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The Manitoba Challenge:

Linking Water and Land Management for Climate Adaptation

Dr. Henry David Venema with
Bryan Oborne and
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Executive Summary

Manitoba's water resources—notably including Lake Winnipeg—are vulnerable to the impacts of climate change. Ecological watershed management is a major opportunity to address climate change vulnerabilities and challenges related to Lake Winnipeg nutrient management and can be pursued as a rural innovation agenda. Climate change adaptation through integrated watershed management and planning (IWMP) should therefore be a major provincial policy priority. We base this conclusion on two key observations:

1. A companion technical study demonstrates that only a very small fraction of available water resources in Manitoba's agricultural region is directly consumed by human activities (irrigation, livestock production and municipal demands). Water availability in southern Manitoba is heavily influenced by watershed management; most water is consumed by evapotranspiration (92 per cent), with runoff accounting for the remaining 8 per cent.

2. Reviews of other scientific assessments of climate change impact studies for western Canada and Manitoba reviewed in this report (Intergovernmental Panel on Climate Change [IPCC], 2007; Sauchyn & Kulshreshtha, 2008) clearly outline Manitoba's future water management challenges. These studies project higher overall aridity, more frequent extreme rainfall events, shifting seasonal precipitation patterns, more frequent agricultural and hydrological drought, and negative water quality impacts because episodic extreme events will produce heavy nutrient loads and longer periods of low flow in streams and rivers.

A climate change adaptation strategy based on ecological watershed management is therefore needed for three key reasons:

- From a provincial perspective, it's the most effective mechanism for regulating water supply.
- The strong consensus from scientific assessments is that integrated management of water and land is crucial for managing climate impacts.
- Ecological watershed management has the significant co-benefit of reducing nutrient loads in Lake Winnipeg.

Adapting to climate change through ecological watershed management poses an institutional challenge. Climate change impacts, specifically more frequent extreme precipitation events and shifting seasonal rainfall patterns, will exacerbate longstanding tensions over agricultural land drainage.

The adaptation priority of conserving runoff for use later in the growing season conflicts with the traditional practice of ever-increasing agricultural land drainage.

The integration of water and land issues has been challenging for Manitoba water policy since the province's entry into confederation. Better integration of water and land management has been proposed since 1921 (the Sullivan Commission), and attempted sporadically since 1959 (the Watershed Conservation Districts Act). We identify the major eras in the history of Manitoba water policy below:

- *The Drainage Era, from 1870 to 1959*. Land and water management issues are effectively severed by the imposition of a grid-iron settlement pattern. This era advances through federal settlement policies, particularly the arrival of the railways, and associated land-clearing and drainage activities to accommodate agricultural settlers.
- *The First Watershed Era, from 1959 to 1990*. The conservation district program created under the 1959 legislation is the first evidence of a serious political commitment to a new institutional model for coordinated land and water management using watershed boundaries to define management units. Most conservation districts are formed, however, on the basis of rural municipal boundaries under the 1976 Conservation Districts Act.
- *The Second Watershed Era, from 1990 to 2009*. Sustainable development and concerns about the health of Lake Winnipeg resonate with Manitobans. The need for a more

integrated approach to water and land management reinforces the original logic of the conservation district program. Non-point source pollution loads on Lake Winnipeg from watershed processes reinforce the conservation district's role as delivery agents for integrated watershed management and planning (IWMP), Manitoba's version of IWRM.

We propose that Manitoba is now on the verge of a new water policy era (the Adaptation Era), where the nature of climate change impacts makes comprehensive water and land management an obvious priority. Greater awareness that climate change worsens Lake Winnipeg eutrophication will sustain political attention. Significantly increased budgetary resources and new economic instruments will be required to support the institutions responsible for IWMP. Linking ecological goods and services instruments to agricultural practice is a logical way to address key adaptation issues, particularly those concerning agricultural land drainage. Coherent ecological goods and services policy is necessary, but not likely sufficient to fully address adaptation needs. The deeper challenge lies in overcoming fractured governance and programming at the water-land interface, repurposing existing resources, and designing new instruments to support and strengthen watershed management and governance.

The Adaptation Era will not arise without legislative commitment. A review of water sector strategic plans conducted by the Rosenberg Forum on Water Policy (University of California) concluded that most strategies fail because of priority conflicts among participating agencies; collaboration is not sustained without reliable funding or a well-resourced new institutional model. The few strategies that succeed go well beyond reliance on standard budgeting and appropriations to long-cycle fiscal commitments, supported by new legislative instruments. Without such support, innovative watershed governance and management succumbs to short-term, expedient responses to climate shocks, sapping resources and undermining longer-term goals. Typical examples include discretionary budget allocations for drainage projects, flood protection, and disaster assistance after flood events—resources that might have a much higher and longer-term benefit if invested in watershed management.

Finding the political will for the long-term commitments required to realize the Adaptation Era will be much easier if those commitments are cast as a rural innovation agenda, stressing the co-benefits of resilient agriculture, vital rural communities, improved water quality and Lake Winnipeg stewardship—and centred on the technological and institutional requirements for effective watershed management and governance.

Our key recommendations to the Government of Manitoba are therefore:

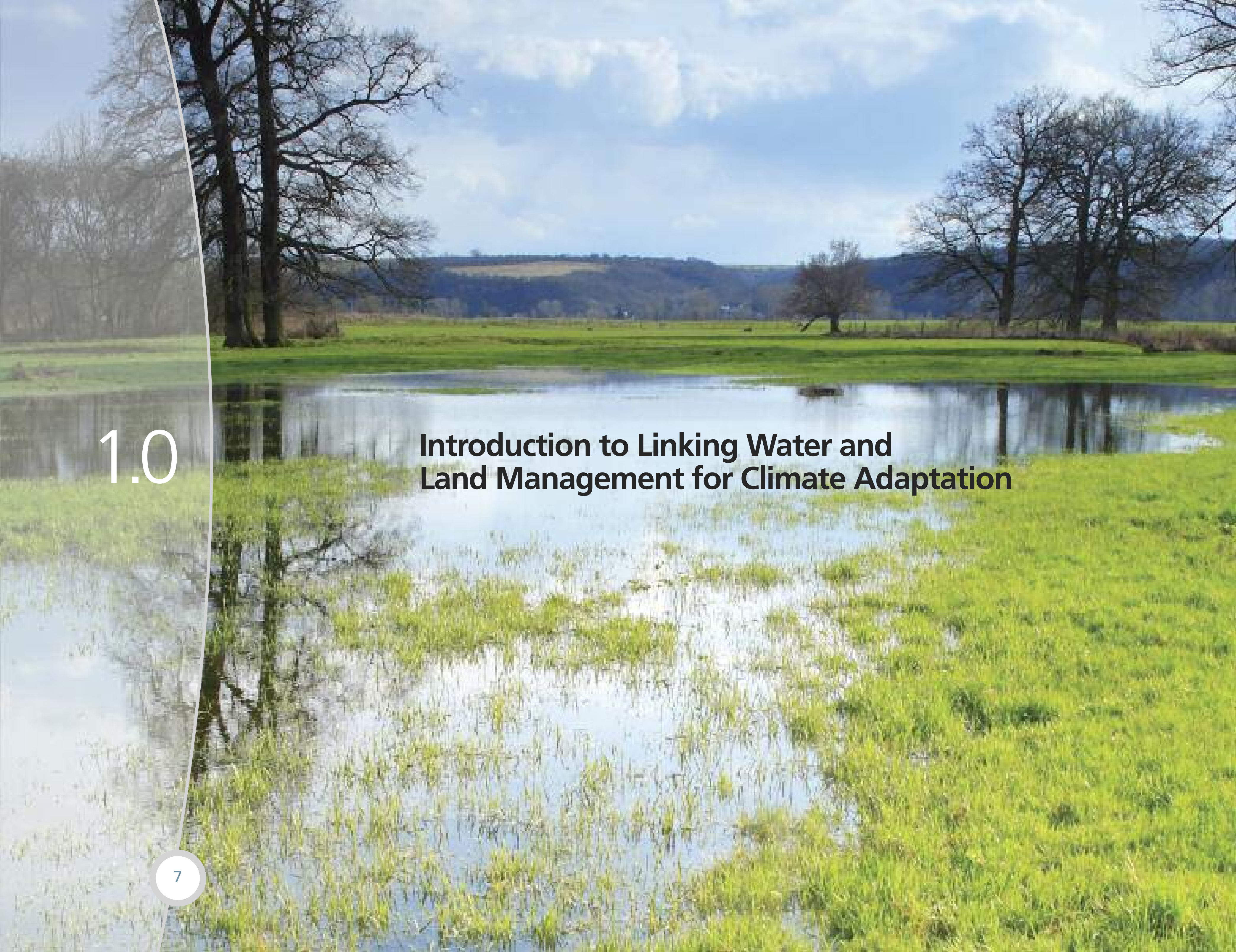
Position climate adaptation internally and publicly as an opportunity to link Manitoba's responses to increased drought and flood resilience and Lake Winnipeg stewardship through a rural innovation agenda centred on the technological and institutional requirements for watershed management and governance.

