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An institutional perspective on local capacity for source water protection

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Abstract

Provision of safe drinking water is one of the global challenges of the 21st century. Effective water treatment is a key aspect of drinking water safety. However, just as important is ensuring that sources of drinking water such as rivers and aquifers are protected from contamination. In that context, source water protection is recognized as the first barrier in a multi-barrier approach to drinking water safety. Source water protection occurs at the local scale, and involves numerous local actors with varying capabilities. Consequently, institutional arrangements (IAs) for land use planning and water management are key determinants shaping local capacity for source water protection. The purpose of this research was to evaluate the extent to which existing IAs enhance or constrain the capacity of local governments to protect source waters. An evaluation framework, developed around four core elements drawing from functional and relational perspectives on capacity and capacity building, was applied to the Oldman River basin, Alberta. Results showed that local capacity for source water protection is constrained by existing IAs that do not encourage the generation of a locally relevant technical knowledge base and which assign legal authority for regulating intensive livestock operations to the provincial government. Formal mechanisms for integrating land use planning and water management, which could help overcome these functional constraints and provide opportunities for broad public involvement, have yet to be developed in Alberta. Meaningful participation can provide local governments with an ability to encourage source protection on private lands and enhance their leverage when confronting public land and livestock production issues. However, if local capacity is to be facilitated through IAs that encourage interaction among local governments, stakeholders and residents, then capacity building initiatives should also take into consideration how existing IAs help to maintain and to reproduce local power differentials.

Keywords: Source water protection; Drinking water; Institutional arrangements; Local capacity; Agricultural production; Evaluation; Alberta, Canada

1. Introduction

Access to safe and reliable sources of drinking water is one of the global challenges of the 21st century (Bernstein, 2002; Davison et al., 2005). Although inadequate drinking water supplies and poor sanitation are especially acute for disenfranchised sectors of the population in developing countries, waterborne disease outbreaks occur frequently in developed countries and are a testament to the potential for contaminated drinking water to affect human lives everywhere (Lepkowski, 1999; Medema et al., 2003a; Hrudey et al., 2003; Smith and Perdek, 2004). In Canada, for example, seven people died and at least 2300 became ill in 2000 after drinking water contaminated with *E. Coli* O157:H7 during the tragic events that affected the town of Walkerton (O'Connor, 2002; Krewski et al., 2004).

Source water protection refers to the development and implementation of policies, plans and activities to prevent or minimize direct or indirect release of pollutants into surface or groundwater resources currently used or intended to be used in the future as sources of drinking water (O'Connor, 2002; Krewski et al., 2004). It typically involves assessing water resources, identifying vulnerable areas,

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surveying all contaminant sources, and selecting, implementing and monitoring a set of policy tools and actions to prevent or minimize contamination, by means of planning processes that emphasize stakeholder involvement and education (Witten et al., 1995; National Research Council, 2000; FWR, 2005). In the context of surface water (e.g., lakes, reservoirs, rivers), source water protection typically takes the form of watershed or catchment management, while for groundwater resources efforts may focus on private wells, municipal water fields, groundwater recharge areas, or whole aquifers (USEPA, 1999; National Research Council, 2000; Macler and Merkle, 2000).

Source water protection, the first of multiple barriers to protect water supplies, "is almost invariably the best method of ensuring safe drinking water and is to be preferred to treating a contaminated water supply to render it suitable for consumption" (WHO, 1993). This is mainly due to pragmatic reasons, as sources of good quality can be easily transformed into safe drinking water at lower costs and with fewer potentially harmful disinfection byproducts (Qian, 2002; Medema et al., 2003b; Krewski et al., 2004). It is important to note, however, that multiple barriers (Table 1) other than source water protection are required in order to ensure the safety of drinking water, as no single barrier can be entirely effective (O'Connor, 2002; Rizak et al., 2003; LeChevallier and Au, 2004; Davison et al., 2005).

The approach to source water protection (or lack thereof) in a particular locale is influenced by and reflective of its hydrological, socioeconomic, cultural, and institutional contexts (Yanggen and Born, 1990; Huebner et al., 1992; de Loë and Kreutzwiser, 2005; Ferreyra and Beard, 2005a). Institutional arrangements for land use planning and water resource management, in particular, are key determinants shaping capacity for source water protection.

Table 1
Multiple barrier approach to ensuring safe and reliable drinking water

Barrier	Focus
Source protection	Keeping raw water as clean as possible through watershed-based risk planning that considers vulnerability of surface and groundwater sources and major contaminant pathways
Treatment	Removing or inactivating contaminants through treatments such as filtration, chlorination, ozonation, or ultraviolet radiation
Distribution system	Protecting treated water from intrusion of contaminants and ensuring appropriate free chlorine residuals throughout the system
Monitoring program	Detecting contaminants that exist in concentrations beyond acceptable limits and returning systems to normal operation through warning or automatic control devices
Contingency responses	Responding to adverse conditions (e.g., deteriorating water quality) with specifically designed and well-rehearsed contingency plans

Source: Adapted from O'Connor (2002).

Institutional arrangements (IAs) include legislation and regulations, policies and guidelines, administrative structures, economic and financial arrangements, and political structures and processes (Mitchell, 1989; Mitchell and Pigram, 1989; Bandaragoda, 2000). Most jurisdictions lack IAs specifically tailored to source water protection, and instead, rely on a patchwork of arrangements that deal with specific activities (e.g., effluent releases), industries (e.g., mining, agriculture), and resources (e.g., land, water). Even where there is legislative support for source water protection, as is the case in the United States and some Canadian provinces, actual implementation is often a voluntary process, especially regarding nonpoint sources of contamination (Pontius, 1996; Trax, 1999; Walter and Walter, 1999; Caruso, 2000).

