of this study to be able to analyze trends regarding specific tool use to estimate impacts on specific valued components in the various cases. Given the highly diverse nature of RA practice a much deeper analysis of RA methodology is needed based on comparisons of like cases in like contexts. For example, RA cases completed for marine and coastal areas should be looked at as a group to discover promising methods, tools and approaches useful for that sector, given that proponents and non-government organizations are interested in applying RA (see for e.g., Clarke Murray et al. 2014). Alternatively, it would be beneficial to evaluate the kinds of methods, tools and approaches used to assess impacts to a particular wildlife species of concern such as caribou, or another widely valued component of environment, society or culture.

4.1.2 International Cases

Internationally, regional-scale assessment has been applied by the United States since the National Environmental Protection Act was introduced in 1969 in the form of programmatic environmental impact assessment. In Canada, regional-scale assessment preceded the first formal federal impact assessment legislation. In fact, many of the best examples of early IA in Canada were regional-scale assessments such as the Mackenzie Valley Pipeline inquiry under Justice Thomas Berger in the early 1970s (Noble 2015). Global institutions began to apply SEA to regions in the 1990s (see for e.g., Louis Berger International, Inc. 1995), and possibly earlier. In the early 21st century, the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP) together promoted the idea of environmental mainstreaming in national and sector development policy, plans, and budgets (World Bank 2011). The Organisation for Economic Co-operation and Development (OECD) also applied SEA at national and sector levels (World Bank 2011). In 1997, UNEP initiated the Global Environmental Outlook (GEO) series of RAs designed in part to inform the United Nations Environment Assembly. For GEO-6 in 2016, the latest iteration of the GEO series, six regional assessments were performed for: Africa; Asia and the Pacific; Latin America and the Caribbean; North America (included in this study); West Asia; and the Pan-European Region.

Between 2005 and 2011, the World Bank completed six of eight planned pilot projects of policy-level SEA, including the 2002-2020 SEA for China’s Hubei Road Network Plan. This Plan encompassed a system of expressways (totalling 5,000 km) and highways (totalling 2,500 km) including road links between all major cities in the province and the capital of Wuhan (World Bank 2011). More recently, the United Nations World Heritage Committee has commissioned or requested at least 21 regional-scale SEAs for world heritage sites, three of which are included in this study: Wood Buffalo SEA (Alberta); Great Barrier Reef Long-term Sustainability Plan (Australia) and the Selous Games Reserve (Tanzania). Additionally, the United Nations Economic Commission for Europe has completed a SEA of the Master Plan of the Municipality of Orhei in the Republic of Moldova (UNDP 2015).

Internationally, the scope of RA practice is difficult to gauge but it appears to be vast and this study does not attempt a comprehensive review of it. Rather, we selected 10 cases (listed in Table 1) that help illustrate the diverse nature of RA practice worldwide. Although our sample cannot be considered ‘representative’ of the larger body of international RA practice, several interesting observations can still be made. Of the 10 international cases sampled, eight final reports were released within the last decade

(80%); six of those (60%) in the last five years. This seems to echo the recent temporal concentration of RA practice within Canada.

Of the 10 international cases, all but one (90%) are strategic in nature. This is far greater than the trend seen within Canada, where 67% of RA cases had a strategic element. That being said, seven of the 10 (70%) international RA cases feature the assessment of cumulative environmental effects, whereas 88% of Canadian cases included a cumulative effects assessment component. Seven of the international RA initiatives (70%) featured both strategic and cumulative effects assessment. This was slightly higher than the trend seen in Canada: 57% of RA cases there were both strategic and focused on cumulative effects. One international case was neither strategic nor cumulative: The Strategic Environmental Assessment of the Selous Games Reserve in Tanzania. Although this RA was one of 21 world heritage site SEAs called for by the United Nations World Heritage Committee, the response document issued by the Tanzanian government emphasizes efforts to implement a range of regional conservation strategies, assess the status of wildlife and ecosystems in the park, and undertake future planning and assessment activities including a strategic environmental assessment of the entire landscape (Tanzania National Commission for UNESCO 2019).

With respect to who is leading international RA initiatives, proponents are typically an industry, national government, or an international government organization. United Nations involvement in RA seems to be strong, either spearheading or prompting $n=3$ (30%) of the cases sampled. With respect to the sectoral focus, the international cases were fairly evenly distributed with three coming from the marine/coastal area planning sectors; three from the oil and gas sector; two from the land use planning sector; and two focused on multi-sector sustainability.

Methodologically, typically a mixed methods approach is used which is unsurprising given the vast scope of the work involved in each assessment. Public engagement is the most commonly used method among the 10 cases ($n=8$ or 80%). This mirrors the trend in Canada: public engagement was also the most commonly used method in RA there.

Perhaps the most interesting observation of international RA cases is how different they are from one another: they have vastly different motivations and goals, and their scope can also be radically different. For example, the Programmatic Environmental Assessment of a rural energy program in Georgia (Eurasia) spear-headed by the United States Agency International Development (USAID 2006: 1) was triggered by regulations (22 CFR 216) and was done to assess the potential environmental impacts of an investment and development program in “a wide variety of energy interventions over a fairly sizeable and diverse territory” in the country of Georgia. The assessment was conducted over a period of seven months and the goal was to gain efficient clearance for planned rural energy projects. By contrast, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) ‘Regional Assessment Report on Biodiversity and Ecosystem Services for Africa’ was an assessment carried out by 127 experts that “analyzes the direct and underlying causes for the observed changes in biodiversity and nature’s contribution to people, and the impact that these changes have on the quality of life of people” (IPBES 2018: iv). The assessment addresses terrestrial, freshwater, and coastal biodiversity and covers current status and trends, going back in time several decades, and future projections with a focus on the 2020-2050 period” (p. iv). The intent is to support decisions at the local, regional, and international levels on an on-going basis. The UNEP GEO-6 RA for North America is similar: it is a wide-ranging, future-focused effort by dozens of leading scientists, policy-makers and other stakeholders to summarize the state of the environment in North America, characterize both trends and mega-trends underlying rapid changes and identify priority issues and actions (UNEP 2016).

Large scale RAs are being undertaken to facilitate nationally important industries as well. For example, the navigational assessment of the Outer Thames Estuary region was carried out for the Thames Estuary Dredging Association as part of the overall Marine Aggregate Regional Environmental Assessment (MAREA). This was a private, voluntary initiative endorsed by the British Marine Aggregate Producers Association, the Crown Estate and the Marine Management Organisation (MarineSpace 2010-2020). The goal was to identify navigational risks and cumulative impacts posed by dredging activities and inform individual dredging companies preparing license applications. The Western Greenland Sea Strategic Environmental Assessment of Hydrocarbon Activities was carried out by the Danish Centre for Environment and Energy and financed by the Greenland Government Bureau of Minerals and Petroleum. Here the goal was to explore the cumulative impacts of activities related to exploration, development and exploitation of oil in the Greenland Sea off the northeast coast of Greenland, including the impacts of climate change on the arctic marine environment and interactions between climate change and contaminants (Boertmann and Mosbech 2012). Similarly, the ‘Scientific Inquiry Into Hydraulic Fracturing of Onshore Unconventional Reservoirs and Associated Activities in the Northern Territory’ was undertaken to determine whether the nature and extent of risks to the environment (aquatic, terrestrial, atmospheric) and the social, cultural and economic conditions of the Northern Territory in Australia could be mitigated to an acceptable level (SIHFNT 2018).

Other international RAs were directed toward ensuring the long-term protection of internationally significant natural areas. Both the Strategic Environmental Assessment of the Selous Game Reserve in Tanzania and the Great Barrier Reef Strategic Environmental Assessment (2050 Long-Term Sustainability Plan and 2050 Water Quality Improvement Plan) were undertaken by federal and state governments in response to requests to do so by the United Nations World Heritage Committee. The Selous Game Reserve and the Great Barrier Reef are both properties on the World Heritage List. As with the Canadian cases, in-depth exploration of these initiatives and the many others not described in this report is warranted to gain a better understanding of the scope of international RA practice and its myriad benefits to proponents and stakeholders. The diversity and ambition of all RA cases examined, coupled with the rising incidence of practice is strongly indicative of perceived, substantive benefits.

4.2 Analysis of Regional Assessment Literature

We identified 64 academic articles on RA published since 2000. These are representative of a wide variety of development sectors and scientific fields of study (see Table 2).