Build internal and external technical capacity on climate change impacts and adaptation responses. The Government of Manitoba should commission a structured analysis of climate change scenarios for the agricultural region of Manitoba and conduct workshops on the role of watershed-based IWRM in reducing the impacts of climate change.

Conduct reviews of water sector climate change adaptation programs undertaken in other jurisdictions, with particular emphasis on ecosystem-scale programs in water conservation, nutrient management and peak flow management. This review should include the role of economic instruments to reinforce adaptation policy priorities.

Develop a legislative framework that makes long-term fiscal commitments consistent with the necessary institutional reform: a rural governance model strongly oriented toward ecological watershed management.

The Manitoba Challenge: Linking Water and Land Management for Climate Adaptation



1.0 Introduction to Linking Water and Land Management for Climate Adaptation

Overview

Although Canada is widely regarded as a water-abundant nation, this coarse generalization belies the reality of regional water resource stress—particularly in the prairie provinces, including Manitoba. In November 2003, the Canadian Standing Senate Committee on Agriculture and Forestry published a report entitled *Climate Change: We Are at Risk*, concluding that more frequent and widespread droughts on the prairies are likely as a result of climate change. Evidence of current vulnerability is compelling; in an analysis of the 2001–2002 prairie-wide drought, the Saskatchewan Research Council observed that water supplies previously believed reliable were negatively affected, and several failed to meet demand requirements, with wide-ranging impacts on agricultural production and processing, water supplies, recreation and tourism (Wheaton et al., 2005). An authoritative synthesis compiled by Natural Resources Canada (Sauchyn & Kulshreshtha, 2008, p. 277) concluded that for the prairie region, "Increases in water scarcity represent the most serious climate risk."

Well-known University of Alberta ecologist David Schindler (Schindler & Donahue, 2006) describes the Canadian prairies as a typical example of the global environmental "hotspots" described by the Millennium Ecosystem Assessment—a dryland agroecosystem confronted by the simultaneous threats from climate change and nutrient over-enrichment.

IISD conducted a prairie-wide cumulative stress analysis of prairie water resources, observing that a significant fraction of southern Manitoba, including most of the Red River Valley, suffers from a combination of high water demand, constrained water availability and high potential impacts on water quality (Venema, 2005). Furthermore, recent concern over eutrophication risks to Lake Winnipeg has heightened public expectation and the political will for improved water resources management (Lake Winnipeg Implementation Committee, 2005).

The creation of Manitoba's Department of Water Stewardship, the release of Manitoba's Water Strategy (Manitoba Conservation, 2003) and the enactment of the 2006 Water Protection Act are all manifestations of the political will to improve water management. The key governance instruments for integrated water resources management are now in place, with the expectation of institutional and budgetary commitments commensurate with the scale of the challenge. The potential to link climate change adaptation and Lake Winnipeg stewardship issues through ecological goods and services programming within Integrated Water Resources Management (IWRM) presents a critical opportunity for water policy coherence in Manitoba that is consistent with *water soft path* principles.

The water soft path concept was demonstrated by Gleick et al. (1995; 2003) in California and advocated in a Canadian context by Brooks (2005). The concept derives from early work by Amory Lovins (1977) on energy soft paths—a groundbreaking analysis that focused on meeting energy demands using geographically distributed, relatively small-scale energy sources supplying ultra-efficient end-use demands. In contrast, conventional ("hard path") approaches typically rely on large, capital-intensive sources of supply and centralized management. The water soft path methodology advocated by Brooks adapts the backcasting approach developed by John Robinson (1982; 1988), and demonstrated by Gleick et al. (1995) in the water sector.

The key insight guiding the water soft paths approach is first that the demand for water is not for the resource itself (with a few important exceptions), but for the services provided by that resource. Many water uses can therefore be modified to minimize water

consumption with no effect on service levels. The second fundamental characteristic of the soft path approach is that it is normative—environmental sustainability and social equity are imperatives (as opposed to goals) that guide every stage of the analysis. As Brookes (1995, p. 3) describes, "the real differences between soft and hard paths lie not with the technologies, but with the socio-political choices about governance of natural resources."

The key operational principles of the soft path approach are:

- resolving supply-demand gaps from the demand side;
- matching quality of supply with quality of demand; and
- *backcasting* to develop a desirable future water-efficient scenario and to find a feasible path (the combination of policies, programs, regulatory and economic instruments) that connects the future with the present.

The key difference from conventional demand-side management (DSM), which attempts to increase the efficiency of existing water systems, is the explicit recognition within soft paths that sustainable production ultimately depends on sustainable consumption. Whereas conventional water resources planning extrapolates current per capita demand to define future capacity requirement, and DSM assumes some uptake of currently available water conservation technology and projects future capacity requirements based on lower per capita demands, the soft path approach—in contrast—develops a future water-use scenario based on broader societal and sustainable development objectives *in addition to* technological advances. It then proposes a suite of policies that connect the present state of water use with this desirable future state.

The Millennium Ecosystem Assessment[1] (MA, 2005) included the following main recommendations for ecosystem management on a watershed basis, which are largely compatible with the principles of the soft path approach:

- inclusive water governance and integrated approaches to water management and the use of mixed instruments, including market-based instruments for water resources management;
- market-based approaches to reallocation to increase water productivity;
- demand-side management of water resources; and
- societal agreement on ecosystem water requirements to balance competing demands.

Furthermore, the Intergovernmental Panel on Climate Change (IPCC, 2007), argues that the vulnerability of freshwater systems to climate change is generally reduced through the application of IWRM principles.

In the Manitoba context, the water soft path approach can be understood as a methodology within IWRM for guiding management goals toward highly efficient water consumption. IISD developed a water budget analysis for agricultural regions of the province, determining that water scarcity in Manitoba will more likely arise from climate change impacts on agro-ecological processes rather from direct human use. Thus the water soft path philosophy manifests in Manitoba as a climate adaptation priority, particularly conservation and enhancement of ecological goods and services for the their water management features.

[1]The Millennium Ecosystem Assessment was an assessment of global ecosystem change and its effects on human well-being conducted by over 1,300 global scientists and experts and published in 2005.

Integrated Water Resources Management

The Global Water Partnership defines IWRM as:

> *a process which promotes the co-ordinated development and management of water, land and related resources in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems. (Jønch-Clausen, 2004)*

IWRM has been described as having three features that differentiate it from traditional resource-based management. First, it is more "bottom-up" than "top-down," and thus emphasizes the building of capacity among local resource users. Second, integrated water resources management encourages cross-sectoral, interdisciplinary management of water resources. Finally, it encompasses the management of other activities (e.g., land use), which affect water resources (i.e., it is focused on comprehensive solutions). IWRM is deemed most effective when implemented as an adaptive process, "evolving dynamically with changing conditions" (Global Development Research Center, 2005).

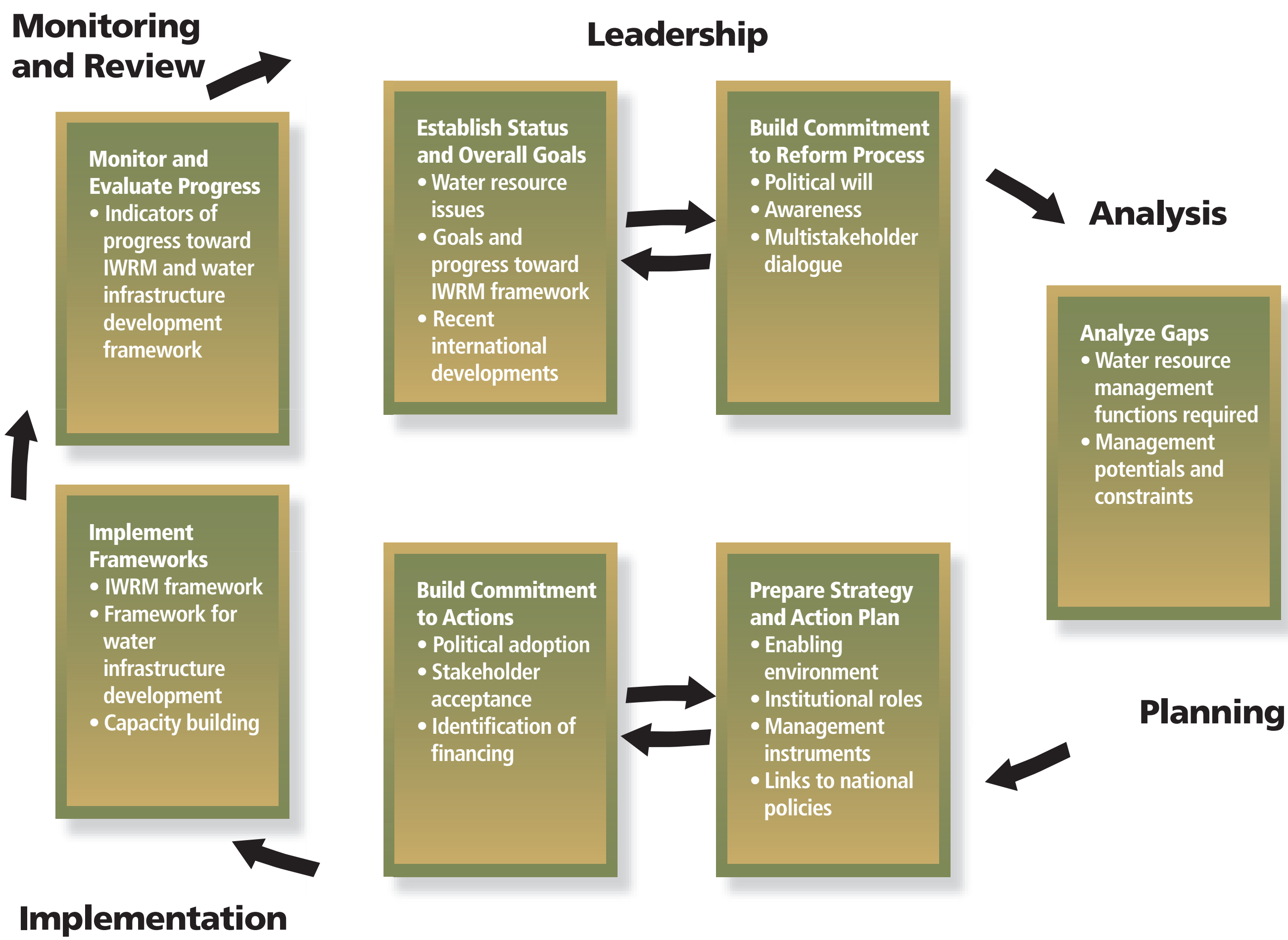
The Global Water Partnership describes integrated management for water resource management as a cyclic process consisting of seven steps, as illustrated in Figure 1: (1) establish status and overall goals; (2) build commitment to reform processes; (3) analyze gaps; (4) prepare strategy and action plan; (5) build commitment to actions; (6) implement frameworks; and (7) monitor and evaluate progress.