This poses significant challenges, especially for rural areas where concerns exist about the potential impacts of agricultural intensification on the quality of drinking water sources (Caldwell, 1998; Napier, 1998; Tilman et al., 2002; Ferreyra, 2006). For example, livestock production in North America and the European Union is characterized by concentration, specialization, and vertical integration, whereby fewer larger-scale producers operate on smaller land bases, often on a contractual basis with processing facilities (Korevaar, 1995; Caldwell, 2001; Welsh and Hubbell, 1999). In this context, voluntary approaches at the farm level have been deemed inadequate to address the potential environmental impacts of intensive livestock operations (Caldwell, 1998; Caruso, 2000). This has important worldwide implications, as intensification is expected to be the trend for agricultural production across the world, fuelled by the rapidly growing demand for food of animal origin in developing countries and increasing dominance of multi-national agribusiness corporations (Llambi, 1998; Delgado et al., 1999; Pretty, 2001; Wall and Beardwood, 2001; Tilman et al., 2002; Ortega et al., 2005; Ferreyra, 2006).

The purpose of this paper is to evaluate the extent to which existing institutional arrangements for land use planning and water management enhance or constrain the capacity of local governments in the Oldman River basin to protect source waters. Livestock production is a major component of the agricultural industry in Alberta, accounting for the largest number of cattle and calves in Canada (Beaulieu and Bédard, 2003; Johnson et al., 2003). Although changes to the regulation of livestock operations, outreach activities of watershed partnerships, and the recent contamination of municipal drinking water supplies in Ontario and Saskatchewan, have raised the profile of water quality protection in Alberta, no formal provincial IAs for source water protection existed at the time this study was completed. In this context, evaluation of existing IAs for land use planning and water management in the Oldman River basin can provide insights into how the capacity of local governments to protect drinking water sources is influenced by the institutional factor. These insights, together with the proposed capacity evaluation framework, can be of relevance not only for Alberta but also for the many other jurisdictions around the world in which concerns for the safety of drinking water sources have not been translated into specific IAs for source water protection.

2. A local capacity approach to source water protection

2.1. Perspectives on capacity and capacity building

The notions of "capacity" and "capacity building" have been advanced in the fields of natural resource management, public administration, health sciences, and community and international development for the last few decades (Honadle, 1986; UNDP, 1994; Goodman et al., 1998; Wolff, 2001; de Loë et al., 2002; MacLean et al., 2003). The conceptual ambiguities and methodological tensions in which the concepts of capacity and capacity building are embedded (Harrow, 2001; Black, 2003) become more obvious when exploring and reflecting upon two central questions: whose capacity are we building, and for what purpose? Debates in the academic literature, mainly relating to community and international development and public health promotion, differentiate between "capacity for action" and "capacity for self-determination" (Honadle, 1986; Casswell, 2001; Harrow, 2001; Himmelman, 2001; Black, 2003). In the former, capacity is conceptualized from a *functional* perspective that focuses on the ability of individuals, organizations, communities and governments, to perform efficiently, effectively and on an ongoing basis, a set of externally defined goals. Capacity for self-determination, conversely, is grounded on a *relational* perspective that focuses on the ability of individuals, organizations, communities and governments to establish and achieve their own goals and agendas. In their more radical form, capacity and capacity building are about empowering marginal groups in society for meaningful participation in relevant socioeconomic and political debates, and about working towards the transformation of the structural power relations that oppress them (Himmelman, 2001; Black, 2003).

Researchers and practitioners within the water field have not generally engaged with the academic debate addressing the paradoxes of capacity and capacity development. Instead, the water community has enthusiastically (and perhaps uncritically) set out to identify and to help overcome the range of interrelated social, political, technical, financial, and institutional factors facilitating or constraining capacity for effective and efficient water management, both in developed and developing countries (Litke and Day, 1998; Shanaghan et al., 1998; GWP, 2000; Al-Jayyousi, 2001; Ivey et al., 2002; CDM, 2004). Capacity and capacity building in the water sector are part of broader (and also problematic) trends in environmental governance that have embraced the "local" through calls for decentralization and participation (Bryant and Wilson, 1998; Agrawal and Gibson, 1999; Kapoor, 2001).

2.2. Local capacity for source water protection: assessing the institutional factor

In this paper, we are concerned with the capacity of local governments for efficient and effective source water protection. Capacity, in this context, is more related to capacity for action towards achieving an externally defined goal (source water protection) than capacity for self-determination. Little disagreement exists with the objective of protecting source waters from contamination. In contrast, determining how to move from rhetoric to practice in a particular locale is a matter of great controversy and debate (Roberts and Lighthall, 1991; Bromley, 1996; Osborn and Cook, 1997; Lepkowski, 1999; Jacobs, 1999; Walter and Walter, 1999; Bellamy and Johnson, 2000). How will vulnerable zones be defined? What kinds of land use practices are to be restricted or discouraged? Who will be compensated and how? More importantly, who will decide, and based upon whose science? If the shift towards devolution and participation in natural resource and environmental management discussed in the previous section is any indication, it will be the local governments, regardless of context and capacity constraints, who will be at the forefront of source water protection. And it will also be local governments for whom capacity building strategies will be designed and implemented.

In this context, evaluation frameworks in which capacity building efforts can be grounded are required. The evaluation framework developed in this paper focuses on the extent to which institutional arrangements facilitate or constrain the capacity of local governments to protect source waters. The framework is based on four core elements: technical knowledge, legal authority, public involvement, and integration of land use planning and water management. These core elements were selected drawing from both functional and relational perspectives on local capacity, with the intent of reflecting the dual nature of source water protection as a technical process and as a social process (Ferreyra and Beard, 2005b). Although we recognize that isolating the institutional component may limit a deeper and more contextualized understanding of local capacity (McDonald et al., 2003), we believe there is value in an evaluative framework that can be used to investigate capacity for source water protection in the many jurisdictions which, as in the case of the Oldman River basin, do not have IAs specifically designed for such purpose. Furthermore, the four elements can be incorporated into more multifaceted and contextual evaluation frameworks of local capacity for source water protection, providing a relevant indication of the role and influence of the institutional factor (Bellamy et al., 1999). A brief description of each element follows.