Table 2. Academic articles on RA according to development sector or scientific field

Development sector/Scientific field	Author(s)
Energy – oil and gas, arctic offshore (n=4)	Fidler and Noble (2013 a,b); Voutier et al. (2008); Horvath and Barnes 2004
Energy – electricity, various sources including solar, wind, tidal, hydro-electric (n=5)	Marshall and Fischer (2006); Jenniches and Worrell (2019); Bastos et al. (2016); Doelle (2009); Sinclair et al. (2017)
Land use planning (including urban) (n=19)	DeMontis et al. (2014); Galler et al. (2016); Helbron et al. (2011); Hill and Lowe (2007); Jackson and Curry (2002); Johnson et al., (2011); Kirchoff et al., (2011); Knaus et al. (2006); Noble (2008); Ogiwara et al. (2016); Onate et al. (2003); Elling (2000); Kooiman and Keshkamat (2012) ; Meng et al. (2014) ; Wei et al. (2020) ;

	Hanusch and Glasson (2008); do Nascimento Nadruz et al. (2018); Zhu and Ru (2008); Weber et al. (2012)
Marine/Ocean studies (n=1)	King and Pushchak (2008)
Mining (n=3)	Atlin and Gibson (2017); Franks et al. (2010); Cavalcanti and La Rovere (2011)
Multiple sectors (cross-cutting) (n=11)	Elling (2000); Beaussier et al. (2019); Cremades et al. (2019); Cronmiller and Noble (2018); Gunn and Noble (2009 a,b); Gunn and Noble (2011); Johnson et al. (2016); Connelly (2011); Gibson et al. (2016); Therivel and Ross (2007)
Watershed management (n=6)	Arnold et al. (2019); Dubé (2003); Macpherson et al. (2010); Macpherson et al. (2013); Wong et al. (2019); Bojorquez-Tapia et al. (2011);
Conservation, biodiversity, wildlife habitat, wetlands (n=4)	Brooks et al. (2016); Diaz et al. (2001); Mortberg et al. (2007); Herlihy et al. (2019)
Policy, governance, regulation (n=9)	Braun (2008); Cooper (2011); Davey et al. (2002); Noble (2005); Olagunju and Gunn (2016a,b); Olagunju and Blakley (2017); Noble and Harriman (2008); Sinclair et al. (2016)
Transportation (n=1)	McGimpsey and Morgan (2013)
Airshed/Atmosphere (n=1)	Chen et al. (2018)
Forestry (n=1)	Johnson et al. (2016)

The greatest proportion of the articles (n=19; 30%) is focused on land-use planning. Water is another prominent topic in RA, with n=11 papers (17%) focused on marine/ocean studies, watershed management and wetland management. An equal number of papers focus on as multi-sectoral development (n=11, 17%). Several RA papers take policy, government and regulation as a focal point (n=9, 14%). Nine papers (14%) focus on the energy sector including oil and gas and renewables such as solar and wind. There is comparatively little RA research focused on mining (n=3); transportation (n=1), the airshed/atmosphere (n=1) or forestry (n=1).

Of the 64 academic articles, n=12 (19%) are case specific evaluations or case comparisons [i.e., Arnold, et al. (2019); Gunn and Noble (2009b); Hanusch and Glasson (2008); Hill and Lowe (2007); Jenniches and Worrell (2019); Marshall and Fischer (2006); McGimpsey and Morgan (2013); Noble (2008); Olagunju and Blakley (2017); Onate et al. (2003); Doelle (2009); Sinclair et al. (2017)]. Regional assessment cases in Canada and internationally over the past 20 years therefore appear to be seldom reported or analyzed in academic literature, considering we have identified at least 52 cases. This is likely due in part to the applied rather than academic or theoretical nature of RA and the absence of an imperative among those closest to the RA initiatives to publish in peer-reviewed journals. It is likely also because a majority of RA initiatives, in Canada at least, are very new and implementation is still in early stages for the majority of cases. In addition to case-specific evaluations and case comparisons, the RA literature also features the following identifiable themes:

- concept and framework development (e.g. Dube 2003; Harriman-Gunn and Noble 2008; Gunn and Noble 2009a; Noble 2005; Noble and Harriman 2008; Gibson et al. 2016; Therivel and Ross 2007; Sinclair et al. 2017);
- integration of principles in RA (e.g. Cremades, et al. 2019) including sustainability principles (e.g. Atlin and Gibson 2017);

- integrating RA with policies and plans or planning processes (e.g. Braun 2008; DeMontis 2014; do Nascimento Nadruz et al. 2018; Elling 2000; Galler et al. 2016; Jackson and Curry 2002; Kirchoff et al. 2011; Olagunju 2016 a,b; Zhu and Ru 2008);
- promising methodologies, tools and techniques (e.g. Beaussier et al. 2019; Bastos et al. 2016; Bojorquez et al. 2011; Brooks, et al. 2016; Diaz et al. 2011; Helbron et al. 2011; Knaus et al. 2006; Macpherson et al. 2010; Macpherson et al. 2013; Meng et al. 2014; Mortberg et al. 2007; Wei et al. 2020), especially for cumulative effects assessment (e.g. Johnson et al. 2011; King and Pushchak 2008; Cavalcanti and Rovere 2011; Wong et al. 2019; Weber et al. 2012);
- implementation challenges (e.g. Fidler and Noble 2013a; Gunn and Noble 2011; Herlihy et al. 2019; Kooiman and Keshkamat 2012), including stakeholder engagement (e.g. Fidler and Noble 2013b; Ogihara et al. 2016; Connelly 2011); and
- application of regional-scale, strategic environmental assessment to tidal energy and oil and gas development programmes (Horvath and Barnes 2004; Doelle 2009).

A keyword search of the 64 academic articles revealed that very few RA papers touch on topics emphasized in the Canadian *IAA 2019* including: climate change; gender; equity and fairness; trade-offs; Indigenous and northern (see Table 3). These kinds of topics are considered important to the future evolution of impact assessment both in Canada and internationally (Gibson et al. 2016) and are germane to RA practice. Table 3 shows that there are few references to ‘gender’ or ‘equity’ in RA literature published in the past 20 years, but a small number of articles do address the subjects of ‘fairness’, ‘climate change’, ‘Indigenous’, ‘trade-offs’ and ‘northern’ issues, nonetheless.

Table 3. Academic articles on RA addressing issues of importance in the *Canadian Impact Assessment Act, 2019*

Key word	Author(s)
Climate change (n=6)	Cremades et al., (2019); do Nascimento Nadruz et al. (2018); Helbron et al. (2011); Johnson et al. (2016); Doelle (2009); Therivel and Ross (2007)
Gender (n=1)	Johnson et al. (2016)
Equity (n=3)	Johnson et al. (2016); Gibson et al. (2016); Weber et al. (2012)
Fairness (n= 6)	Atlin and Gibson (2017); Herlihy et al. (2019); Johnson et al. (2016); Olagunju and Gunn (2016 a,b); Gibson et al. (2016)
Trade-offs (n=5)	Cremades et al. (2019); Galler et al. (2016); Johnson et al. (2016); Gibson et al. (2016); Weber et al. (2012)
Indigenous (n=6)	Johnson et al. (2016); Atlin and Gibson (2017); Fidler and Noble (2013 a,b); Arnold et al. (2019); Therivel and Ross (2007)
Northern (n=4)	Johnson et al. (2016); Voutier et al. (2008); Bastos et al. (2016); Weber et al. (2012)

Cremades et al. (2019) examined the topic ‘climate change’ in the context of integrating the water-energy-land nexus with climate considerations to guide decision and policy-making for planning and management of natural resources. They stressed the importance of considering this nexus when assessing the impacts of climate change adaptation within and across diverse economic sectors given that trying to adapt a sector to climate change could have unintended and undesirable consequences across sectors and scales. Likewise, do Nascimento Nadruz et al. (2018) studied the integration of climate change objectives within the context of sectoral and regional planning. They highlighted the relevance of region-centered strategic environmental assessment (SEA) as a key instrument to reconcile climate change concerns in planning including the exploration of alternatives to respond to climate change policies. Their examination of regional/sectoral SEA practices in Brazil to ascertain the level of

integration of climate change perspectives in assessment processes revealed that the SEAs barely addressed climate change issues, particularly when assessed against the broader objectives of the country's National Policy of Climate Change (NPCC). They concluded that SEA can be effectively applied to address the gaps/inconsistencies between national climate policy objectives and the integration of climate change concerns in sectoral and regional policies and plans. Similarly, Helbron et al. (2011) examined the use of indicators in land use adaptation to climate change within SEA-based regional land use planning (SEA-REP). Importantly, they emphasized the role of SEA as a decision-support instrument that can contribute to the prevention of conflicts in climate change policies.

Olagunju and Gunn (2016) discussed the topic 'fairness' as a key attribute of effective cross-domain integration in RA, highlighting the importance of transparency, perceived openness, and fairness in engaging institutional actors across various domains, as well as in improving the overall quality of decision-making processes. Acknowledging the relevance of 'trade-offs' in sustainability decision-making, Cremades et al. (2019) also explained that decisions involving adaptation to climate change impacts must take into account potential trade-offs across economic sectors and societal goals, including across spatial and temporal scales. Galler et al. (2016) also referenced 'trade-offs' in the context of ecosystem services (ES), identifying that the ES concept can serve as a background to promote more harmonised consideration of trade-offs and multifunctionality in planning and governance processes.

In their article, Atlin and Gibson (2017) referenced the topic 'Indigenous' in the context of the cumulative impacts of mining developments on the livelihood of Indigenous communities, particularly with regard to the vulnerabilities and negative legacies that such developments inflict on Indigenous groups. Similarly, Arnold et al. (2017) highlighted the importance of community-based and Indigenous knowledge, including the challenges in effectively incorporating Indigenous knowledge in decision-making in cumulative effects assessment and regional assessments. Voutier et al. (2008) focused on approaches for enabling the sustainable development of 'northern' energy resources. Importantly, they note that efforts to incorporate environmental, economic, and social objectives in IA for northern energy development projects have often rendered decision-making and regulatory processes more ambiguous.

More broadly speaking, we were able to synthesize the following key messages from academic RA literature:

Recommendations for good practice:

- In order to facilitate more sustainable outcomes, regional-level planning and assessments should incorporate sustainability-led objectives that best align with public interest and concerns about development activities (Kirchhoff et al. 2011; Johnson et al. 2016; Atlin and Gibson 2017; Olagunju and Blakley 2017, and continually inform broader sustainability agendas and allow for strategy formulation at different scales (e.g. local Agenda 21) (Braun 2008; Cooper 2011; McGimpsey and Morgan 2013);
- The use of scenarios as a tool for visioning and planning is recommended to provide a wholistic picture of possibilities, risks and objectives regarding a range of development trajectories (Mortberg et al. 2007; Noble 2008; Cavalcanti and La Rovere 2011; Atlin and Gibson 2017);
- Evident openness, transparency, effective engagement, and impartiality are important attributes that can enhance the quality and validity of decisions in RA (Fidler and Noble 2013; De Montis et al.