Manitoba's IWRM vision is expressed through the general goals of the Manitoba Water Strategy, and specifically through requirements for integrated watershed management planning (IWMP) as legislated in the 2006 Water Protection Act. The act calls for IWRM activities to be supported through the creation of "watershed districts" across the province, building on the existing efforts of the longstanding conservation districts program.

IISD (Oborne, 2005, p.75) has previously analyzed the Manitoba Water Strategy and observed key omissions from the perspective of a dynamic IWRM process, specifically the lack of time-bound commitments, formalized indicators and performance measures.

This report develops the rationale for a much more focused political commitment to Manitoba's Water Strategy, necessitated by the impact of climate change. Successfully adapting to climate change will have major Lake Winnipeg stewardship co-benefits but will require overcoming a long institutional history of managing land and water issues in silos.

Figure 1 >
The "Integrated Water Resources Management Cycle" as described by the Global Water Partnership (Jønch-Clausen, 2004) and showing the basic strategic management elements of leadership, analysis, planning, implementation, and monitoring and review.

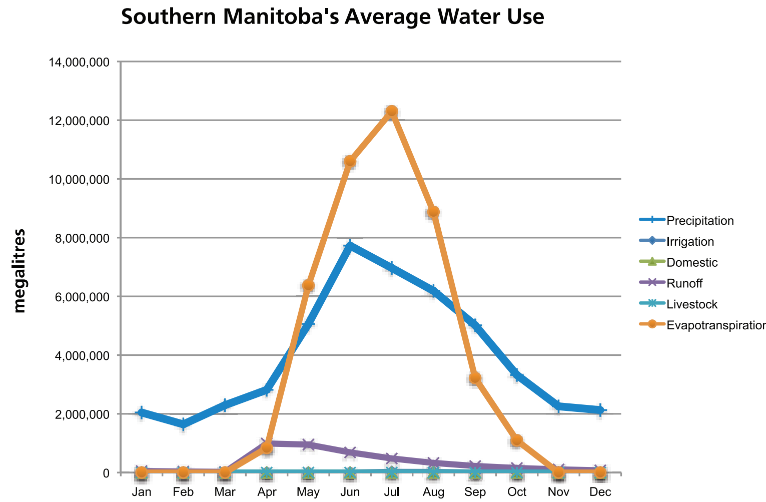


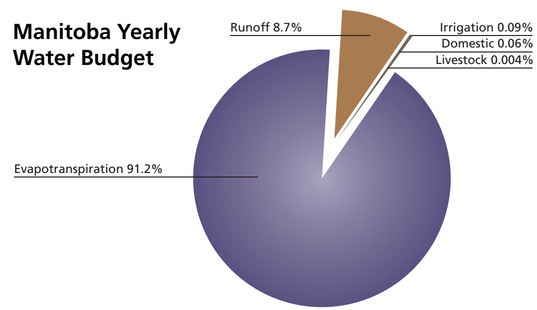
Report Organization

This report consists of three main sections. First, we provide an analysis of projected and historical climate impacts on water resources on the Canadian prairies (Chapter 2), which provides the fundamental rationale for a more integrated, risk-averse and demand-side orientation to water resources management, such as the soft path paradigm. Second, we provide a historical analysis of the key institutions governing integrated water resources management in Manitoba (Chapter 3). The historical perspective is consistent with path dependency theory drawn from the social sciences, which emphasizes how events are sequenced, and the significance of "critical junctures," which may alter historical (and policy) trajectories.

The historical analysis identifies two overlapping but inconsistent strands of Manitoba water policy. The first strand involves an era focused almost exclusively on agricultural land drainage, dating from the earliest phase of European settlement, and is generally not consistent with soft path principles. The second policy strand is a place-based ecosystem management paradigm that dates from early attempts at watershed management via the conservation district program beginning in the late 1950s, elements of which continue to flourish. The conservation district approach is largely consistent with soft path principles.[2]

Finally we conclude with some observations and recommendations for water resource governance in Manitoba, emphasizing a move toward using climate adaptation as a normative, guiding concept for water policy in the province.





Source: McCandless and Venema (2007)

[2]Expressed objectives of the Manitoba Water Strategy:
1. Water Quality – to protect and enhance our aquatic ecosystems by ensuring that surface water and ground water quality is adequate for designated uses and ecosystem needs.
2. Conservation – to conserve and manage the lakes, rivers and wetlands of Manitoba so as to protect the ability of the environment to sustain life and provide environmental, economic and aesthetic benefits to existing and future generations.
3. Use and Allocation – to ensure the long-term sustainability of the province's surface water and ground water for the benefit of all Manitobans.
4. Water Supply – to develop and manage the province's water resources to ensure that water is available to meet priority needs and to support sustainable economic development and environmental quality.
5. Flooding – to alleviate human suffering and minimize the economic costs of damages caused by flooding.
6. Drainage – to enhance the economic viability of Manitoba's agricultural community through the provision of a comprehensively planned drainage infrastructure (Manitoba Water Stewardship, 2005).

2.0 Global Environmental Change: Regional and Historical Perspectives

2.1 Manitoba Hydrology and Global Environmental Change

The preface to the United Nations World Water Development Report (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2006), observes that many water-related disasters occurred in the first few years of the 21st century, and they are a prominent illustration of the fundamental changes that are affecting water resources worldwide and are probably related to global climate change. This study drew heavily on the work of the Water Systems Analysis Group, which specializes in global hydrological systems analysis and maps water resources at a global scale. The report indicated that “the combination of lower precipitation and higher evaporation in many regions is diminishing water quantities in rivers, lakes and groundwater storage, while increased pollution is damaging ecosystems” (UNESCO, 2006, p. ix).

Temperature and precipitation trend analyses and climate change projections reported by the IPCC (2007), the Millennium Ecosystem Assessment (2005) and Grosshans, Venema and Barg (2005) also indicate that the Canadian prairies—including Manitoba—have been historically vulnerable to climatic stress and are vulnerable to further climate change. Climate change may amplify variability in an already highly variable climate and impose generally higher aridity on the prairies. Although mitigation of greenhouse gas (GHG) emissions is a common factor in Manitoba’s contemporary policy discourse on climate change, an equivalent discourse on adaptation to climate change is generally absent. In the next section, we put the risk of future deleterious climate change impacts on Manitoba water resources into the regional and historical context for climatic stress.

2.2 A History of Climate Stress on the Canadian Prairies: Palliser's Expedition, Drought and Historic Climate Variability

The earliest scientific assessment of the Canadian prairies produced a foreboding assessment of a hostile and variable climate. From 1857 to 1860, Captain John Palliser led a group of scientists into what was then the virtually unknown (to European explorers) territory lying west of the Red River Settlement. Palliser's group, known as the British North American Exploring Expedition, was charged by the government of the day with exploring, studying and mapping the plains between the North Saskatchewan River and the current American border. They identified a triangular region bounded by the lines adjoining Cartwright, Manitoba, Lloydminster, Saskatchewan, and Calgary, Alberta, (now known as Palliser's Triangle) as arid and unsuitable for settled cultivation. Palliser warned that disaster would befall those who tried to settle the region. A subsequent expedition by Henry Yule Hind reached different conclusions from Palliser's, probably because of a different geographic focus.