2.2.1. Technical knowledge

Local governments dealing with land use planning and water management issues need technical knowledge about the location, extent, and characteristics of water sources in their jurisdictions (Lennox et al., 1990; McGary Meij and Abdalla, 1990; Yanggen and Born, 1990; Balco, 1992; Foster and Skinner, 1995; Witten et al., 1995; Lin et al., 2000; de Loë and Kreutzwiser, 2005). Technical knowledge about the particularities of water sources in individual jurisdictions can provide for local decision-making and implementation processes in which the potential negative impacts of land use practices on drinking water can be properly taken into consideration. Technical knowledge can also provide local governments with the necessary legitimacy to engage with senior levels of government, donor agencies and consultants, in the often expert-dominated debate surrounding water quality issues.

2.2.2. Legal authority

Local governments should have the legal authority to influence existing and future land uses and management practices in both urban and rural areas (Balco, 1992; Centner and Mullen, 2002; Peckenham et al., 2002). Key powers include the ability to protect sensitive or vulnerable areas from potentially unsafe land use practices (e.g., use of hazardous substances, high density development). This is particularly relevant when land use practices implemented upstream can affect water quality and quantity of downstream jurisdictions (Page, 2001). Thus, legal authority that facilitates local capacity for source water protection extends across political boundaries to protect sources located outside the affected local jurisdiction.

2.2.3. Public involvement

Source water protection involves making tradeoffs between local economic development and public health. Support from nongovernment organizations, industry and commerce, landowners and local residents is essential if municipalities are to prioritize the protection of drinking water sources among the multiple socioeconomic goals to be balanced (Lennox et al., 1990; Lin et al., 2000; Centner and Mullen, 2002; de Loë et al., 2002; Ivey et al., 2002; Peckenham et al., 2002; Davies and Mazumder, 2003; de Loë and Kreutzwiser, 2005). IAs can facilitate public support for source water protection when they provide for public awareness, but more importantly, when they provide opportunities for meaningful involvement in decision-making and implementation.

2.2.4. Land and water integration

IAs that can facilitate source water protection address the interrelationship between land use practices and the quality and quantity of water sources (Gray et al., 2001; FitzGibbon and Plummer, 2004). Land and water integration, however, implies the allocation of costs and benefits across a broad range of public and private interests (Watson et al., 1996; Jacobs, 1999; Postel and Thompson, 2005). Thus, the capacity of local governments for source water protection can be facilitated by land use planning processes that recognize and are constrained by the public health imperatives of protecting drinking water sources on a watershed basis.

3. Case study: the Oldman River basin

3.1. Setting

The Oldman River and its tributaries (Fig. 1) drain approximately 23,000 km^2 of southern Alberta, Canada, and 2100 km^2 of northern Montana, United States. Lethbridge, with a population of about 73,000 in 2004, is the largest city in this agricultural watershed, which is characterized by about 20 small settlements of fewer than 10,000 residents (Statistics Canada, 2004a). The Oldman River and its tributaries and reservoirs are the primary water sources in the basin, although groundwater plays an important role as a supply for some small municipal systems and rural domestic consumption. Water from agricultural drains is used for irrigation, livestock watering, and, in some cases, domestic water supplies (ORBWQI and Alberta Agriculture Food and Rural Development [AAFRD], 2000).

Between 1981 and 2001, the concentration of cattle in Alberta registered an increase of more than 50%, growing to over 6.6 million animals (Statistics Canada, 2004b). In the Oldman River basin, a total of 1.2 million head of cattle, 2.3 million hens and chickens and 360,000 pigs were reported in 2001. The County of Lethbridge (surrounding the City of Lethbridge) accounted for 583,531 head of cattle, the largest concentration of any county in the province. Livestock production is carried out in confined feeding operations (CFOs), large feedlots where over 400 animal units (a measure based on the type and number of animals) are enclosed for the purpose of growing, sustaining, finishing or breeding by means other than grazing (Beaulieu, 2001). Field crops such as wheat, barley, and alfalfa are commonly grown to support the livestock industry, with more than half a million acres of irrigated farmland. With the rapidly growing livestock industry and discharges from storm drains and sewage treatment plants, contamination of surface and groundwater sources with manure and agrochemicals is a major concern (ORBWQI, 2000a; Johnson et al., 2003; Rock and Mayer, 2004).

Water quality monitoring in tributaries of the Oldman River has shown total P and total N concentrations in excess of the Alberta Surface Water Quality Guidelines, and levels of fecal coliforms that occasionally exceed provincial guidelines for contact recreation and irrigation (ORBWQI, 2000a; AAFRD, 2002a,b). Concentrations of total dissolved solids and NO_3-N in excess of federal drinking water guidelines, and concentrations of fecal coliforms, herbicides, and salinity in excess of provincial irrigation and contact recreation guidelines, have been recorded from the outlet of Battersea Drain (AAFRD, 2000a). Furthermore, Southern Alberta has a semi-arid climate and persistent low stream flow volumes in the Oldman River and tributaries could exacerbate water quality conditions, as less water is available for contaminant dilution (CAESAWQC, 1998; AAFRD, 2002a,b; Rock and Mayer, 2004). It is important to note that the Lethbridge region has one of the highest levels of enteric disease in the county