2014; Olagunju and Gunn 2016; Johnson et al. 2016; Atlin and Gibson 2017). Emphasis should be on enhancing participatory planning, public participation, and institutional capacity building in the assessment process (Braun 2008; Kooiman and Keshkamat 2012; Olagunju and Gunn 2016);

- Many authors agree that RA can and should contribute to institutional capacity building (Braun 2008; Franks et al. 2010; McGimpsey and Morgan 2013; Brooks et al. 2016; Johnson et al. 2016; Olagunju and Gunn 2016; Olagunju and Blakley 2017), but there is limited evidence in the literature of how RA actually promotes institutional capacity building in practice (McGimpsey and Morgan 2013);
- Horizontal integration between management bodies, vertical integration from the strategic level and regional scale to the operational level and project scale, and an overarching vision to guide regional planning and development are three essentials of a more coordinated regional approach to planning for marine resources and offshore development (Johnson et al. 2011; Fidler and Noble 2013a; Brooks et al. 2016);
- Managing the cumulative impacts of developments at a regional scale will require more advanced CEA approaches including greater coordination and planning and multi-stakeholder monitoring (Dube 2003; Noble 2005; Franks et al. 2010; Arnold et al. 2019);
- Scholars are increasingly promoting distinct conceptualizations, methodologies, and approaches to RA to improve theory and practice. Some examples include: ecosystem services (ES) concept to spatial planning (Galler et al. 2016); conceptualizing RA as a ‘boundary object’ to facilitate knowledge sharing in complex multi-agency contexts (Bojorquez-Tapia et al. 2011); the data envelopment analysis (DEA) model to identify opportunities to improve environmental performance and enhance socio-economic outcomes in regional assessments (Macpherson et al. 2013); and Economic-Environment Integrated Models (EEIM) to perform ex ante economic and environmental assessment of policies at different scales (Beaussier et al. 2019); and
- Approaches and methodologies focused on GIS and spatial planning have increasingly received attention in the RA literature over the last decade (Bojorquez-Tapia et al. 2011; Kooiman and Keshkamat 2012; Bastos et al. 2016; Chen et al. 2018; Wei et al. 2020).

Potential outcomes of RA practice:

- Opportunities exist to advance good governance through collective visioning, innovative leadership, learning from failure, and collaborative science and management. Addressing policy gaps and enabling stronger government policy integration remains a key opportunity for RA-led regional planning (Johnson et al. 2011; Fidler and Noble, 2013b; De Montis et al. 2014; Galler et al. 2016; Olagunju and Gunn 2016; Ogihara et al. 2016; Olagunju and Blakley 2017);
- Opportunities exist to more effectively address socio-economic impacts through the integration of impact benefit agreements (IBA) proactively in the assessment process, with particular reference to how such agreements contribute to the regional goals and maximize economic benefits, prior to specific project-based negotiations (Fidler and Noble 2013);
- Regional assessment has the potential to address cumulative effects; cumulative effects knowledge can add value to the regulatory setting surrounding development approval processes (Noble 2008; Atlin and Gibson 2017; Arnold et al. 2019; Wong et al. 2019); and

- Opportunities exist to break down government and management ‘silos’ through RA, address the recurrent challenges of cross-domain integration, and advance the coordination of disparate institutional, disciplinary, and transactional imperatives and mandates (Olagunju and Gunn 2016; Atlin and Gibson 2017; Galler et al. 2016).

Barriers and challenges:

- There is noted skepticism about the value of scenario planning in uncertain decision contexts, difficulty in defining the scope of RA and cumulative effects assessment in certain contexts, and governance and coordination challenges stemming from jurisdictional fragmentation (Mortberg et al. 2007; Johnson et al, 2011; Fidler and Noble 2013b; De Montis et al. 2014; Olagunju and Blakley 2017);
- The legislative and regulatory context and politically sensitive nature of institutional and governance issues will likely continue to challenge RA efforts across economic sectors and scales (Fidler and Noble 2013 a,b; Olagunju and Gunn 2016; Atlin and Gibson 2017; Cronmiller and Noble 2017; Wong et al. 2019);
- Convincing decision-makers, who are often operating under considerable financial and time constraints, of the value of strategic level RAs remains difficult particularly in non-mandatory settings (McGimpsey and Morgan 2013; Cronmiller and Noble 2017; Johnson et al. 2016);
- “Numerous difficulties await those creating regional-scale environmental assessments, from data having inconsistent spatial or temporal scales to poorly-understood environmental processes and indicators” (Macpherson et al. 2010: 1918; Macpherson et al. 2013; Brooks et al. 2016); and
- Integration of climate change concerns in RA is a growing area of work requiring more attention, particularly in the Canadian context (Helbron et al. 2011; do Nascimento Nadruz et al. 2018; Cremades et al. 2019).

4.3 Research Strengths and Gaps

After examining both the academic literature and the 52 cases of RA, we were able to characterize research strengths and gaps. Some of the points below come directly from sources examined and some from our synthesis of the evidence. Notably, the body of academic literature is not yet large enough to have developed many discernable strengths.

Research strengths:

- Regional assessment academic literature is fairly well-developed with respect to establishing expected principles, aims and expected methodological components of RA. This particular area of scholarship shows signs of beginning to mature. Approaches to regional planning and impact assessment processes have evolved positively in certain jurisdictions toward more strategic, long-term, participative, integrated and tiered approach, reflecting a commitment to sustainability (Kirchoff et al. 2011). Based on the evidence examined herein, it also appears that the emphasis of regional-scale assessment has gradually shifted away from simply facilitating project approval toward also addressing key issues of governance, a focus on institutional capacity building including relationship building across institutions, socio-political dimensions, innovation and collaborative science and management;

- The argument that RA is critical to support decision-making related to sustainable development is well established;
- The potentially fruitful relationship of RA and cumulative effects assessment is widely recognized;
- The need for 'tiering' or connection of RA to other 'upstream' and 'downstream' planning and assessment processes including impact and benefit agreements has been determined, as has the need for RA to influence or streamline project environmental-impact assessment;
- The potential benefits of regional assessment beyond informing project-based impact assessment are also widely discussed in the literature and extend to such elements as institutional development and capacity building; improved coordination and cooperation for environmental management and monitoring; improved governance; and so on.

Research gaps:

- In general, the academic literature on RA is currently quite divorced from the practice record;
- Despite increased calls from scholars to foster more effective RA practices, there is a dearth of studies that seek to derive lessons from past and current RA practice to help advance RA concept and practice and learn from experience. There are very case studies of RA and even fewer multi-case comparative analyses even though dozens of RAs have been completed;
- There is a need to clearly understand how RA as a 'boundary object' facilitates knowledge sharing in complex and challenging multi-agency contexts. Specifically, there is a need to understand how the concept of environmental ontologies enables effective communication between knowledge producers (scientists) and (policymakers) (Bojorquez-Tapia et al. 2011);
- Further research is needed to understand the specific, tangible value-added benefits of tiered regional and project planning and assessments where such tiering exists, and to understand how RA contributes to planning for positive legacies and sustainable futures (Atlin and Gibson, 2017; Johnson et al. 2016);
- There is a lack of research addressing best practices to both understand and address the socio-political and institutional capacity dimensions of RA initiatives;
- There is a need to better understand the ways in which certain institutional arrangements affect the advancement and implementation of RA (Fidler and Noble 2013b);
- There is a need to clarify the potential benefits of scenario analysis in RA: the literature both promotes scenario analysis and warns against its utility in certain planning contexts. Examination of the Canadian cases shows that use of scenario analysis is not particularly common in RA;
- There is a need to better connect RA scholarship to issues of topical importance in Canadian impact assessment including Indigenous and northern issues; equity, fairness, and 'trade-offs', and so on;
- Given their importance to sustainable development on a global scale, climate change issues are still not often addressed in RA literature (Nadruz et al. 2018); and
- Given the small number of in-depth case analyses in the RA literature, it is difficult to derive 'lessons' or 'best practices' from the literature at this stage. This work remains to be done via rigorous case studies.

5.0 Implications

“Decision-makers need input from researchers on issues involving science and society” (Rosen 2018: 671). Arguably, RA will serve as an important nexus of science and society in the coming years. This section explores several implications of our research for Canadian environmental policy and RA practice.

5.1 Environmental Policy

- Lessons learned from previous RA practice in Canada should be used to assist in developing practitioner guidance for RA conducted under the *IAA 2019*.
- The federal government should clearly communicate what RA conducted under the *IAA 2019* is meant to achieve with respect to influencing project-based IAs. RA practice is diverse and any connections or benefits it may have to regulatory IA should not be assumed.
- The federal government should articulate clear goals and expectations for cumulative effects assessment exercises performed as part of RAs initiated under the *IAA 2019*, including expectations for assessment of climate, northern, Indigenous, and other key issues, and specify how regional-scale assessment of such differs from project-based cumulative effects assessment as defined in the *Act*.
- Federal and provincial governments should take under advisement the results of existing RA reports (including relevant international RAs in Canadian jurisdictions) when embarking on future environmental planning and management initiatives that apply to the same regions.
- Federal and provincial governments should explore ways to support and leverage RA initiatives to advance environmental science and policy making. For example, regional assessment processes should be used as an incubator for novel research studies and subsequent environmental management experiments. Regional assessments can potentially contribute much to the study of ecological thresholds, limits and tipping points and social-ecological system resilience which are all key to sustainability development.
- Proponents of RA should be encouraged by policymakers to address climate change, food security and water security considerations in their practice as urgent matters facing the international policy making community.
- Policymakers should strive to use the scientific and community knowledge generated in RA to better address social issues, particularly in the RA environment and particularly for Indigenous communities affected by industrial development.
- Policymakers should recognize that any RA initiative is a long-term investment that with proper scaffolding, including robust communication and open data protocols, can benefit regional development and environmental protection efforts in myriad ways for decades to come.