Government policy followed Hind's recommendations, and the early settlement of the prairies coincided with an unusual sustained run of moist years from the late 1890s to the early 1900s, with 12 years of average or above-average precipitation. Increased soil moisture reserves provided for good crop yields and led to bumper harvests in 1905 and 1915. The success of harvests in the early years of settlement encouraged further agricultural expansion and population growth. Despite early promise, the 20th century (and the beginning of the 21st century) has been punctuated by droughts, such as those in 1906, 1936–1938, 1961, 1976–1977, 1980, 1984–1985, 1988 and 2001–2003 (Godwin, 1986; Gan, 2000; Wheaton et al., 2005).

Recent paleo-climatic research also indicates that the Canadian prairies have been subject to high historic climatic variability. Current research suggests a sequence of long-term, broad-scale climatic trends, roughly synchronous over wide areas, and their associated ecological responses. Much of the knowledge of post-glacial environments in the prairie provinces has been derived from the study of pollen records recovered from lakes and wetlands. There are about 100 paleo-environmental records available, with more from Alberta than the other prairie provinces.

At a generalized level, paleo-environmental records for the prairies concur in showing a broad three-part division of the post-glacial period. The early part (prior to about 9,000 years BP), for which there are comparatively few records, shows a sequence of rapid vegetation changes that reflect the post-glacial migration of plants into the region, soil development and landscape response to post-glacial conditions, all of which tend to blur the climate signal. Between around 9,000 and about 6,000 BP, most records show evidence of aridity, increased salinity and higher-than-present temperatures, with the prairie grasslands probably extending up to about 80 km farther north than their present range. After about 6,000 BP, increased moisture and probably cooler temperatures are inferred from rising lake levels, decreased salinity and the southward advance of the boreal forest margin. This cooler, wetter interval resulted in renewed ice accumulation in the Canadian Rockies and led to the first well-marked neoglacial advance around 4,000 BP. A series of ice advances have occurred in the last 4,000 years, although most glaciers show their maximum advances in the last few centuries.

These general climate changes include considerably smaller-scale variability. For example, within the last millennium there were two broad climate phases: the Medieval Warm Period, ending around the 12th century, followed by the Little Ice Age.[3] The paleo-climatic record for the past 1,000 years

[3]A cold period that lasted from about 1550 to about 1850 in Europe, North America and Asia. This period was marked by the rapid expansion of mountain glaciers, especially in the Alps, Norway, Ireland and Alaska. There were three maxima, beginning about 1650, 1770 and 1850, each separated by slight warming intervals.

indicates that periodic and severe drought episodes are common and that drought conditions prior to Euro-Canadian settlement far exceeded anything experienced in the last century (Sauchyn and Beaudoin, 1998). The most severe drought of the past 500 years is thought to have occurred between approximately 1791 and 1800 (Herrington, Johnson & Hunter, 1997). Historically, drought has been found to occur every 30 to 50 years, a pattern repeated in the 20th century. The key concerns regarding future climate change are essentially threefold and interrelated:

- first, regardless of anthropogenic climate change, a return to paleo-climatic norms would entail higher regional climate variability and risk of drought;
- second, climate change impacts superimposed on climate norms from the 20th century will also result in more variability, higher-frequency drought episodes and increased aridity; and
- third, climate change impacts will amplify the increased climate variability and aridity associated with a return to paleo-climatic norms.

We analyze the context for these concerns in the next section.

2.3 Anthropogenic Climate Change: Old Risks Amplified

Manitoba lies in the transition zone to the Great Plains region of North America, where water use generally exceeds natural supply (see Figure 2). Figure 3 (opposite page) meanwhile shows that Manitoba lies in a high-variability transition zone between semi-arid and sub-humid climatic regimes, as shown by the Climate Moisture Index–Coefficient of Variation (CMI-CV) levels.

Figure 2 >

Water Use in Excess of Natural Supply
(average annual) (UNESCO, 2006).

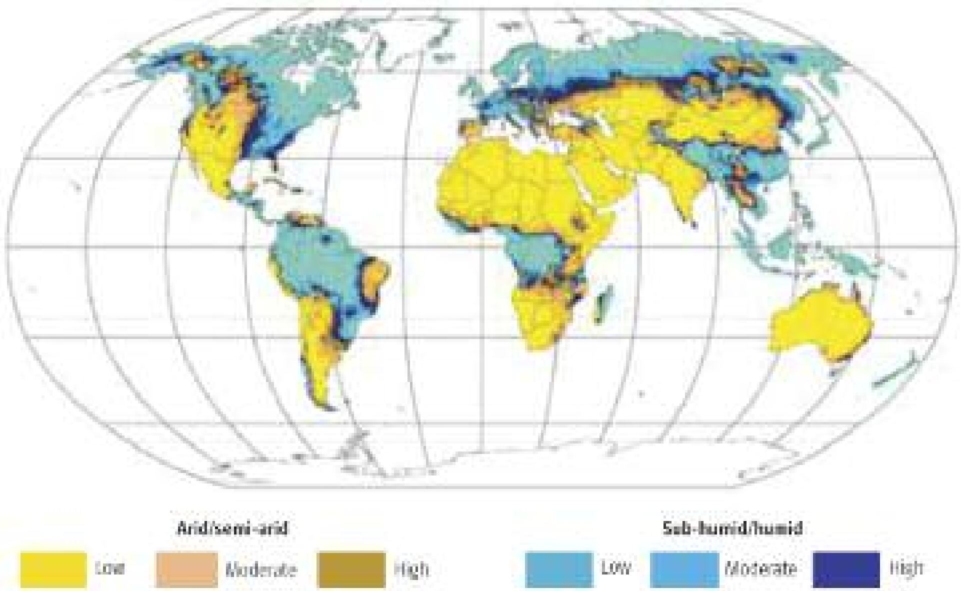
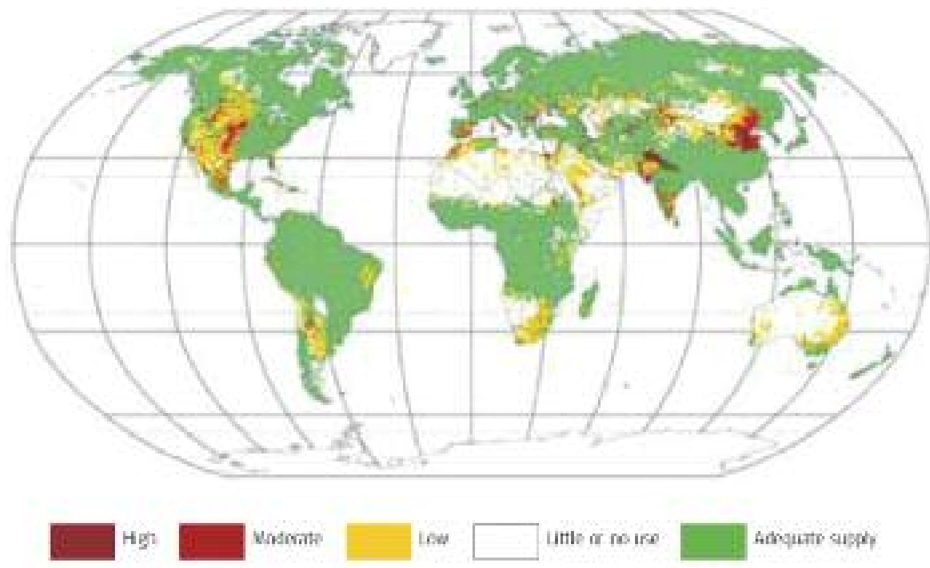


Figure 3 >

Climate Moisture Index–Coefficient of Variation
(UNESCO, 2006).



The Climate Moisture Index (CMI) is a useful measure of available fresh water (Willmott and Feddema, 1992) and a function of climate that indicates the balance between annual precipitation and evaporation. CMI values range from +1 to -1, with wet climates showing positive values and dry climates showing negative values. The coefficient of variation (CV) is the ratio of annual deviation from the long-term annual mean and indicates the variability of CMI over multiple years. The CMI-CV is critical to determining the reliability of water supplies. A value that is <0.25 is considered low, between 0.25 and 0.75 moderate and >0.75 high. Increased climatic variability corresponds to larger annual and inter-annual fluctuations and lower predictability in the climate.

High CMI variability (as expressed by the CMI-CV index) generally occurs along the interfaces between different **climate** zones; important examples being the Sahelian/tropical interface region of North Africa and the Great Plains region of North America—transition regions well-known for periodic severe droughts and water scarcity. Similarly, Maybank et al. (1995) describe inter-annual precipitation variability as the major factor controlling the frequency, intensity and duration of drought.