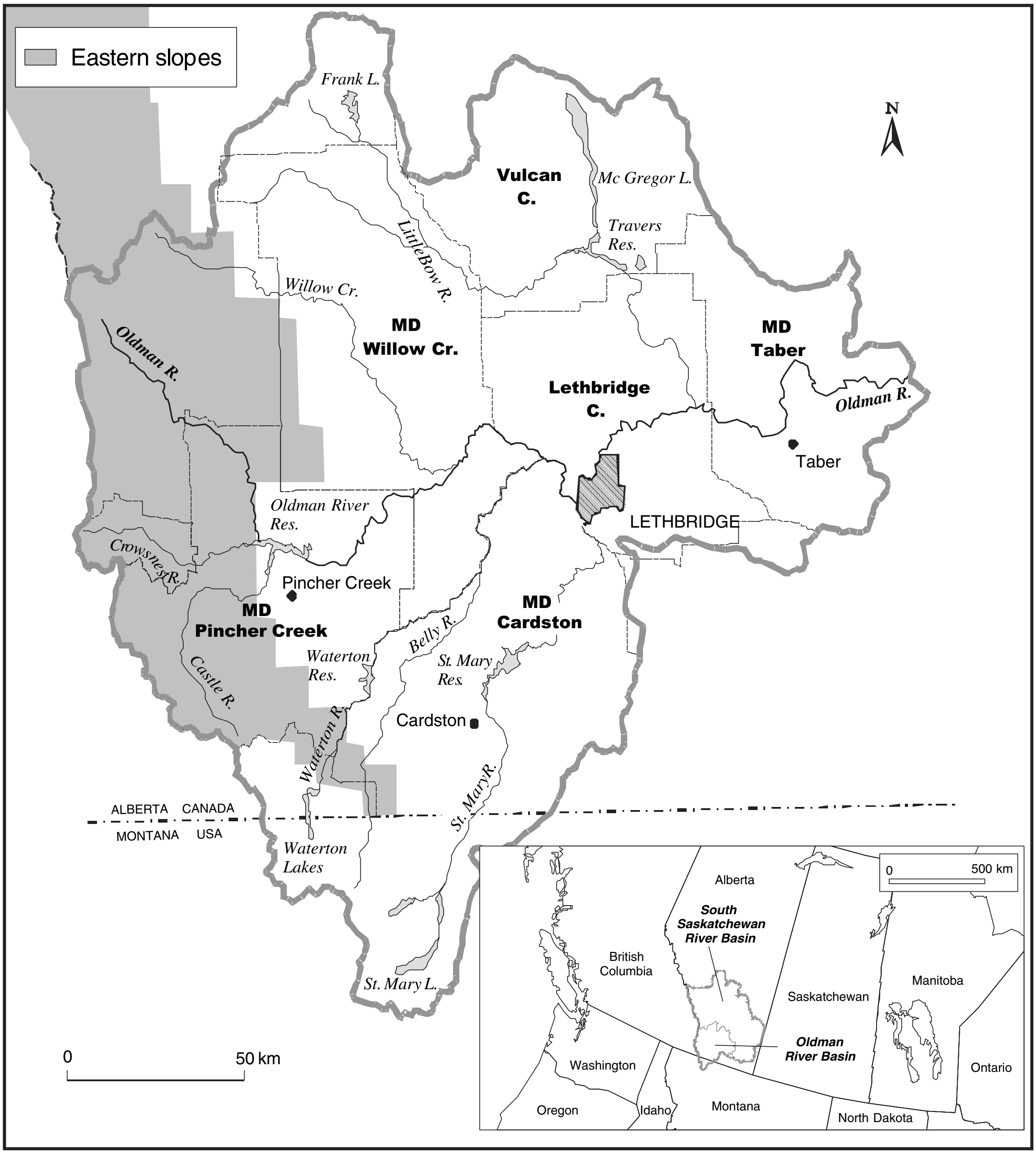

Fig. 1. The Oldman River basin, Alberta, Canada.

(Johnson et al., 2003). Furthermore, although detected pesticide levels in surface water samples from the Oldman River Basin in 1998 were acceptable for humans and livestock, guidelines do not exist for many pesticides and frequency of detection becomes significantly higher with technological advances (AAFRD, 2000b).

3.2. Institutional arrangements

Under Canada's *Constitution Act*, provinces have primary jurisdiction over water management and are, therefore, key actors in source water protection (de Loë and Kreutzwiser, 2005). In Alberta, however, there are no formal provincial mechanisms for protecting source waters. Rather, the institutional landscape is fragmented, with responsibilities for water quality and land use distributed among provincial departments and quasi-judicial boards, municipalities, and watershed advisory bodies (Table 2).

The *Water Act* (Revised Statutes of Alberta [R.S.A.] 2000, Chapter W-3) is the most important piece of water-related legislation, establishing a water allocation system based on the prior appropriation doctrine. Water quality issues are partially addressed under the *Environmental Protection and Enhancement Act* (R.S.A. 2000, Chapter E-12), which allows for provincial regulation of some land use activities affecting surface and groundwater resources, and the release of substances into water bodies. Provincial land management responsibilities are largely restricted to public

Table 2
Selected institutional arrangements pertinent to source water protection in the Oldman River basin