5.2 Regional Assessment Practice

- In Canada, Indigenous experiences must be “understood as a series of situated and grounded experiences of colonialism and capitalist production” (Rossiter and Wood 2005: 351). Regional assessment is therefore an opportunity to strengthen relationships and build mutual understanding, and should be used to avoid over-commitment to mega-projects at an early stage (Flyvbjerg 2014);
- Because science underpins good policy but rarely defines it, RA practitioners should strive to connect broadly and early with policy- and decision-makers, including both staff members at

government agencies who implement policy and lawmakers and members of the executive branches of government to enact policy change.

- To increase the policy impact of their work, proponents of RA must strive to provide clear and concise summaries of existing scientific evidence, in accessible language, to help policy makers understand decision and management options. Science communication must be attuned to the 'bigger picture' (the political and economic context) and the specific needs, capabilities, motivations, and opportunities of decision-makers.
- Proponents of RA should continue to make final reports easily accessible in the public domain
- Blogging and using social media will help to externalize the benefits of RA by synthesizing key messages that may be important to the public, and well as invite broader public engagement.
- The RA practice community in Canada is sufficiently large to support regular national conferences to support mutual learning. Internationally, special sessions of the annual conference of the *International Association of Impact Assessment* (and similar venues such as *International Symposium on Society and Resource Management*) should be held to spotlight the achievements of RA practitioners and highlight their needs.

6.0 Conclusion

The purpose of this study was to characterize RA practice in Canada and internationally and identify some of the emerging good practices that can render RA as helpful as possible to decision-making about natural resources development and conservation. Specifically, our aims were to investigate key characteristics of RA practice; promising methods, tools and approaches commonly used; and lessons, opportunities and challenges, as well as critical knowledge gaps in research and practice. The full scope of RA practice in Canada and internationally, past present and future, is difficult to gauge, in part due to (i) the multiple forms that RA takes as a policy, plan, or programme development exercises or as ongoing partnerships; (ii) the fact that that very often, they are not labelled as 'regional assessments'; (ii) the large number of potential cases; and (iii) the fact that some RA reports are internal or proprietary documents and not publicly available. However, based on our review of 164 academic papers and 52 case documents, we are able to conclude that:

- In general, we find that the academic literature is quite divorced from the RA practice record and that there is a significant gap in reporting and analyzing case experiences, especially for early attempts at RA which were completed up to 20 years ago or more;
- Elective or voluntary RA practice is already widespread in Canada and likely around the world as well. It does not *need* to be mandated through legislation or regulation, although it can be, and is in certain jurisdictions;
- Regional assessments are being conducted by a broad range of proponents from international development agencies and fund managers, to national, state and provincial governments, to industry organizations, to research science and policy consortiums acting in a non-profit capacity; to Indigenous governments, nations and Indian bands;
- That said, RA practice appears to be relatively new: nearly three-quarters of the Canadian RA final reports we studied were released within the last 5-10 years. This trend is echoed internationally. As a concept, RA has enjoyed widespread academic support for decades and this is now translating into a robust, though young, body of practice;

- At present, it is likely possible to identify the inputs of an RA exercise (impetus, goals, scope, valued components, inputs/resources, assessment activities, assumptions and uncertainties, audience, and so on) for many cases, as well as the immediate outputs in terms of case documentation (including scoping reports, draft and final reports, action plans, public commentary on the reports, and so on). However, for the vast majority of cases it is likely too early to be able to verify predictions, or determine outcomes (either short-, mid- or long-term, expressed as changes in knowledge, awareness, practices, or conditions);
- It is also too early in the majority of cases to determine what key external factors, if any, will ultimately facilitate or hinder the implementation or success of a given RA initiative;
- Approximately nine in 10 Canadian RA cases include cumulative effects assessment as a core component, but more than one third of RA cases do not have a strategic component. A little more than half of RA cases combine both cumulative and strategic assessment. Thus, cumulative effects assessment is central to RA practice, although building in a strategic element to the assessment is not necessarily;
- Methods, tools and approaches most commonly used in RA are similar to those for other forms of impact assessment and include public engagement, incorporation of Traditional Knowledge, modelling, GIS and expert evaluation. Scenario analysis is not as commonly used;
- It would be premature given the small number of in-depth cases analyses within academic literature and the early state of RA outcomes in many instances, to attempt to judge what RA can or cannot realistically accomplish at present;
- Clearly, the diversity, ambition, and momentum displayed among all RA cases examined, coupled with rising incidents of practice in Canada and elsewhere, is strongly indicative of widespread belief in substantive procedural and transactive benefits.

The results of this project and subsequent academic publications will potentially lead to more effective RA design and implementation by increasing knowledge about what it is, what it is being used for, and the myriad possibilities for design and implementation. In Canada, defining good practices for RA is essential as the Canadian Environmental Assessment Agency pursues RA pilot projects in the north, the Ontario government begins RA for the 'Ring of Fire mineral belt', the Manitoba government undertakes a review of decision-making related to hydro-electric project development in the Nelson River watershed, and so on.

6.1 Future Areas of Research

There are several recommended next steps to advance global and Canadian knowledge about RA:

- Further meta-analysis of the RA cases to determine additional characteristics including spatial extent of assessment areas, which valued components have been selected as focal points for the assessment, temporal scope of impact analyses, etc.;
- In-depth comparison of RA cases within the same sector (e.g. energy, marine/ocean studies, land use planning, and so on) to determine best practices that could lead to more efficient and effective RA and achieve desired outcomes within that sector;
- In-depth comparison of RA cases where timing is urgent and global significance is high, and conversely, in lesser known/more regional and remote resource management contexts in funding constrained environments where available guidance and leadership capacity is poor;

- In-depth analysis of earlier completed cases of RA such as the Kyoquot Sound Coastal Plan (2003) and the Johnstone-Bute Coastal Plan (2004) in British Columbia; the Cumulative Effects Assessment of the North Saskatchewan River Watershed (2009) in Saskatchewan; the North Yukon Regional Land Use Plan (2009) in Yukon Territory; and the Keewatin Regional Land Use Plan (2000) in Nunuvut. It may be possible in these cases to determine not only outputs but short-, mid-, and long-term outcomes and implementation challenges;
- In-depth comparison of specific methods, tools and approaches used to assess impacts to particular valued components in RA. This will help to illuminate best practices for determining impacts to species at risk, keystone species, and other priority environmental, cultural and social components of common concern;
- Connection of RA to policy and governance mechanisms in implementation phases; and
- The best means of creating and maintaining regional databases for ongoing use in the process of monitoring, adaptive management and public engagement.

7.0 Knowledge Mobilization Activities

Electronic and Social Media Distribution

A key objective of our project is to develop knowledge that is of direct benefit to policymakers and practitioners in Canada and internationally. We intend to reach both academic and non-academic audiences by adjusting our formats, language, and emphasis on infographics as needed to facilitate straightforward transfer of knowledge. A combination of internet-based information distribution (e.g. Impact Assessment Associations' newsletters and message boards; the team's project and university-based websites, Twitter) and placement of key messages in industry, government, and public venues such as *Conservation Canada* and *Horizons* are planned throughout 2020 to help disseminate the results broadly to practitioner, policy, and non-government audiences. Additionally, we plan to disseminate select project results to the media and interested organizations via the project website and other online channels.

Peer-Reviewed Journal Articles

Later in 2020, we will submit multiple peer-reviewed manuscripts to internationally renowned Open Access journals such as *Environmental Impact Assessment Review*, the *Journal of Environmental Assessment, Policy and Management*, and *Society and Natural Resources*.

Student Involvement & Conference Presentations

Three student research assistants received high quality training and mentorship through this project. The research and teamwork skills they've gained, particularly with regard to qualitative data analysis, are relevant for both academic and private/public sector career paths. Students will present select research results at the Ontario Association for Impact Assessment annual conference in the fall of 2020, or a similar venue.

Webinar

We will disseminate our final research results to colleagues via webinar in late 2020. The goal is to facilitate cross-sectoral, bi-national conversation about the ongoing challenges, promising practices, and

knowledge needs in RA. The webinar will facilitate both information transfer and relationship building among participants and encourage continued knowledge synthesis and exchange beyond the life of the grant.