The Fourth Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (2007) illustrates that anthropogenic climate change (which they state as an "unequivocal" scientific fact) is projected to manifest in western Canada as higher climatic variability and aridity. IPCC research illustrates the spatial trends of global warming through the 20th century (Figure 4) and indicates that northwestern North America has experienced higher-than-average rates of temperature increase. The spatial and temporal trends of the Palmer Drought Sensitivity Index (PDSI)

are similarly concerning (Figure 5). The PDSI was developed in the 1960s to quantify the severity of drought conditions (National Agricultural Decision Support System [NADSS], 2007). It is based on more than just precipitation data and uses a supply-and-demand model for the amount of moisture in the soil. The value of the PDSI is reflective of how the soil moisture compares with normal conditions and usually incorporates a combination of the current conditions and the previous PDSI value, so that it also reflects trend progressions. As Figure 5 indicates, the PDSI is increasing—indicative of increasing aridity at a global scale—and notably shows western Canada as an aridity hotspot. Similarly, Zhang, Hogg and Mekis (2001) found that mean annual streamflow across Canada has been decreasing since 1947, attributable to a relative increase in temperature since the mid-1960s and essentially zero increase in precipitation.

Figure 4 >

Spatial Distribution of Temperature Increases
(Trends significant at the 5 per cent level are indicated by white + marks) (IPCC, 2007).

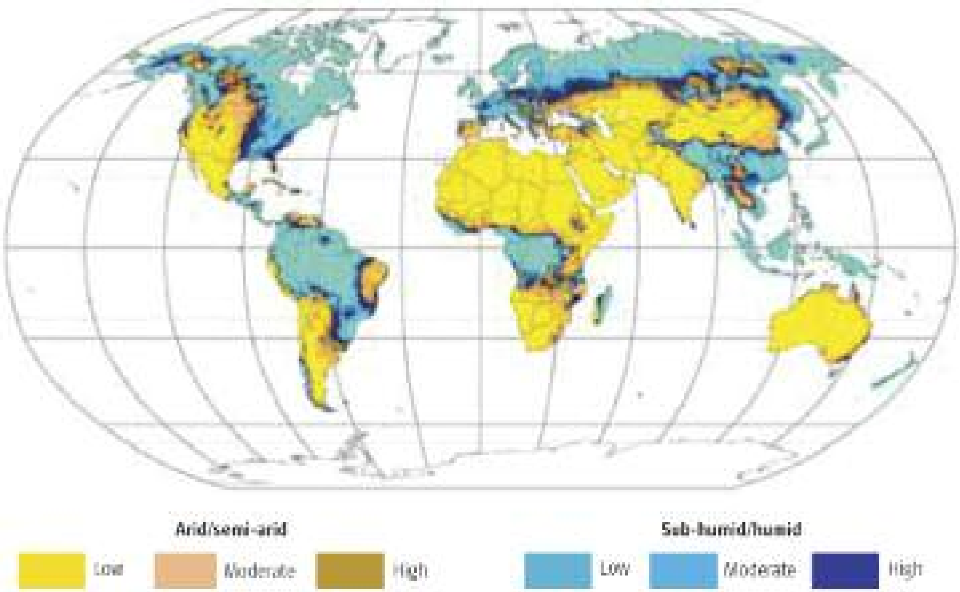


Figure 5 >

The Palmer Drought Severity Index
Spatial and Temporal Trends (1900–2002) (IPCC, 2007).

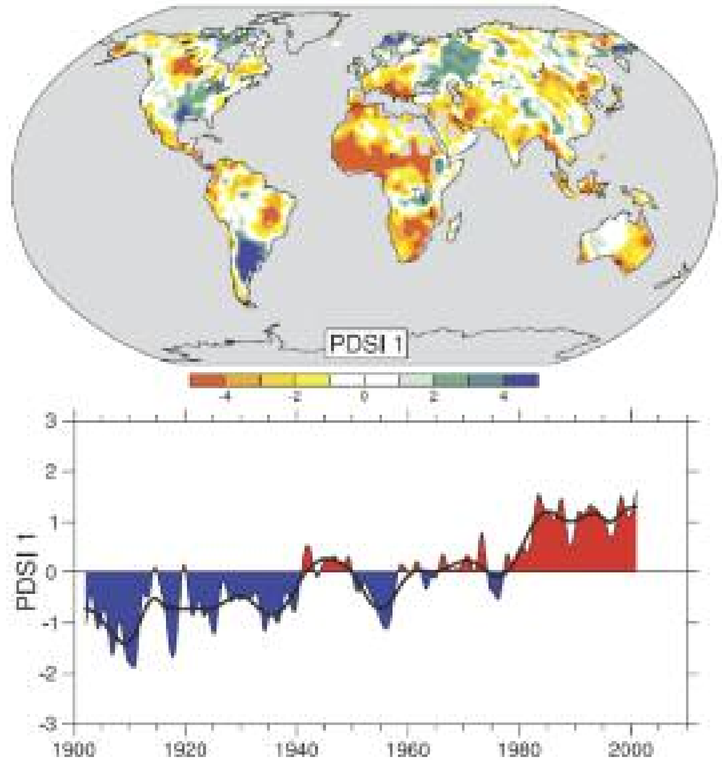
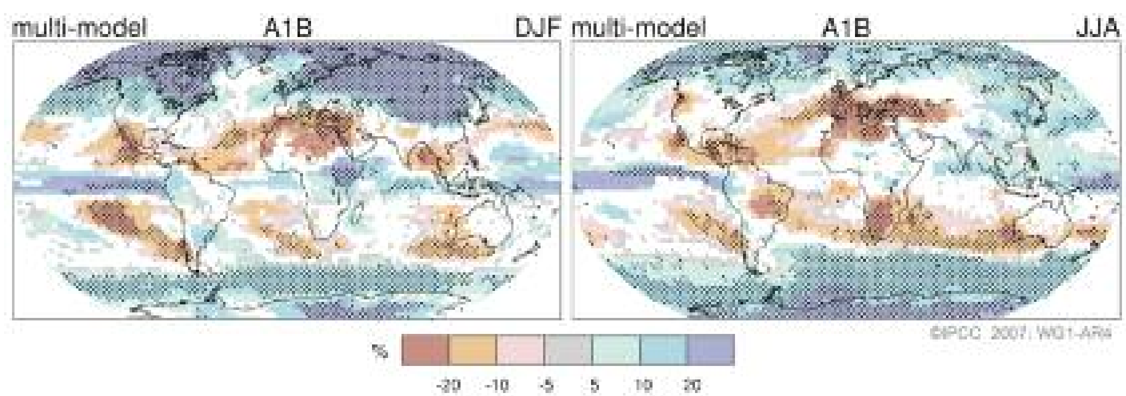


Figure 6 >

Projected Patterns for Precipitation Changes
This figure indicates that the annual distribution of precipitation will change in our part of the world, with slightly more rain in the winter months (December, January and February) and basically no change in the growing season (June, July and August). (IPCC, 2007).



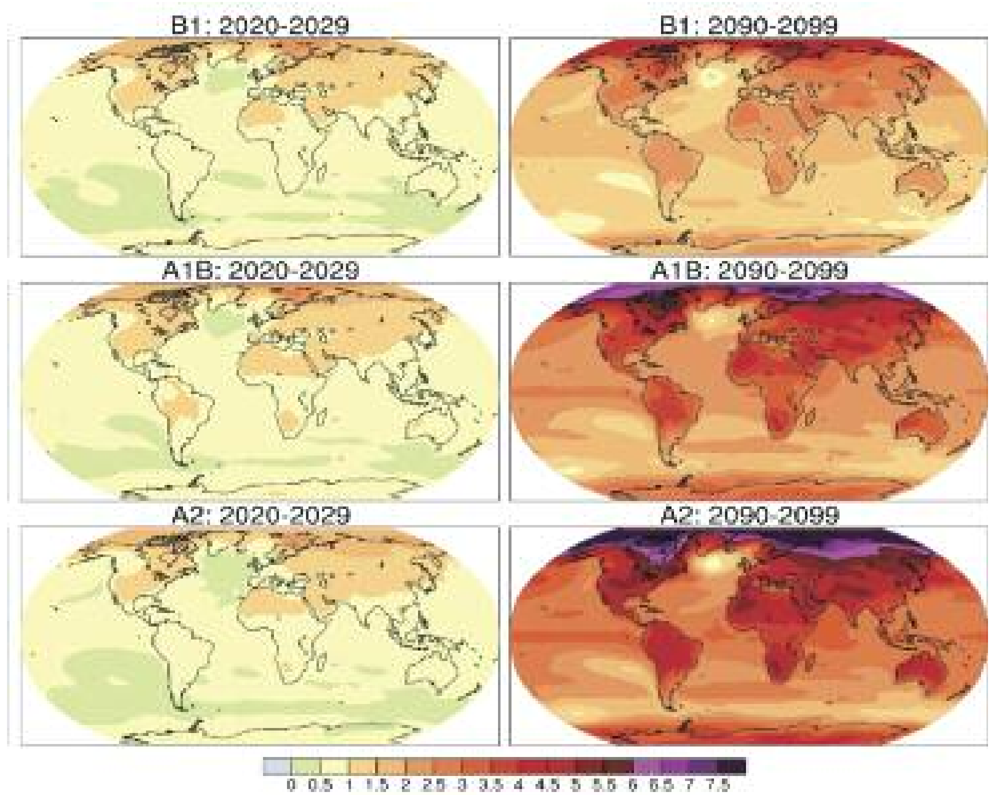


Figure 7 >

Projections of Future Changes in Climate

This figure shows that western Canada is projected to experience temperature increases at a faster rate than most of the world.[4] The combination of unchanged growing season precipitation and higher temperatures could lead to higher overall aridity. (IPCC, 2007).