Institutional arrangement	Contribution to source water protection
Environmental Protection and Enhancement Act[a]	Regulation of land use activities for environmental protection, on lands adjacent to surface water bodies or affecting aquifers Authority for issuance of environmental protection orders, environmental impact assessment process Requirement for groundwater-reliant public water utilities to monitor raw water quality
Water Act[b]	Framework for Water Management Planning (Section 7): authorization for basin-scale water management plans, establishment of minimum flows Regulation of construction and maintenance of groundwater wells Authority to restrict land and water use around reservoirs on public lands
Public land management statutes and policies	At least six pieces of legislation allowing creation of special management areas and/or regulation of land use activities on public lands (e.g., Public Lands Act,[c] Forest Reserves Act[d]) Policy for Resource Management of the Eastern Slopes: nonbinding land use zoning to guide management of public lands in Eastern Slopes planning area (incl. headwaters of the Oldman River)
Southern Alberta Sustainability Strategy	Nonbinding regional strategy under development to integrate water and other resource management with economic, social, and environmental concerns in Southern Alberta (incl. Oldman River basin)
Agricultural Operation Practices Act[e]	Authority for provincial quasi-judicial Natural Resources Conservation Board to approve applications for confined feeding operations and manure storage facilities
Municipal Government Act[f]	Authority for municipal regulation of development (bylaws to classify/regulate development, development permit systems, area structure plans, design standards, conservation easements, environmental reserves), intermunicipal land use plans and service agreements, public water utilities Land Use Policies (Section 622): municipal planning to be consistent with provincial policy statements
Land Titles Act[g]	Primary authorization for voluntary adoption of conservation easements by landowners
Safety Codes Act[h]	Authorizes municipalities to administer/enforce provincial regulations on private septic systems
Water for Life Strategy	Nonbinding provincial strategy proposes multi-stakeholder advisory groups at provincial, watershed, and community levels, voluntary source water protection by municipalities and watershed groups
Cows and Fish Program (Alberta Riparian Habitat Management Program)	Partnership between provincial and federal departments, farm commodity groups, conservation groups, local agricultural producers and communities Assists with voluntary riparian health inventories, establishment of best management practice demonstration sites
Oldman River Basin Water Quality Initiative	Grassroots partnership between federal and provincial departments, agricultural commodity and interest groups, private industry, health region, municipalities, irrigation districts, and other stakeholders Early focus on water quality monitoring, future focus on links between land use activities and water quality, and encouraging urban and rural land use practice change

[a] Revised Statutes of Alberta (R.S.A.) 2000, Chapter E-12.
[b] R.S.A. 2000, Chapter W-3.
[c] R.S.A. 2000, Chapter P-40.
[d] R.S.A. 2000, Chapter F-20.
[e] R.S.A. 2000, Chapter A-7.
[f] R.S.A. 2000, Chapter M-26.
[g] R.S.A. 2000, Chapter L-4.
[h] R.S.A. 2000, Chapter S-1.

lands, which are managed under at least six statutes (Table 1). Municipal land use planning powers are authorized under the *Municipal Government Act* (R.S.A. 2000, Chapter M-26), and include the regulation of new development through zoning bylaws (ordinances), permit systems, and design standards. In the case of new or expanded CFOs, however, municipal planning decisions are superceded by provincial regulation. Under the *Agricultural Operation Practices Act* (R.S.A. 2000, Chapter A-7) the provincial quasi-judicial Natural Resources Conservation Board (NRCB) assumed in 2002 responsibility for approving all CFOs across Alberta.

Other IAs include the Oldman River Basin Water Quality Initiative and Cows and Fish, initiatives dedicated to monitoring and assessing water quality and riparian health, respectively (ORBWQI, 2002; Fitch and Ambrose, 2003). These partnerships encourage voluntary best management practices on private lands. The Alberta Government's new Water for Life Strategy aims to build on such grassroots approaches, suggesting watershed stewardship groups be responsible for developing and implementing "on-the-ground" solutions to problems identified through watershed planning (Alberta Environment, 2003a).

Table 3
Elements and indicator questions to assess the extent to which institutional arrangements facilitate or constrain source water protection at the local level

Element	Indicator questions
Technical knowledge	What is the level of technical knowledge about drinking water sources and their potential threats at the local level? To what extent, and how, do institutional arrangements contribute to the development of a local technical knowledge base of source waters and their potential threats?
Legal authority	To what extent can existing institutional arrangements be used to manage existing and future land uses and management practices to prevent or minimize potential threats? To what extent can existing and future land uses and management practices be influenced in sensitive or vulnerable areas (e.g., wellhead areas, recharge areas, reservoirs)? To what extent, and how, can existing and future land uses and management practices be influenced in sensitive or vulnerable areas when they are physically located outside local jurisdictional boundaries?
Public Involvement	How aware are stakeholders and decision-makers of the potential impacts of land use activities on source water quality? To what extent, and how, have stakeholders participated in the selection and implementation of institutional arrangements for source water protection?
Land and water integration	To what extent are institutional arrangements for land and water management integrated? To what extent does existing local land use planning support the practice of source water protection at a watershed or regional groundwater scale?

3.3. Methods

Existing IAs for land use planning and water management in the Oldman River basin were examined using the evaluation framework described in Section 2.2. Questions addressing relevant aspects of each of the four core elements in the framework were used as indicators for the evaluation (Table 3). Positive responses to indicator questions, derived from analysis of primary and secondary data, suggested the presence of institutional arrangements that facilitate local capacity for source water protection. This is a standard methodological approach that has been used to assess capacity in the water field in a number of different contexts, including integrated resource management (Mitchell and Pigram, 1989), irrigation management (Merrey et al., 1995), groundwater management (de Loë et al., 2002), and management of water systems (USEPA, 1998).

Data gathering and analysis were conducted between January and November 2003. Written documents included more than 60 federal, provincial, and local government laws, policies, and regulations; and over 70 municipal, provincial, watershed agency, consultant and academic documents. Twenty-one key informants were selected for on-site interviews according to their familiarity with land use planning or water management at the provincial, watershed, or municipal levels (Table 4). Informants were initially identified from appropriate web sites and publications, but a "snowball" approach was followed at a later stage. Interviews were semi-structured, based on a predetermined interview protocol drawing from indicator questions in Table 3, and ranged from a half hour to two hours. They were digitally recorded and transcribed.

Following a case study research approach (Yin, 2003), interview data were used to corroborate data gathered from document analysis, and to provide insights into issues that were not available from documentary sources. For this purpose, a case study database was developed in which data from documentary and key informant sources were categorized under each of the four elements of the framework. The data were then analyzed to provide responses to the indicator questions posed in the evaluative framework. As the purpose of the study was to gain a deeper understanding of the extent to which institutional factors enhance or constrain local capacity for source water protection in the Oldman River basin, rather than to assess absolute capacity, a detailed narrative approach was used to answer indicator questions.