Literature Cited

- Arnold, L., Hanna, K., & Noble, B. (2019). Freshwater cumulative effects and environmental assessment in the Mackenzie Valley, Northwest Territories: Challenges and decision-maker needs. *Impact Assessment and Project Appraisal*, 37(6): 516–525. <https://doi.org/10.1080/14615517.2019.1596596>
- Atlin, C., & Gibson, R. (2017). Lasting regional gains from non-renewable resource extraction: The role of sustainability-based cumulative effects assessment and regional planning for mining development in Canada. *Extractive Industries and Society*, 4(1): 36–52. <http://doi.org/10.1016/j.exis.2017.01.005>
- Bastos, R., Pinhanços, A., Santos, M., Fernandes, R., Vicente, J., Morinha, F., ... Cabral, J. (2016). Evaluating the regional cumulative impact of wind farms on birds: How can spatially explicit dynamic modelling improve impact assessments and monitoring? *Journal of Applied Ecology*, 53(5): 1330–1340. <http://doi.org/10.1111/1365-2664.12451>
- Beaussier, T., Cauria, S., Bellon-Maurel, V., & Loiseau, E. (2019). Coupling economic models and environmental assessment methods to support regional policies: A critical review. *Journal of Cleaner Production*, 216: 408-421 <https://doi.org.cyber.usask.ca/10.1016/j.jclepro.2019.01.020>
- Bojorquez-Tapia, L., Luna-Gonzalez, L., Cruz-Bello, G., Gomes-Priego, P., Juarez-Marusch, L., & Rosas-Perez, I. (2011). Regional environmental assessment for multiagency policy-making: Implementing an environmental ontology through GIS-MCDA. *Environment & Planning, B: Planning & Design*, 38(3): 539-563. <https://doi.org.cyber.usask.ca/10.1068/b36129>
- Braun, R. (2008). Regional environmental assessment (REA) and local Agenda 21 implementation. *Environment Development and Sustainability*, 10: 19–39. <https://doi.org/10.1007/s10668-006-9036-5>
- Brooks, T., Akçakaya, H., Burgess, N., Butchart, S., Hilton-Taylor, C., Hoffmann, M., ... Young, B. (2016). Analysing biodiversity and conservation knowledge products to support regional environmental assessments. *Scientific Data*, 3:(160007) <https://doi.org/10.1038/sdata.2016.7>
- Cavalcanti, P. & Lèbre La Rovere, E. (2011). Strategic environmental assessment of mining activities: A methodology for quantification of cumulative impacts on the air quality. *Journal of the Air & Waste Management Association*, 61(4): 377-389. <https://doi.org/10.3155/1047-3289.61.4.377>
- Canadian Council of Ministers of the Environment (CCME). (2009). Regional strategic environmental assessment in Canada: Principles and guidance. Winnipeg, MB. https://www.ccme.ca/files/Resources/enviro_assessment/rsea_principles_guidance_e.pdf
- Chen, X., Zhang, Y., Wang, Y., Yu, Q., & Ma, W. (2018). The spatial-scale effect of an atmospheric environmental impact assessment in regional strategic environmental assessment (R-SEA). *Environmental Modeling & Assessment*, 23(5): 529-556. <https://doi.org/10.1007/s10666-018-9590-x>
- Clarke Murray, C., Mach, M., & Martone, R. (2014). Cumulative effects in marine ecosystems: Scientific perspectives on its challenges and solutions. WWF-Canada and Center For Ocean Solutions.
- Connelly, R. (2011). Canadian and international EIA frameworks as they apply to cumulative effects. *Environmental Impact Assessment Review*, 31(5): 453-456. <https://doi.org/10.1016/j.eiar.2011.01.007>
- Cooper, M. (2011). CEA in policies and plans: UK case studies. *Environmental Impact Assessment Review*, 31(5): 465-480. <https://doi.org.cyber.usask.ca/10.1016/j.eiar.2011.01.009>

- Cremades, R., Mitter, H., Todose, N., Sanches-Plaza, A., Graves, A. Broekman, A., ...Marin, M. (2019). Ten principles to integrate the water-energy-land nexus with climate services for co-producing local and regional environmental assessments. *Science of the Total Environment*, 693, (n.p).
<https://doi.org/10.1016/j.scitotenv.2019.133662>
- Cronmiller, J., & Noble, B. (2018). Integrating environmental monitoring with cumulative effects management and decision making. *Integrated Environmental Assessment and Management*, 14(3): 407–417. <https://doi.org/10.1002/ieam.4034>
- Davey, L., Barnes, J., Horvath, C. and Griffiths, A. (2002). Addressing cumulative effects III: Sectoral and regional environmental assessment. In: *Cumulative Effects Management Tools and Approaches*, Edited by Kennedy, A. Edmonton, AB: Alberta Society of Professional Biologists.
- DeMontis, A., Ledda, A., Caschili, S., Ganciu, A., & Barra, M. (2014). SEA effectiveness for landscape and master planning: An investigation in Sardinia. *Environmental Impact Assessment Review*, 47(1): 1-13. <https://doi.org/10.1016/j.eiar.2014.03.002>
- Díaz, M., Illera, J., & Hedo, D. (2001). Strategic environmental assessment of plans and programs: A methodology for estimating effects on biodiversity. *Environmental Management*, 28(2): 267-279. <https://doi.org/10.1007/s0026702412>
- Doelle, M. (2009). Role of Strategic environmental assessments in energy governance: A case study of tidal energy in Nova Scotia's Bay of Fundy. *Journal of Energy & Natural Resources Law*, 27(2): 112-144. <https://doi.org/10.1080/02646811.2009.11435210>
- do Nascimento Nadruz, V., Lucia Casteli Figueiredo Gallardo, A., Montañó, M., Ramos, H., & Ruiz, M. (2018). Identifying the missing link between climate change policies and sectoral/regional planning supported by strategic environmental assessment in emergent economies: Lessons from Brazil. *Renewable & Sustainable Energy Reviews*, 88: 46–53. <https://doi.org.cyber.usask.ca/10.1016/j.rser.2018.02.006>
- Dubé, M. (2003). Cumulative effect assessment in Canada: A regional framework for aquatic ecosystems. *Environmental Impact Assessment Review*, 23(6): 723–745. [https://doi.org/10.1016/S0195-9255\(03\)00113-6](https://doi.org/10.1016/S0195-9255(03)00113-6)
- Elling, B. (2000). Integration of strategic environmental assessment into regional spatial planning. *Impact Assessment and Project Appraisal*, 18(3): 233–243. <https://doi.org/10.3152/147154600781767367>
- Expert Panel. (2007). Building Common Ground: A New Vision for Impact Assessment in Canada: The Final Report of the Expert Panel for the Review of Environmental Assessment Processes. Her Majesty the Queen in Right of Canada, as represented by the Minister of Environment and Climate Change. Retrieved from:
<https://www.canada.ca/en/services/environment/conservation/assessments/environmental-reviews/environmental-assessment-processes/building-common-ground.html>
- Fidler, C., & Noble, B. (2013a). Advancing regional strategic environmental assessment in Canada's western arctic: Implementation opportunities and challenges. *Journal of Environmental Assessment Policy and Management*, 15(1): 1-27. <https://doi.org/10.1142/S1464333213500075>
- Fidler, C., & Noble, B. (2013b). Stakeholder perceptions of current planning, assessment and science initiatives in Canada's Beaufort Sea. *Arctic*, 66(2): 179-190. <https://doi.org/10.14430/arctic4289>
- Fischer, T. (2003). Strategic environmental assessment in post-modern times. *Environmental Impact Assessment Review*, 23: 155-170. [https://doi.org/10.1016/S0195-9255\(02\)00094-X](https://doi.org/10.1016/S0195-9255(02)00094-X)
- Flyvbjerg, B., (2014). What you should know about mega-projects and why: An overview. *Project Management Journal*, 45(2): 6-19.
- Franks, D., Brereton, D., & Moran, C. (2010). Managing the cumulative impacts of coal mining on regional communities and environments in Australia. *Impact Assessment and Project Appraisal*, 28(4): 299–312. <https://doi.org/10.3152/146155110X12838715793129>

- Galler, C., Albert, C., & von Haaren, C. (2016). From regional environmental planning to implementation: Paths and challenges of integrating ecosystem services. *Ecosystem Services*, 18: 118–129. <https://doi.org/10.1016/j.ecoser.2016.02.031>
- Gibson, R., Doelle, M., & Sinclair, J. (2016). Fulfilling the promise: Basic components of next generation impact assessment. [Monograph] Retrieved from: https://uwaterloo.ca/next-generation-environmental-assessment/sites/ca.next-generation-environmental-assessment/files/uploads/files/gibsondoellesinclair_nextgenea_monograph_3aug16.pdf
- Gunn, J. & Noble, B. (2009a). A conceptual basis and methodological framework for regional strategic environmental assessment (R-SEA). *Impact Assessment and Project Appraisal*, 27(4): 258-270. <https://doi.org/10.3152/146155109X479440>
- Gunn, J., & Noble, B. (2009b) Integrating cumulative effects in regional strategic environmental assessment frameworks: Lessons from practice. *Journal of Environmental Assessment Policy and Management*, 11(3): 1-24. <https://doi.org/10.1142/S1464333209003361>
- Gunn, J., & Noble, B. (2011). Conceptual and methodological challenges to integrating SEA and cumulative effects assessment. *Environmental Impact Assessment Review*, 31(2): 154–160. <https://doi.org/10.1016/j.eiar.2009.12.003>
- Government of Canada. (2019). Overview of Canada’s responses to the World Heritage Committee decisions regarding Wood Buffalo National Park World Heritage Site. https://www.pc.gc.ca/en/pn-np/nt/woodbuffalo/info/action/SEA_EES
- Hanusch, M., & Glasson, J., (2008). Much ado about SEA/SA monitoring: The performance of English regional spatial strategies, and some German comparisons. *Environmental Impact Assessment Review*, 28(8): 601-617. <https://doi.org/10.1016/j.eiar.2007.12.001>
- Harriman-Gunn, J., and Noble, B. (2008). Characterizing project and strategic approaches to regional cumulative effects assessment in Canada. *Journal of Environmental Policy Assessment and Management*, 10(1): 25-50. <https://doi.org/10.1142/S1464333208002944>
- Helbron, H., Schmidt, M., Glasson, J., & Downes, N. (2011). Indicators for strategic environmental assessment in regional land use planning to assess conflicts with adaptation to global climate change. *Ecological Indicators*, 11(1): 90–95. <https://doi.org/10.1016/j.ecolind.2009.06.016>
- Herlihy, A., Kentula, M., Magee, T., Lomnický, G., Nahlik, A., & Serenbetz, G. (2019). Striving for consistency in the National Wetland Condition Assessment: Developing a reference condition approach for assessing wetlands at a continental scale. *Environmental Monitoring and Assessment*, 191(1): 327. <https://doi.org/10.1007/s10661-019-7325-3>
- Hill, E., & Lowe, J. (2007) Regional impact assessment: an Australian example. *Impact Assessment and Project Appraisal*, 25(3): 189-197. <https://doi.org/10.3152/146155107X217307>
- Horvath, C., & Barnes, J. (2004). Applying a regional strategic environmental assessment approach to the management of offshore oil and gas development. In *24th Annual Conference of the International Association of Impact Assessment, Calgary*. Retrieved from: https://www.iaia.org/pdf/IAIAMemberDocuments/Publications/Conference_Materials/IAIA04/PapersPDF/SN3.5-Barnes-Applying%20a%20Regional%20SEA%20Approach%20to%20the%20Management%20of%20Offshore%20Oil%20and%20Gas.pdf
- Hunsaker, C. (1989). *Ecosystem assessment methods for cumulative effects at the regional scale* (No. CONF-891098--11). Oak Ridge National Lab. RN:24000773.
- Jackson, T., & Curry, J. (2002). Regional development and land use planning in rural British Columbia: Peace in the woods? *Regional Studies*, 36(4): 439–443. <https://doi.org/10.1080/00343400220131205>