For Manitoba, the fundamental water resources policy issue is the extent to which higher overall aridity on the prairies extends into the province and affects water supply. To date, two relevant Global Circulation Model (GCM) impact studies have been conducted for the prairies. Sauchyn, Barrow, Hopkinson & Leavitt (2002) used results from three different GCM scenarios (HadCM3, CGCM2 and CSIROMk2b) to estimate future aridity on the Canadian prairies. Nyirfa and Harron (2001) used the CGCM1 model to estimate the impact of climate change on land suitability for agriculture, as it has been applied in previous agricultural adaptation studies in Canada (Bootsma et al., 2001) and is considered to perform well in reproducing present baseline climate characteristics (Hengeveld, 2000). The two studies produced broadly similar results.

Although precipitation increases in all the GCM scenarios, this gain is offset by higher temperatures, which increase the potential evapotranspiration, thus increasing moisture deficits. The moisture deficit (defined by Nyirfa and Harron, 2001, as

[4]Figure shows projected temperature increases over different global circulation models "B1," "A1B" and "A2" and refers to standardized IPCC emissions scenarios. For example, if aggressive GHG reduction is successful (scenario B1), temperature increases are less than in A2, which assumes high GHG emissions.

precipitation minus potential evapotranspiration) for the nominal "normal" period (1961–1990) is shown in Figure 6. The projected moisture deficit for the 2040–2069 period is shown in Figure 7 and reveals an increase in the overall extent of regions affected by moisture stress—the regions of highest moisture deficit correspond quite closely to Palliser's Triangle. Regions of high moisture deficit extend well into the agricultural region of Manitoba.

Sauchyn et al. (2002) investigate a broader range of climate scenarios, but have similar results. Sauchyn et al.'s HadCM3 model is cooler and wetter than the CGCM1 scenario used by Nyirfa and Harron, the CSIROMk2b is similar to CGCM1, and the CGCM2 is hotter and drier than CGCM1. Sauchyn et al. conclude that the climate projections suggest a general increase in dry conditions; the cooler, wetter scenario (HadCM3) merely delays the onset of increasing aridity, whereas the hotter, dryer scenario (CGCM2) reveals a possible desertification risk.

In reviewing climate change hydrological impact studies, the IPCC (2007) report finds that, relative to western and central North America, the prairies can expect increased winter river flows and decreased summer flow in the context of increased variability, including rain-induced flood events—particularly earlier in the year as less precipitation falls as snow and more as rain. The IPCC characterizes this as "a very robust finding." The projected redistribution of precipitation on an annual basis and the overall higher aridity are greatly concerning, as the foremost water resources management consideration in Manitoba has historically been to drain agricultural land as quickly as possible in the spring. If less precipitation is available in the growing season and the largest fraction of the overall precipitation will occur in winter, then an important policy priority will be harvesting the spring runoff for later use during the growing season—very different from how water resources policy has traditionally been implemented in Manitoba. The institutional history of this hard separation of land and water is reviewed in detail in Chapter 3.

Recent anecdotal evidence is consistent with climate change projections. Writing in the *Globe and Mail* (Oct. 1, 2007), Martin Middlestadt (2007) describes a new agricultural phenomenon, observed nationwide and particularly prominent on the prairies, of ample early-season moisture and heat followed by extreme moisture deficits through the later growing season.

The research and evidence linking high-frequency rainfall events and longer drought episodes to climate change is also well-established. A generally warming climate produces increased convection from surface heating, resulting in increased precipitable water in the lower troposphere (Bruce, 2007). Trenberth, Dai, Rasmussen and Parsons (2003) argue that such increases in total water vapour result in higher-intensity rainfall events and simultaneously increased evapotranspiration, leading to an increase in the duration of drought episodes between rainfall events.

In a recent report entitled *Planning for Extremes: Adapting to Impacts of Soil and Water from Higher Intensity Rains with Climate Change in the Great Lakes Basin*, the Ontario Chapter of the Soil and Water Conservation Society (2006) documents an average increase in intensity or frequency of heavy rainfall events of 4 to 7 per cent per decade since 1970, resulting in an estimated 9 to 20 per cent increase in erosion from upland areas, depending on the month. Exposure to an increase in the frequency of extreme events is an important linkage between climate change impacts on water supply and impacts on water quality, as will be reviewed in the next section.

2.4 Ecosystem and Water Quality Impacts

In addition to the risk to dryland agriculture posed by climate change, the Millennium Ecosystem Assessment also identifies nutrient over-enrichment as a critical global environmental issue. Since 1960, flows of biologically available nitrogen in terrestrial ecosystems have doubled, and flows of phosphorus have tripled, primarily due to the application of synthetic fertilizers.

The current eutrophication (oxygen deprivation) of Lake Winnipeg is a useful integrative indicator of nutrient stresses on the prairies. Lake Winnipeg is the tenth-largest permanent freshwater lake, in area, in the world, and supports the largest freshwater fishery in North America. Rivers flowing into Lake Winnipeg drain a vast swath of the Great Plains encompassing parts of four Canadian provinces (about 80 per cent of the cultivable land on the prairies), as well as parts of four American states, as shown in Figure 8.

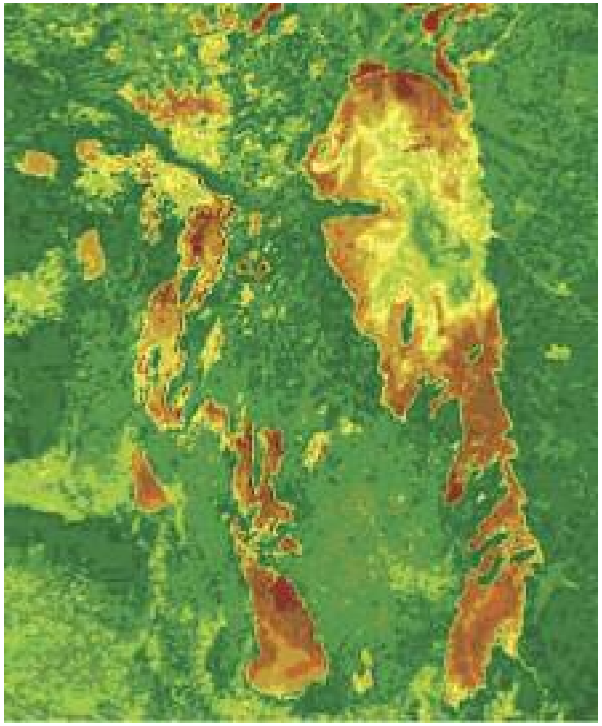
Figure 8 >

The Lake Winnipeg Watershed
(source: Lake Winnipeg Stewardship Board [LWSB], n.d.).

Like many lakes in human-dominated ecosystems elsewhere in the world, Lake Winnipeg is currently under increasing ecological stress from a variety of factors, including invasive species and erosion. Nutrient pollution is currently regarded, however, as the most severe threat to Lake Winnipeg water quality. Figure 9 illustrates a blue-green algal bloom that occurred in the lake's north basin in 2001. Larger blooms have been reported in most years since. Algal blooms are a typical ecosystem response to excessive nutrient enrichment, usually by nitrogen and phosphorus.

Figure 9 >

Algal Bloom in Lake Winnipeg North Basin
(source: McCullough, Cooley & Hocheim, 2001; as cited in Stainton, Salki, Hendzel & Kling, 2003). Image derived from AVHRR satellite imagery September 26th, 2001. Brown shows low chlorophyll (less phytoplankton); green indicates more chlorophyll (more phytoplankton).

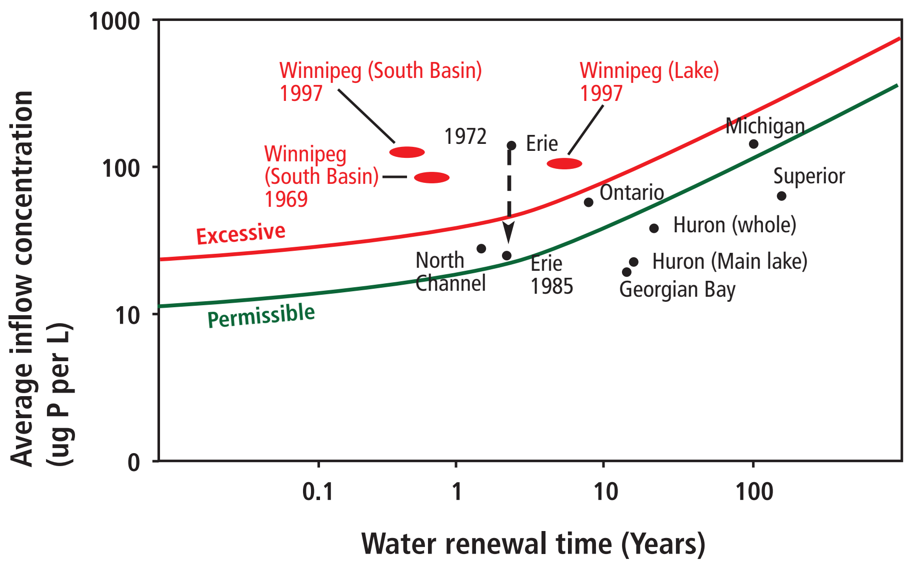


Woods (1999) compares the ecological state of Lake Winnipeg's south basin to that of Lake Erie's in the early 1970s. The serious deterioration of the lower St. Lawrence Great Lakes (particularly Erie) prompted extensive research on eutrophication dynamics (including, notably, at the Experimental Lakes Area), and investigation by the International Joint Commission on remediation measures. Stewart et al. (2000) suggest that on the basis of inflow phosphorus concentration and water renewal time, Lake Winnipeg is significantly more stressed than Lake Erie was prior to remediation efforts (Figure 10).