Table 4
Agency representation of key informants selected for interviews

Organization	Number of key informants
Municipal water managers and land use planners	7
City of Lethbridge	
County of Lethbridge	
Town of Taber	
Municipal District of Taber	
Oldman River Intermunicipal Service Agency	
Provincial government departments	9
Alberta Environment	
Alberta Sustainable Resource Development	
Alberta Agriculture, Food and Rural Development	
Natural Resources Conservation Board	1
Oldman River Basin Water Quality Initiative	4[a]
Southern Alberta Environmental Group	1
Irrigation districts	2
Lethbridge Northern Irrigation District	
St. Mary River Irrigation District	

[a] Three key informants from the Oldman River Basin Water Quality Initiative are also listed as key informants in other categories (provincial government departments, municipal water managers and land use planners).

4. Local capacity for source water protection in the Oldman River basin, Alberta

The analysis of existing IAs pertinent to source water protection in the Oldman River basin is summarized in Table 5. Important strengths and weaknesses in regard to local capacity for source water protection are discussed in more detail in the following sub-sections. It is important to note that individual arrangements were evaluated in terms of their contribution to local capacity for source water protection, not in terms of their stated objectives.

4.1. Technical knowledge

At both the provincial and watershed scales, existing IAs are contributing to developing a technical knowledge base on source water quality and the impacts of some land use activities, notably agriculture, on water quality. Key contributions include background studies for the South Saskatchewan River Basin Water Management Plan; agricultural sub-basin water quality monitoring under the Canadian–Alberta Environmentally Sustainable Agriculture program; a decade of riparian health local outreach by the provincial Cows and Fish; and open internet access for municipalities to the provincial Natural Resources Conservation Board decisions and supporting materials concerning confined feeding operations (CAESAWQC, 1998; Alberta Environment, 2003b; Fitch and Ambrose, 2003).

The Oldman River Basin Water Quality Initiative (ORBWQI), a voluntary local–provincial–federal partnership among governments, nongovernmental organizations, and industries, conducted in conjunction with Alberta Environment an intensive 5-year monitoring program of water quality and quantity in the Oldman River basin. Monitored contaminants included nutrient, fecal coliforms, and pesticide levels in surface water bodies and some groundwater sources, in agricultural sub-basins of the Oldman River basin, irrigation canals, urban stormwater outfalls, and upstream and downstream of some watershed communities (ORBWQI, 2000a; AAFRD, 2002a,b). ORBWQI is also concerned with raising awareness about threats to source waters at the watershed scale by conducting a manure management survey of livestock operations; mapping land use and surface water and groundwater vulnerability to contamination; and establishing and monitoring the effectiveness of best management practice pilot projects (ORBWQI, 2000a,b).

However, existing IAs do little to develop local- or municipal-scale understanding of drinking water source quality and potential contaminants. Land Use Policies under the *Municipal Government Act*, with which municipal development plans are to be consistent, "encourage" municipalities to identify significant water resources within their boundaries (Alberta Municipal Affairs, 1996). The weak language of the policy does little to spur municipalities to invest their limited resources in water resource and vulnerability assessments and contaminant source inventories.

An additional weakness is the limited requirement for source (or raw) water quality monitoring by public water suppliers. Regulation 122/93 under the *Environmental Protection and Enhancement Act*, the Potable Water Regulation, stipulates that public utilities reliant on groundwater sources must monitor raw and treated water quality, but

Table 5
Summary of major strengths and weaknesses of institutional arrangements (IAs) pertinent to source water protection in the Oldman River basin

Criteria	Strengths	Weaknesses
Technical knowledge	Strong contribution of provincial IAs and ORBWQI to watershed- and provincial-scale knowledge of water quality, sensitivity of source water areas, and impacts of agriculture and some other land uses	Weak contribution of IAs guiding local land use planning and drinking water management to local-scale knowledge of source water quality and contaminant sources useful for planning
Legal authority	IAs provide mechanisms for provincial or municipal protection of sensitive or vulnerable water supply areas, and regulation of development, on public and private land	Provincial IAs for protection of special areas and watershed planning are not geared towards, or widely used, for water quality protection Municipalities are limited in managing existing land uses, and activities outside their boundaries that could contaminate source waters Municipal preferences for locating CFOs may be superceded under appeal to the NRCB
Public involvement	Public support for watershed approach to water quality management, and interest in mechanisms to integrate water quality protection and land use planning Partnership-based initiatives demonstrate commitment by local and some provincial stakeholders to assessing the impacts of land use activities on water quality	Existing IAs neglect source water protection. Roles, responsibilities, and tools for source water protection are unclear Limited opportunity for stakeholders to participate in selection of formal source water protection tools
Land and water integration	Long history of provincial watershed-scale planning and integrated resource management initiatives Voluntary, multi-stakeholder programs strongly contribute to individual and community awareness of impacts of land use on water quality	Historic and current focus on water supply issues overshadows water quality protection Weak provincial direction for integration of municipal responsibilities for land use planning and drinking water supply

utilities on surface water sources (the majority in southern Alberta) are only required to monitor "treated" water quality. While some municipalities monitor the turbidity and pH of raw water at their intake, the purpose of such monitoring is to fine-tune their water treatment systems, rather than to monitor source water quality on an ongoing basis (Kaupp, 2003, personal communication; Lewis, 2003, personal communication). The ORBWQI's 5-year intensive monitoring program made some source water quality data available to municipalities. However, as the Initiative's focus shifts away from data collection towards facilitating change, a void may be created in the current, comprehensive water quality database (ORBWQI, 2003). Furthermore, the Initiative intends to disband around 2008, when its second 5-year mandate is completed (Devent, 2003, personal communication; ORBWQI, 2003). Land use planning agencies and water utilities have the potential to contribute local scale data on water quality, but current IAs provide little incentive to municipalities to make source water knowledge a priority.