- Jenniches, S., & Worrell, E. (2019). Regional economic and environmental impacts of renewable energy developments: Solar PV in the Aachen Region. *Energy for Sustainable Development*, 48: 11–24. <https://doi.org/10.1016/j.esd.2018.10.004>
- Johnson, D., Lalonde, K., McEachern, M., Kenny, J., Mendoza, G., Buffin, A., & Rich, K. (2011). Improving cumulative effects assessment in Alberta: Regional strategic assessment. *Environmental Impact Assessment Review*, 31(5): 481-483. <https://doi.org/10.1016/j.eiar.2011.01.010>
- Johnson, et al. 2016. Chapter 8: A Revolution in Strategy, Not Evolution.... In: Gillingham et al. The Integration Imperative.
- King, S., & Pushchak, R. (2008). Incorporating cumulative effects into environmental assessments of mariculture: Limitations and failures of current siting methods. *Environmental Impact Assessment Review*, 28(8): 572-586. <https://doi.org/10.1016/j.eiar.2007.12.002>
- Kirchhoff, D., McCarthy, D., Crandall, D., & Whitelaw, G. (2011). Strategic environmental assessment and regional infrastructure planning: The case of York Region, Ontario, Canada. *Impact Assessment and Project Appraisal*, 29(1): 11–26. <https://doi.org/10.3152/146155111X12913679730430>
- Knaus, M., Lohr, D., & O'Regan, B. (2006). Valuation of ecological impacts – a regional approach using the ecological footprint concept. *Environmental Impact Assessment*, 26(2): 156-169. <https://doi-org.cyber.usask.ca/10.1016/j.eiar.2005.04.010>
- Kooiman, A., & Keshkamat, S. (2012). Scale in regional environmental planning: The reconstruction of North-Brabant, the Netherlands. *Journal of Environmental Assessment Policy and Management*, 14(1): 1250004. <https://doi.org/10.1142/S1464333212500044>
- Johan C., Kuylentierna, I., Rodhe, H., Cinderby, S. & Hicks, K. (2001). Acidification in Developing Countries: Ecosystem Sensitivity and the Critical Load Approach on a Global Scale. *Ambio*, 30(1): 20-28. <https://www.jstor.org/stable/4315096>
- Louis Berger International, Inc. (1995). Preparation of the primary urban road component of the proposed 'strategic urban road infrastructure project [Executive summary of the summary environmental assessment.] <http://documents.worldbank.org/curated/en/175011468752364750/pdf/multi-page.pdf>
- Macpherson, A., Principe, P., & Smith, E. (2010). A directional distance function approach to regional environmental-economic assessments. *Ecological Economics*, 69(10): 1918–1925. <https://doi-org.cyber.usask.ca/10.1016/j.ecolecon.2010.04.012>
- Macpherson, A., Principe, P., & Shao, Y. (2013). Controlling for exogenous environmental variables when using data envelopment analysis for regional environmental assessments. *Journal of Environmental Management*, 119: 220-229. <https://doi.org/10.1016/j.jenvman.2012.12.044>
- MarineSpace. (2010-2020). Marine Aggregate Regional Environmental Assessment document repository. Retrieved from: <http://www.marine-aggregate-rea.info>
- Marshall, R., & Fischer, T. (2006). Regional electricity transmission planning and SEA: The case of the electricity company Scottish Power. *Journal of Environmental Planning and Management*, 49(2): 279–299. <https://doi.org/10.1080/09640560500508155>
- McGimpsey, P., & Morgan, R. (2013). The application of strategic environmental assessment in a non-mandatory context: Regional transport planning in New Zealand. *Environmental Impact Assessment Review*, 43: 56–64. <https://doi.org/10.1016/j.eiar.2013.05.007>
- Meng, X., Zhang, Y., Yu, X., Bai, J., Chai, Y., & Li, Y. (2014). Regional environmental risk assessment for the Nanjing Chemical Industry Park: An analysis based on information diffusion theory. *Stochastic Environmental Research & Risk Assessment*, 28(8): 2217–2233. <https://doi-org.cyber.usask.ca/10.1007/s00477-014-0886-3>
- Mörtberg, U., Balfors, B., & Knol, W. (2007). Landscape ecological assessment: A tool for integrating biodiversity issues in strategic environmental assessment and planning. *Journal of Environmental Management*, 82(4): 457-470. <https://doi.org/10.1016/j.jenvman.2006.01.005>

- Noble, B. (2015). *Introduction to Environmental Impact Assessment: A Guide to Principles and Practice*, 3rd ed. Oxford University Press Canada: Toronto.
- Noble, B. (2005). Regional cumulative effects assessment: Towards a strategic framework. *Research and Development Monograph Series, (September)*, 89. Retrieved from: <http://www.ceaa.gc.ca/default.asp?lang=En&n=570DC764-1&toc=show&offset=1>
- Noble, B. (2000). Strategic environmental assessment: What is it? What makes it strategic? *Journal of Environmental Assessment Policy and Management*, 2(2):203-224. <https://doi.org/10.1142/S146433320000014X>
- Noble, B. & Harriman, J. (2008). *Strengthening the Foundation for Regional Scale Strategic Environmental Assessment in Canada.*, Ontario, Canada: Canadian Council of Ministers of Environment. Research report prepared for the Canadian Council of Ministers of Environment Environmental Assessment Task Group under contract agreement.
- Noble, B. (2008). Strategic approaches to regional cumulative effects assessment: A case study of the Great Sand Hills, Canada. *Impact Assessment and Project Appraisal*, 26(2): 78-90. <http://dx.doi.org/10.3152/146155108X316405>
- Ogihara, A., Shimaoka, M., & Roppongi, H. (2016). Potentialities for a regional public participation framework in Asia: An environmental assessment perspective. *Land Use Policy*, 52(2016): 535-542. <http://dx.doi.org/10.3152/146155108X316405>
- Olagunju, A., & Gunn, J. (2016a). Challenges to integrating planning and policy-making with environmental assessment on a regional scale – a multi-institutional perspective. *Impact Assessment & Project Appraisal*, 34(3):236253. <https://doi.org.cyber.usask.ca/10.1080/14615517.2016.1176412>
- Olagunju, A., & Gunn, J. (2016b). Integration of environmental assessment with planning and policy-making on a regional scale: A literature review. *Environmental Impact Assessment Review*, 61: 68 - 77. <http://dx.doi.org/10.1016/j.eiar.2016.07.005>
- Olagunju, A., & Blakley, J. (2017). Towards an environmental governance agenda in regional environmental assessment: A case study of the Crown Managers Partnership. *Journal of Environmental Assessment Policy and Management*, 19(2): 1750009. <https://doi.org/10.1142/S1464333217500090>
- Onate, J., Pereira, D., & Suarez, F. (2003). Strategic environmental assessment of the effects of European Union's regional development plans in Donana National Park (Spain). *Environmental Management*, 31(5): 0642-0655. <https://doi.org/10.1007/s00267-002-2932-z>
- PBL Netherlands Environmental Assessment Agency. (2003). Critical levels and critical loads as a tool for air quality management. In: Hewitt, C. & Jackson, A., eds. *Handbook of atmospheric science: Principles and applications*. Oxford: Blackwell Publishing, 562-602. <http://dx.doi.org/10.1002/9780>
- Rossiter, D., & Wood, P. (2005). Fantastic topographies: Neo-liberal responses to Aboriginal land claims in British Columbia. *Canadian Geographer*, 49 (4): 352-366.
- Rosen, J. (2018). How your science can shape policy. *Nature*, 560: 671-673.
- Sinclair, A., Doelle, M., & Duinker, P. (2017). Looking up, down, and sideways: Reconceiving cumulative effects assessment as a mindset. *Environmental Impact Assessment Review*, 62: 183-194. <https://doi.org/10.1016/j.eiar.2016.04.007>
- Therivel, R., & Ross, B. (2007). Cumulative effects assessment: Does scale matter? *Environmental Impact Assessment Review*, 27(5): 365-385. <https://doi.org/10.1016/j.eiar.2007.02.001>
- Voutier, K., Dixit, B., Millman, P., Reid, J., & Sparkes, A. (2008). Sustainable energy development in Canada's Mackenzie Delta-Beaufort Sea coastal region. *Arctic*, 61: 103-110. <https://doi.org/10.1007/s00267-002-2932-z>
- Weber, M., Krogman, N., & Antoniuk, T. (2012). Cumulative effects assessment: linking social, ecological, and governance dimensions. *Ecology and Society*, 17(2). <https://www.jstor.org/stable/26269026>