Figure 10 >

Phosphorus Concentrations in Inflow Water as a Function of Water Renewal Time

(sources: Stainton et al., 2003; Laurentian Lakes data from the International Joint Commission, 1976; Lake Winnipeg data from Brunskill, Elliott & Campbell, 1980; Patalas & Salki, 1992; Stewart et al., 2000). The water quality stresses prominently demonstrated by Lake Winnipeg are projected to worsen with climate change due to primary mechanisms, an increased frequency of low-flow periods (consistent with increasing overall aridity) that stress aquatic ecosystems, and episodic heavy nutrient loading associated with an increased frequency of extreme events.



Consistent with the IPCC observation of the increasing Palmer Drought Severity Index, Yulianti and Burn (1988) observed a trend of decreasing stream flows throughout the Canadian prairies for the period of 1912–1993. According to their study, 10.8 per cent of the 77 rivers examined for the study had a significant increase in the number of low-flow days, (seven days) and 20.3 per cent of rivers showed a significant increase in summer low-flow days, whereas 4.1 per cent of the rivers showed a significant decrease in summer low-flow days. These, according to the authors, were alarming statistics due to the fact that the aquatic ecosystem is most stressed under low-flow conditions. It also indicated that water quality issues would be exacerbated in the future.

Environment Canada (2001) reports that aquatic ecosystems and water resources in the prairie provinces face a range of threats related to human activities, and that these will be exacerbated by climate change. They include:

- physical disruptions and associated problems, including (a) agricultural and forestry land-use impacts, (b) urban water withdrawals, (c) sewage effluent and storm water runoff, and (d) impacts of dams and diversions;
- chemical contamination, including (a) persistent organic pollutants and mercury, (b) endocrine-disrupting substances, (c) nutrients (nitrogen and phosphorus), (d) urban runoff and municipal wastewater effluents, and (e) aquatic acidification; and
- biological contamination, i.e., waterborne pathogens.

Other studies on the Canadian prairies demonstrate that prolonged droughts associated with climate warming will likely result in soil erosion from agricultural lands and forest fire burned areas. Such erosion creates sedimentation problems and increases the eutrophication of local water bodies. It also leads to increased pathogen loading in streams in summer (Hyland et al., 2003; Johnson et al., 2003; Little, Saffran & Fent, 2003).

Bourne, Armstrong and Jones (2002) assessed total measured stream nutrient loads (TMSNL) from 41 monitoring stations in Manitoba to understand the current magnitude and sources of major nutrient loads in the province. Their analysis proved that TMSNL originate from two major sources in the province: (1) nutrients arising from within-stream processes including direct effluent discharge from point sources, release from stream-bed and bank sediments, atmospheric deposition to surface water and the infiltration of ground water to streams and lakes; and (2) nutrients arising from watershed processes including atmospheric deposition to land surface, the application of animal manure, nutrient release from soils and vegetation, increased nutrient transport due to enhanced drainage and removal of riparian vegetation, and the application of inorganic fertilizer.

According to Bourne et al. it is clear that within Manitoba, watershed processes such as the runoff of nutrients from diffuse agricultural sources and from natural processes contribute the largest mass of nutrients to both the Assiniboine and Red rivers. Within the Assiniboine River Basin, 71 per cent of total nitrogen (TN) and 76 per cent of total phosphorous (TP) were contributed from watershed processes, while in the Red River Basin, 59 per cent of TN and 73 per cent of TP were similarly contributed from watershed processes.

Furthermore, the management of headwater streams within watersheds is particularly important for managing nutrient loads, and particularly vulnerable to episodic extreme precipitation events associated with climate change. Freeman, Pringle and Jackson (2007) estimate that headwater streams encompass more than two-thirds of total stream length within most watersheds, directly connecting upland and riparian areas to the rest of the drainage system. Headwater catchments control the recharge of aquifers, the movement of water and the amount of residence time of water within a watershed—time water spends in the system. Associated hydrological processes in these streams also control the type of

material, including nutrients, that travels to downstream waters, and the time and distance it travels. Alexander, Boyer, Smith, Schwartz and Moore (2007) observe the major influence that headwater areas have in shaping downstream water quantity and quality; approximately 70 per cent of the mean annual water volume and 65 per cent of the nitrogen flux in second-order streams declines only marginally to about 55 per cent and 40 per cent in fourth and higher-order rivers.

The basic dynamic of upstream catchments controlling nutrient fluxes is evident in Manitoba research. South Tobacco Creek, a small headland agricultural watershed on the Pembina Escarpment, has total nitrogen and phosphorous concentrations one order of magnitude greater than higher-order waterways in the Red River Basin (Environment Canada, 2006).

Anthropogenic alterations to natural systems that reduce the residence time within a watershed (such as wetland removal and drainage channelization) generally amplify flood peaks, and they increase nutrient loads by decreasing the time available for in-stream biological processes to remove nutrients, increasing the scour of nutrient-laden stream-bank sediments. It is important to note that riparian areas are critical locations for the denitrification process, particularly during floods, when increased water depths serve to improve nitrogen contacts with "microbially reactive floodplain sediments" (Alexander et al., 2007, p. 46). Similarly, wetlands have also been widely recognized for their ability to remove excess nutrients and improve downstream water quality (Newbold, 2005).

The Manitoba agricultural landscape has been heavily modified since European settlement, mostly through the channelization of natural drainage systems and removal of forest cover and wetlands. Hanuta (2006) documented this landscape transformation throughout the Manitoba portion of the Red River Basin since European settlement, comparing 1871 to 1877 Dominion Land Surveys and surveyor log books with 1999 to 2002 Landsat imagery (Figure 11 and Figure 12).

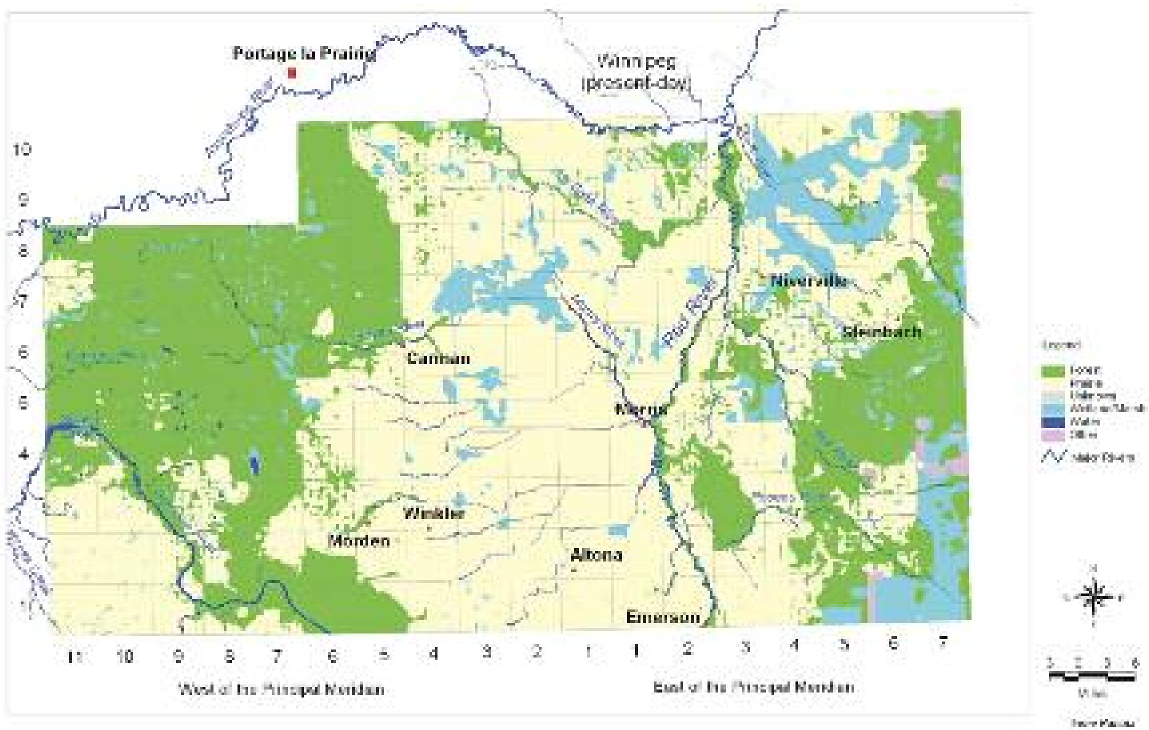


Figure 11 >

A pre-settlement reconstruction of the landscape of the Red River Basin study area
(source: Hanuta, 2006).