4.2. Legal authority

Public land management legislation (e.g., *Public Lands Act, Forest Reserves Act*), the *Environmental Protection and Enhancement Act* (EPEA), and the *Municipal Government Act* assign broad authorities to provincial agencies and municipalities that could allow them to restrict potentially polluting activities in sensitive source water areas. Under the EPEA, codes of practice, bylaws, and regulations govern some land uses and activities (e.g., landfills, pesticide use, wastewater and storm drainage, substance releases) that could contaminate water. Legislation pertaining to public lands creates provincial powers to regulate land use activities on those lands and to designate and manage land use in special areas (e.g., establishment of forest land use zones for protection of sensitive watershed resources under the *Forest Reserves Act*).

These powers to create and manage special areas could be used to protect sensitive drinking water source areas on public land (which includes much of the headwaters of the Oldman River). However, these IAs were not created with the intent of protecting source waters, and there is little evidence to suggest that they have been, or will be, used for that purpose. Where these arrangements relate to water management, the emphasis in this semi-arid region has been on maintenance of flow, rather than on water quality protection. As a result, water management plans and related tools under the *Water Act* may affect water quality only indirectly, mainly through the establishment of minimum flows that could enhance dilution of contaminants (Alberta Environment, 2002; Sly, 2003, personal communication).

The *Municipal Government Act* authorizes municipalities to use zoning bylaws, permit systems, standards, conservation easements, and area structure plans to classify and regulate development. All of this could be used to protect sensitive source water areas from new development. However, municipal bylaws only apply within a municipality's jurisdiction, and cannot be retroactive. This limits municipalities' ability to manage existing and historic land use activities, and constrains their ability to protect source waters outside of their political boundaries. The Act does allow for municipalities to plan together across municipal boundaries through adoption of intermunicipal development plans and service agreements. These joint plans could provide a forum for municipalities to discuss land use planning restrictions near drinking water sources. Municipalities are much more restricted regarding the initial approvals for CFOs and manure storage facilities granted by the provincial Natural Resources Conservation Board. Although these approvals must have regard for municipal development plans, they may supercede municipal guidelines upon appeal. This has happened in at least one instance in the Municipal District of Willow Creek (Cumming, 2003, personal communication; Harty, 2003, personal communication).

4.3. Public involvement

Participation by provincial, municipal, nongovernmental, and industrial representatives and landowners, in programs such as the Oldman River Basin Water Quality Initiative and Cows and Fish shows an interest on the part of many stakeholders to assess the impacts of land use activities on water quality, and to consider implementation of best management practices. Stakeholder support for these programs bodes well for progress in water quality protection through grassroots, informal, and nonregulatory approaches. Understanding of the links between land use practices and water quality, and a willingness to modify practices, could indicate support for a more formal, provincial-scale approach to protecting drinking water sources. Public consultations for the provincial Water for Life Strategy have indeed revealed strong public support for a watershed approach to water quality management, which is reflected in the Strategy itself (Alberta Environment, 2003a; Equus Consulting Group Incorporated, 2002, 2003). However, early concerns regarding accountability for source water protection, support for grassroots initiatives, and integration of land use planning and water quality protection went largely unaddressed in the final version of the Strategy (Alberta Environment, 2003a; Equus Consulting Group Incorporated, 2002, 2003). In fact, the final version makes almost no reference to source water protection (Alberta Environment, 2003a). In contrast, the draft Strategy released early in 2003 proposed a number of specific source protection action items such as (Alberta Environment, 2003c, p. 15):

> "Develop a watershed and source protection framework in collaboration with Watershed Advisory Councils, Watershed Protection Groups, municipalities and stakeholders.
>
> Prepare watershed and source protection plans during the appropriate phases of watershed planning initiatives.

Encourage communities with drinking water systems to prepare, or participate in the preparation of, source protection plans.
Support and encourage the establishment of Watershed Protection Groups…"

While these action items provided few details on what constitutes a source protection plan, or how it could be implemented, they indicated that Alberta Environment was considering source water protection and its role in watershed management. Removal of these fairly broad statements from the final Strategy suggests that the Province is not prepared to make source water protection a priority in the foreseeable future regardless of public support. Furthermore, there are few formal opportunities for public involvement in land use decision-making and, when they do exist, they may not be open to all. For instance, under the *Agricultural Operation Practices Act*, "directly affected parties" may participate in the application review process for CFOs and manure management facilities. However, "directly affected parties" has been narrowly defined in legislation and regulation to include downstream water license holders (within 10 miles), municipalities, and nearby landowners (1/2–4 miles away, depending on the size of the CFO). And although members of grassroots public interest groups have participated in past application processes as directly affected parties (e.g., NRCB, 2002), no grassroots organization has qualified as such.

4.4. Land and water integration

Alberta's "integrated resource management" initiatives date back to the 1947 creation of the Eastern Rockies Forest Conservation Board to manage the Eastern Slopes (Fig. 1) – that portion of the Rocky Mountains that drains into southern Alberta, and contains much of the headwaters of the Oldman River and its tributaries (Government of Alberta, 1984). Public lands in the Eastern Slopes area have traditionally been managed on a watershed scale, and this continues to be the approach used today, under the Policy for Resource Management of the Eastern Slopes (Government of Alberta, 1984). The Policy establishes provincial land use zoning over public lands in the policy area, restricting new land use activities to varying extents, and placing priority on "watershed protection" (Government of Alberta, 1984). The Policy spawned the creation of at least 14 local and 13 sub-regional integrated resource plans to provide more tailored guidance for provincial land use management decisions in parts of the Eastern Slopes area (Mortemore, 2002). Unfortunately, in practice, integrated resource plans have limited influence, as they are nonregulatory tools intended simply to guide provincial land use planning decisions on public lands. Furthermore, understanding of "watershed protection" is essentially limited to maintenance of surface water flows. The focus on water quantity is reinforced in watershed management plans approved under the *Water Act*, which are intended to address issues of water allocation for irrigation and other uses, largely neglecting water quality protection.