- Wei, W., Shi, S., Zhang, X., Zhou, L., Xie, B., Zhou, J., & Li, C. (2020). Regional-scale assessment of environmental vulnerability in an arid inland basin. *Ecological Indicators*, 109: 105792. [https://doi-org.cyber.usask.ca/10.1016/j.ecolind.2019.105792](https://doi.org/cyber.usask.ca/10.1016/j.ecolind.2019.105792)
- Wong, L., Noble, B., & Hanna, K. (2019). Water Quality Monitoring to Support Cumulative Effects Assessment and Decision Making in the Mackenzie Valley, Northwest Territories, Canada. *Integrated environmental assessment and management*, 15(6): 988-999. <https://doi.org/10.1002/ieam.4179>
- Zu, D. & Rhu, J. (2008). Strategic environmental assessment in China: Motivations, politics and effectiveness. *Journal of Environmental Management*, 88: 615-626. <https://doi.org/10.1016/j.jenvman.2007.03.040>

RA Case Documents (by jurisdiction)

Alberta

- Government of Alberta. (2012). Lower Athabasca Regional Plan 2012-2022. Retrieved from: <https://landuse.alberta.ca/LandUse%20Documents/Lower%20Athabasca%20Regional%20Plan%202012-2022%20Approved%202012-08.pdf>
- Government of Alberta. (2018). South Saskatchewan Regional Plan 2014-2024. Retrieved from: <https://landuse.alberta.ca/LandUse%20Documents/South%20Saskatchewan%20Regional%20Plan%202014-2024%20-%20May%202018.pdf>
- North Saskatchewan Watershed Alliance. (NSWA). 2009. Cumulative Effects Assessment of the North Saskatchewan River Watershed using ALCES. Retrieved from: http://nswa.ab.ca/cumulative_effects
- Parks Canada. (2018). Strategic Environmental Assessment of Wood Buffalo National Park World Heritage Site. Volume 1: Milestone 3 – Final SEA report. Retrieved from: <http://parkscanadahistory.com/publications/woodbuffalo/sea-rpt-v1-e-2018.pdf>
- Silvatech Consulting. (2008). Chief Mountain Study Executive Summary. Retrieved from: <https://www.alces.ca/reports/>
- Sustainable Ecosystems Working Group. 2005. Terrestrial Ecosystem Management Framework for the Regional Municipality of Wood Buffalo. Cumulative Environmental Management Association. Fort McMurray, Alberta. Retrieved from: <http://library.cemaonline.ca/ckan/dataset/fa0531a0-f485-4cd5-8d1d-2007a417ffbd/resource/3157fbf9-271f-4eea-979b-91e479e50284/download/temffinalpackage.pdf>
- Wilson, B., & Hudson, M. (2011). Chief Mountain Cumulative Effects Study: Assessing the Footprint of Human Activity in Southwest Alberta.

Arctic, Canadian

- Allard, M., & Lemay, M. (2012). Nunavik and Nunatsiavet: From Science to Policy An Integrated Regional Impact Study (IRIS 4) of Climate Change and Moderization. ArcticNet: Quebec City, Canada. Retrieved from: http://www.arcticnet.ulaval.ca/pdf/media/iris_report_complete.pdf
- Bell, T. & Brown, T. (2018). From Science to Policy in the Eastern Canadian Arctic: An Integrated Regional Impact Study (IRIS 2) of Climate Change and Moderization. ArcticNet: Quebec City, Canada. Retrieved from: http://www.arcticnet.ulaval.ca/pdf/media/29170_IRIS_East_full%20report_web.pdf
- Kuzyk, Z. & Candlish, L. (2019). From Science to Policy in the Greater Hudson Bay Marine Region: An Integrated Regional Impact Study (IRIS 3) of Climate Change and Modernization. ArcticNet: Québec City, Canada. Retrieved from: <http://arcticnet.ulaval.ca/docs/IRIS3-HudsonBay-VF.pdf>

Stern, G. & Gaden, A. (2015). From Science to Policy in the Western and Central Canadian Arctic: An Integrated Regional Impact Study (IRIS 1) of Climate Change and Modernization. ArcticNet: Quebec City, Canada. Retrieved from: http://www.arcticnet.ulaval.ca/pdf/media/IRIS_FromScience_ArcticNet_Ir.pdf

British Columbia

BC Ministry of Forests, Lands and Natural Resource Operations and Rural Development (2018). Howe Sound Cumulative Effects Project Aquatic Ecosystems - Watershed Condition Current Condition Report. Retrieved from: https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/cumulative-effects/south-coast-region/howe-sound/hs_watershed_condition_ce_report.pdf

BC Ministry of Forests, Lands and Natural Resource Operations and Rural Development and Ministry of Environment and Climate Change Strategy. (2018). Current Condition Report for Grizzly Bear in the Northeast Region 2015 Analysis. Retrieved from: https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/cumulative-effects/cef_ne_grizzly_bear_ccr_final_october2018_updated_july19.pdf

BC Ministry of Sustainable Resource Management. (2003). Eight Peaks Winter Recreation Sustainable Resource Management Planning (SRMP). Retrieved from: https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/land-water-use/crown-land/land-use-plans-and-objectives/thompsonokanagan-region/eightpeaks-srmp/8peaks_srmp.pdf

BC Ministry of Sustainable Resource Management, Coast & Marine Planning Branch (2002). The Baynes Sound Coastal Plan for Shellfish Aquaculture. (December 2002). Retrieved from: https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/land-water-use/crown-land/land-use-plans-and-objectives/coastal-marine/baynes-sound-coastal-plan/baynes_plan.pdf

BC Ministry of Sustainable Resource Management (MSRM), Coast & Marine Planning Branch (2003). Cortes Island Coastal Plan for Shellfish Aquaculture. (July 2003). Retrieved from: https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/land-water-use/crown-land/land-use-plans-and-objectives/coastal-marine/cortes-island-coastal-plan/ci_plan.pdf

BC Ministry of Sustainable Resource Management, Coast & Marine Planning Branch. (2004). The Johnstone-Bute Coastal Plan. Retrieved from: https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/land-water-use/crown-land/land-use-plans-and-objectives/coastal-marine/johnstone-bute-coastal-plan/johnstone_bute_coastal_plan.pdf

BC Ministry of Sustainable Resource Management, Coast & Marine Planning Branch. (2003). The Kyuquot Sound Coastal Plan. Retrieved from: https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/natural-resource-use/land-water-use/crown-land/land-use-plans-and-objectives/coastal-marine/kyuquot-sound-coastal-plan/kyuquot_coastal_plan.pdf

Dawson, R., Hoffos, R., & McGirr, M. (2015). A Broad Scale Cumulative Impact Assessment Framework for the Cariboo-Chilcotin. Forests, Lands and Natural Resource Operations. Retrieved from: https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/cumulative-effects/ce_assessment_for_cariboo-chilcotin_18_mar_2016.pdf

Elk Valley Cumulative Effects Management Framework Working Group. (2018). Elk Valley Cumulative Effects Assessment and Management Report. Retrieved from: https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/cumulative-effects/draft_elk_valley_ceam_12122018_draft.pdf

- Tesera Systems Inc. Project Team. (2003). Robson Valley Enhanced Forest Management Pilot Project. Retrieved from: http://www.env.gov.bc.ca/omineca/documents/cwd_2002_reportf.pdf
- Wilson, B., Carlson, M., Iverson, M., Straker, J., & Sharpe, S. (2016). An Assessment of the Cumulative Effects of Land Use and Management in SSN. Retrieved from: <https://www.alces.ca/reports/?show=10&page=1&sort=title&direction=asc>
- Vadal, E., & Lewis, B. (2015). Cumulative Effects Assessment for the Merritt Operational Trial. Retrieved from: https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/cumulative-effects/ce_assessment_for_merritt_8_jan_2016.pdf
- Metlakatla Cumulative Effects Management Program. (2019). Methods, Results, and Future Direction of a First Nation-led CEM Program. Retrieved from: https://metlakatlacem.ca/wp-content/uploads/2020/02/Metlakatla_CEM-Synopsis_FIN.pdf

International

- Anatec UK Limited (2009). Navigation Impacts Review: Thames Estuary Dredging Areas. Thames Estuary Dredging Association/ERM Ltd.
- United Nations Environment Program (UNEP). (2016). Global Environmental Outlook (GEO-6) Regional Assessment for North America. Retrieved from: <https://www.unenvironment.org/resources/global-environment-outlook-6>
- Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). The Regional Assessment Report on Biodiversity and Ecosystem Services for Africa. Retrieved from: https://ipbes.net/sites/default/files/africa_assessment_report_20181219_0.pdf
- Australian Government, Department of Agriculture, Water and Environment. (2015). Reef 2050 Long-Term Sustainability Plan. Retrieved from: <https://www.environment.gov.au/marine/gbr/long-term-sustainability-plan>
- Australian Government, Queensland Government. (2018). Reef 2050 Water Quality Improvement Plan. Retrieved from: <https://www.reefplan.qld.gov.au>
- Boertman, D., Mosbech, A., Schiedek, D. & Johansen, K. (eds). (2009). The Western Greenland SEA. A Preliminary Strategic Environmental Impact Assessment of Hydrocarbon Activities in the Kanumas East Area. National Environmental Research Institute, Aarhus University, Denmark. NERI Technical report no. 719. Retrieved from: <http://www.dmu.dk/Pub/FR719.pdf>
- Scientific Inquiry into Hydraulic Fracturing in the Northern Territory (SIHFNT). (2018). Strategic Regional Environmental and Baseline Assessment: Final Report. Darwin: The Scientific Inquiry into Hydraulic Fracturing in the Northern Territory. Retrieved from: <https://frackinginquiry.nt.gov.au/inquiry-reports?a=494286>
- United Republic of Tanzania, Ministry of Natural Resources and Tourism, Tanzania Wildlife Management Authority. (2019). A Report on State of Conservation of Selous Game Reserve World Heritage Property (N199).
- United States Agency for International Development. (2006). Programmatic Environmental Assessment: Rural Energy Program in Georgia. Retrieved from: <http://siteresources.worldbank.org/INTGEORGIA/Resources/PEARReportENG.pdf>
- World Bank, Municipal Development Fund of Georgia. (2016). The Strategic Environmental, Social and Cultural Heritage Assessment of the Regional Development and Tourism Development Strategies of Samtckhe-Javakheti and Mtsketa-Mtianeti: Third Regional Development Project. Retrieved from: <http://documents.worldbank.org/curated/en/410941481095959336/pdf/SFG2732-EA-P150696-Box396336B-PUBLIC-Disclosed-12-6-2016.pdf>