Provincial riparian and rangeland health programs, on the other hand, encourage integration of land and water concerns on private lands. The Cows and Fish initiative promotes awareness and knowledge about riparian health through development and distribution of field guides for riparian health assessment and fact sheets, establishment of best management practice demonstration sites, and training in techniques for conducting riparian health inventories (Fitch and Ambrose, 2003). The key link between healthy riparian zones and the protection of water quality is emphasized in the Cows and Fish outreach materials. The provincial Alberta Sustainable Resource Development department has adopted a similar integrated approach, using rangeland health assessment as a tool to encourage appropriate management of public lands used by private individuals and companies (Adams et al., 2003). All these provincial programs, however, are advisory in nature.

The Province's Water for Life Strategy suggests a more formal approach for the integration of land and water issues, based on the creation of three types of partnerships (Alberta Environment, 2003a):

Provincial Water Advisory Council: a multi-stakeholder group to oversee implementation of the strategy across Alberta.
Watershed Planning and Advisory Councils: multi-stakeholder watershed committees to promote watershed planning and adoption of best management practices in each watershed.
Watershed Stewardship Groups: grassroots groups already in existence in many watersheds, involved in developing and implementing locally relevant strategies.

However, the Province has not proposed any clear mechanisms for linking the activities of Watershed Planning and Advisory Councils with municipal land use planning (Alberta Environment, 2003a). Furthermore, the *Municipal Government Act* and provincial Land Use Policies, which outline land use planning and water supply responsibilities, offer few means for addressing this concern. Lack of formal mechanisms for integration of land use planning and water management was a key concern raised during public consultation for the Water For Life Strategy (Equus Consulting Group Incorporated, 2003; Morrison, 2003).

5. Conclusions

IAs tailored to source water protection at the local level are lacking in many jurisdictions across the world. Trends toward environmental devolution and public participation imply that local governments, facing increasing local, national and international pressures to protect sources of drinking water, have to rely on existing IAs for land use planning and water management. Their capacity to do so, however, is highly variable. In Alberta, the capacity of local governments for source water protection is constrained by existing IAs, as illustrated in the Oldman River basin. At the municipal level, disconnection of land use planning and water management constrains the generation of a local technical knowledge base concerning water resources. Although technical information is being generated at the provincial level and made available to municipalities through partnership programs and other communication activities, no formal mechanism is in place to allow or to encourage local officials to transform this information into locally relevant knowledge.

The capacity of local governments to protect source water is also constrained by institutional arrangements that assign the responsibility for regulating intensive livestock operations, an important potential pollution source, to the provincial government, leaving municipalities to address other rural and urban land uses. Provincial control over confined feeding operations and manure storage facilities, in the absence of provincial commitment to source water protection, has the potential to compromise strategies designed and implemented at the local level. This institutional impediment to locally devised source water protection planning is reinforced by a widely held belief that Alberta Environment, with jurisdiction over water quality protection under the *Environmental Protection and Enhancement Act*, is the actor responsible for source water protection across Alberta. This is a critical barrier to the development of local capacity for source water protection, in that many important local actors do not see themselves as having a role.

Formal mechanisms for land and water integration on a watershed basis, which could help overcome local capacity constraints regarding technical knowledge and legal authority and, at the same time, provide opportunities for broad public involvement, have yet to be realized in Alberta. Although multi-stakeholder watershed partnerships are the cornerstone of the Province's new Water for Life Strategy, no clear indication has been given regarding their relevance for municipal land use planning. This was a strongly voiced concern during the rounds of public consultation held during the draft of the Strategy.

Insights provided by the analysis of IAs in the Oldman River basin, based on the four core elements in the evaluation framework, highlight the importance of institutional factors in determining the capacity of local governments for source water protection. From a *functional* perspective, IAs in Alberta reinforce power differentials between senior and local levels of government. Consequently, progress toward development of formal source water protection strategies will be limited until the Province exercises leadership in that direction. In this context, the *relational* components of local capacity for source water protection hold the greatest promise. Opportunities for meaningful involvement can enhance the capacity of local governments for source water protection, as evidenced by the success of partnerships such as Cows and Fish, the ORBWQI, and watershed stewardship groups. Meaningful participation can provide local governments not only with the possibility of protecting drinking water sources through voluntary adoption of BMPs on private lands, but can also enhance their leverage when confronting provincial government practices regarding public lands and the livestock industry. Eventually, meaningful public participation may force provincial action and legislative change – a situation evident in other contexts (Connelly, 2006).

The case of the Oldman River basin may be particularly relevant for other jurisdictions around the world in which the commitment of senior levels of government to economic production has not been balanced by an equal commitment to environmental protection, and in which it is the local governments that bear the burden of source water protection. Under these conditions, strong institutional support to facilitate meaningful and broad public involvement and land and water integration will be necessary to overcome other capacity-related deficiencies, such as limited technical knowledge and restricted legal authority.

Evaluation of institutional arrangements through the lens provided by the capacity evaluation framework used in this paper can provide useful insights regarding the capacity of local governments vis a vis senior levels of government or, potentially, multilateral agencies and donor organizations. In so doing, however, it assumes local governments are committed to source water protection and can address potential conflicting interests at the local level. If, as this study suggests, local capacity for source water protection can be facilitated by IAs that encourage interaction among a wide range of local stakeholders and residents, then evaluation frameworks should also take into consideration how IAs help to maintain and to reproduce power differentials among them. Relational perspectives on capacity and capacity building, advanced by scholars and practitioners in community development and public health promotion, have much to offer in this regard.

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