Manitoba

Manitoba Government and Manitoba Hydro. (2015). Regional cumulative effects assessment for hydroelectric developments on the Churchill, Burntwood and Nelson River Systems Phase II Report, Part I Preamble and Master Table of Contents. Retrieved from: https://www.hydro.mb.ca/docs/regulatory_affairs/pdf/rcea/rcea_phase2_part_i_preamble_and_introduction.pdf

Manitoba Government and Manitoba Hydro. (2015). Regional cumulative effects assessment for hydroelectric developments on the Churchill, Burntwood and Nelson River Systems Phase II Report, Part II Hydroelectric project description. Retrieved from: https://www.hydro.mb.ca/docs/regulatory_affairs/pdf/rcea/rcea_phase2_part_ii_hydroelectric_development_project_description.pdf

Manitoba Government and Manitoba Hydro. (2015). Regional cumulative effects assessment for hydroelectric developments on the Churchill, Burntwood and Nelson River Systems Phase II Report, Part III People. Retrieved from: https://www.hydro.mb.ca/docs/regulatory_affairs/pdf/rcea/rcea_phase2_part_iii_people.pdf

Manitoba Government and Manitoba Hydro. (2015). Regional cumulative effects assessment for hydroelectric developments on the Churchill, Burntwood and Nelson River Systems Phase II Report, Part IV Physical Environment (part 1). Retrieved from: https://www.hydro.mb.ca/docs/regulatory_affairs/pdf/rcea/rcea_phase2_part_iv_physical_environment_1.pdf

Manitoba Government and Manitoba Hydro. (2015). Regional cumulative effects assessment for hydroelectric developments on the Churchill, Burntwood and Nelson River Systems Phase II Report, Part IV Physical Environment (part 2). Retrieved from: https://www.hydro.mb.ca/docs/regulatory_affairs/pdf/rcea/rcea_phase2_part_iv_physical_environment_2.pdf

Manitoba Government and Manitoba Hydro. (2015). Regional cumulative effects assessment for hydroelectric developments on the Churchill, Burntwood and Nelson River Systems Phase II Report, Part IV Physical Environment (part 3). Retrieved from: https://www.hydro.mb.ca/docs/regulatory_affairs/pdf/rcea/rcea_phase2_part_iv_physical_environment_3.pdf

Manitoba Government and Manitoba Hydro. (2015). Regional cumulative effects assessment for hydroelectric developments on the Churchill, Burntwood and Nelson River Systems Phase II Report, Part IV Physical Environment (part 5). Retrieved from: https://www.hydro.mb.ca/docs/regulatory_affairs/pdf/rcea/rcea_phase2_part_iv_physical_environment_5.pdf

Newfoundland and Labrador

Bangay, G., Foote, W., Anderson, G., Rustad, M., & Storey, K. (2020). Regional Assessment of Offshore Oil and Gas Exploratory Drilling East of Newfoundland and Labrador. Retrieved from: <https://iaac-aeic.gc.ca/050/documents/p80156/134068E.pdf>

Northwest Territories

Northwest Territories Cumulative Impact Monitoring Program (NWT CIMP) Action Plan 2016-2020. Retrieved from:

https://www.enr.gov.nt.ca/sites/enr/files/press_pdf_cam_nwtcimp_nwt_cimp_action_plan_2016-2020_designed_30_september_2015.pdf

Ttichq Ndek'awoo Ttichq Government. (2013). Ttichq Wenek'e Ttichq Land Use Plan. Retrieved from: https://research.tlicho.ca/sites/default/files/105-landuseplan_final_version2_0_1_0.pdf

Nova Scotia

Amex Foster Wheeler, Environment & Infrastructure. (2016). Strategic environmental assessment Sydney Basin and Orpheus Graben offshore Cape Breton Nova Scotia. Canada-Nova Scotia Offshore Petroleum Board (CNSOPB). Retrieved from:

https://www.cnsopb.ns.ca/sites/default/files/resource/75345.8_sea_sydney_basin_and_orpheus_graben_offshore_cape_breton_final.pdf

OEER Association. (2008). Fundy tidal energy strategic environmental assessment final report. Prepared for the Nova Scotia Department of Energy. Retrieved from: <https://oera.ca/sites/default/files/2019-05/Fundy%20Tidal%20Energy%20Strategic%20Environmental%20Assessment%20Final%20Report.pdf>

Stantec Consulting Ltd. (2012). Strategic environmental assessment for the Eastern Scotian Shelf – Middle and Sable Island banks. Canada-Nova Scotia Offshore Petroleum Board (CNSOPB). Retrieved from: https://www.cnsopb.ns.ca/sites/default/files/resource/15581_75354.7.1_sea_-_eastern_scotian_shelf_and_slope_middle_and_sable_island_banks_2012_final_reportsphase1a_10032012.pdf

Stantec Consulting Ltd. (2013). Strategic environmental assessment for offshore petroleum exploration activities: Eastern Scotian Slope (eastern portion) and Laurentian Fan (western portion) (Phase 2B). Canada-Nova Scotia Offshore Petroleum Board (CNSOPB). Retrieved from: https://www.cnsopb.ns.ca/sites/default/files/resource/seareport_phase2b_final_1_0.pdf

Stantec Consulting Ltd. (2012). Strategic environmental assessment for offshore petroleum exploration activities: Eastern Scotian Slope (Phase 1B). Canada-Nova Scotia Offshore Petroleum Board (CNSOPB). Retrieved from: https://www.cnsopb.ns.ca/sites/default/files/resource/15581_75345.7.2_sea_-_eastern_scotian_shelf_and_slope_middle_and_sable_island_banks_2012_final_reports_phase1b_10032012.pdf

Stantec Consulting Ltd. (2019). Middle Scotian Shelf and Slope strategic environmental assessment (final report). Canada-Nova Scotia Offshore Petroleum Board (CNSOPB). Retrieved from: https://www.cnsopb.ns.ca/sites/default/files/resource/final_middle_scotian_shelf_sea_.pdf

Stantec Consulting Ltd. (2013). Strategic environmental assessment for offshore petroleum exploration activities: Misaine and Banquereau Banks (Phase 2A). Canada-Nova Scotia Offshore Petroleum Board (CNSOPB). Retrieved from: https://www.cnsopb.ns.ca/sites/default/files/resource/seareport_phase2a_final_0.pdf

Stantec Consulting Ltd. (2014). Strategic environmental assessment for offshore petroleum exploration activities: Western Scotian Shelf (Phase 3A). Canada-Nova Scotia Offshore Petroleum Board (CNSOPB). Retrieved from: https://www.cnsopb.ns.ca/sites/default/files/resource/sea_phase3a_apr_22_2014.pdf

Nunuvat

Nunavut Impact Review Board. (2019). Final Report for the Strategic Environmental Assessment in Baffin Bay and Davis Strait. NIRB File No. 17SN034. Retrieved from:

<https://www.nirb.ca/publications/Strategic%20Environmental%20Assessment/first%20row-first%20file%20-190731-17SN034-Final%20SEA%20Report-Volume%201-OPAE.pdf>

Nunavut Planning Commission. (2000). Keewatin Regional Land Use Plan. Retrieved from: <https://lupit.nunavut.ca/portal/registry.php?public=docs&g=2&c=1011&searchtext=>

Saskatchewan

Carlson, M., MacDonald, R., Wilson, B., Nordquist, D., Chernos, M., & Milligan, S. (2019). Assessment of the Cumulative Effects of Climate Change and Land Use to the Trans Mountain Pipeline and Wildlife Habitat in the North Thompson Watershed. Adams Lake Indian Band. Retrieved from:

https://s3.amazonaws.com/kajabi-storefronts-production/sites/7447/downloads/INUyJE0uQNYKDCsLXi8e_20190326_Copyright_ALIB_TMX_CFX_Final_Report.pdf

Great Sand Hills Advisory Committee. (2007). Great Sand Hills Regional Environmental Study. Regina: Great Plains Research Centre. Retrieved from:

<http://www.environment.gov.sk.ca/GSHRETableOfContents>

Yukon

Government of Canada (GoC). (2016). Beaufort Regional Environmental Assessment: Key Findings: Research and Working Group Results 2011-2015. Retrieved from:

https://rsea.inuvialuit.com/docs/NCR10615510-v1-BREA_FINAL_REPORT.PDF

Tr'ondëk Hwëch'in, First Nation of Na-cho Nyäk Dun, Vuntut Gwitchin First Nation, Gwich'in Tribal Council and Government of Yukon. (2019). Peel Watershed Regional Land Use Plan. Retrieved from:

https://yukon.ca/sites/yukon.ca/files/emr/emr-peel-watershed-regional-land-use-plan_0.pdf

Vuntut Gwitchin Government and Government of Yukon (2009). North Yukon Regional Land Use Plan: Nichih Gwanał'in Looking Forward. Retrieved from: <https://yukon.ca/sites/yukon.ca/files/emr/emr-north-yukon-regional-land-use-plan.pdf>