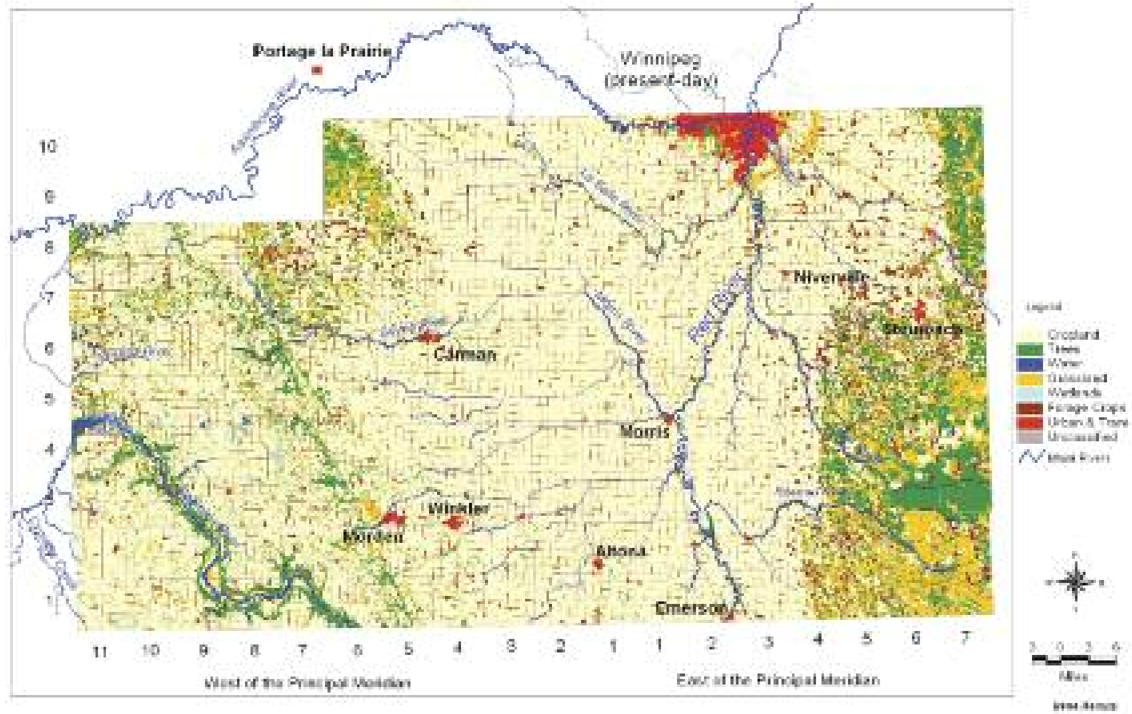


Figure 12 >

The landscape within the Red River Basin is now dominated by cropland, as shown by Landsat imagery (source: Hanuta, 2006).

Essentially, at a time of high uncertainty about the future climate and hydrology of Manitoba, we have lost many critical ecological assets: wetlands and forests that could buffer extreme hydrological events, modulate the annual hydrologic budget, intercept nutrient loads and moderate local micro-climates. This post-settlement landscape transformation took place because the priority of land clearing and drainage for agriculture trumped all other forms of ecosystem management.

Prominent Canadian ecologist David Schindler (2001) argues that the interaction of climate change and nutrient loading from intensive agriculture will have multiple negative impacts on prairie water resources, including increased risks to human health from pathogenic bacteria and toxic algal blooms. Schindler (2001, p. 21) argues, that "only comprehensive approaches to the conservation and management of the catchments that supply drinking water can prevent major water problems."

Clearly, successfully adapting water resources management to future climate change impacts is deeply interwoven with agroecosystem management for both water supply and water quality.

2.5 Policy Implications for Water Resources Management

In August 2006, a landmark assessment of the last 50 years of water management practices was released. The *Comprehensive Assessment of Water Management in Agriculture* critically examines policies and practices of water use and development over the last half century. The *Comprehensive Assessment* was co-sponsored by the Consultative Group on International Agricultural Research, the UN Food and Agriculture Organization, the Ramsar Convention on Wetlands and the Convention on Biological Diversity (Molden, 2007). The basic objective of this assessment was to gain insight into the fundamental challenge of balancing the water-food-environment equation globally.

The *Comprehensive Assessment* includes some frank observations on our collective capacity to manage current and future water scarcity, including that induced by climate change. Frank Rijsberman, Director General of the International Water Management Institute (IWMI), which coordinated the study, observes that

> *the last 50 years of water management practices are no model for the future when it comes to dealing with water scarcity…We need radical change in the institutions and organizations responsible for managing our earth's water supplies and a vastly different way of thinking about water management.*

David Molden of IWMI, coordinator of the assessment, similarly notes that

> *the prevailing attitude of the last 50 years has been that water is a free, renewable resource and that the main challenge is to capture it and make it available to people without regard to the environmental consequences.*

The *Comprehensive Assessment* recommends a bold new agenda for agricultural water management—one oriented toward obtaining the maximum social, environmental and economic value out of every drop of water—"be it from a river basin or a rainstorm." The main points from this new water management agenda include:

- a re-orientation away from supply-side responses—rather a recognition that in large parts of the world that are water scarce, demand-side measures, particularly reallocations of water to higher use values, are the only practical options;
- increased water productivity at farm level—soil and water conservation practices such as conservation tillage are absolutely critical, according to Molden: "achieving sustainable water use cannot be separated from sustainable management of soil fertility";
- managing agriculture for multiple ecosystem services by getting higher total economic values through basin-level "multi-functional" and integrated planning for domestic use, crop growth, aquaculture, livestock and ecosystems such as wetlands, with, for example, biodiversity and soil erosion control co-benefits; and
- government reform—water resource governance structures will need significant restructuring to reallocate from lower- to higher-value uses, specifically with respect to the appropriate incentives for water conservation.

The *Comprehensive Assessment's* conclusions are largely consistent with the literature on water resource adaptation to climate change. The seminal study of the issue (Williams, 1989) provides the following guidelines for adapting policy in climatically altered hydrologic regimes:

- changes in agricultural methods;
- incentives for watershed management;
- integration of ecosystem needs in water resources planning; and
- operating policy redesign of existing water resources systems.

A more recent report (Nelson, Schmitt, Cohen, Ketabi & Wilkinson, 2007) also focuses on adaptation to climate change in the water resources sector and places greater explicit emphasis on demand-side management, but argues many of the same principles Williams noted two decades earlier:

- a foremost emphasis on water conservation; water efficiency investments are essential "no-regrets" strategies;
- integrated regional management for multiple benefits (supply stability, water quality, energy conservation, flood management and ecosystem benefits);
- greater use of economic instruments with "beneficiary pays" financing; and
- protection and restoration of aquatic impacts—healthy ecosystems will be more resistant to climate impacts and provide multiple water quality, recreation and flood-protection benefits.

Fundamentally, the watershed-based ecosystem management principles associated with Integrated Water Resources Management are a climate change adaptation priority obvious to the research community. The recent IPCC Fourth Assessment Report made the general point unambiguously:

> *It can be expected that the paradigm of Integrated Water Resources Management will be increasingly followed around the world, which will move water, as a resource and habitat, into the centre of policy-making.* ***This is likely to decrease the vulnerability of freshwater systems to climate change.*** *[emphasis added] (Kundzewicz* et al.*, 2007)*

Recent Canadian water policy analyses all emphasize similar and very complimentary principles—particularly watershed-based management systems that integrate ecosystem management and infrastructure management approaches (Pollution Probe, 2007; Maas & Telfer, 2009; Hoover, 2007). Pollution Probe conducted a series of national workshops toward creating a vision and strategy for water policy in Canada. Their report summarizing the recommendations from the series of workshops includes the need for watershed-level management of water, demand-side management, better water quality monitoring and management, and the appropriate pricing of water. In an unpublished report on the need for and components of a national water policy and strategy, the Sierra Club of Canada notes a need for water conservation efficiency, the development of community resilience to extreme events, the need to assist water planning by improving the understanding of climate change impacts on water, and the need to link infrastructure grants to water conservation and efficiency. The Conference Board of Canada, in turn, in its report (Hoover, 2007) assessing water governance and management in Canada, reiterates the need for clear watershed governance structures, a "nested" approach to watershed governance, and adequate information and sufficient budgets to conduct monitoring and measuring for effective stewardship of water resources.

The key themes from the recent international and Canadian literature is that, whether driven by water supply, water quality, or specific climate change risks, best practice water resources management will focus on: (1) water conservation and efficiency; (2) integrated watershed-based agroecological management; and (3) economic instruments that reinforce incentive structures around principles (1) and (2).

In this context, the water soft path approach is a planning philosophy for establishing goals around principles (1) and (2), and, through a backcasting approach, designing a policy pathway to achieve goals (1) and (2), based on the increased use of economic instruments. A fundamental policy and governance challenge, however, is grafting such an approach onto an appropriate institutional structure and assuring a sufficiently high level of institutional capacity to implement it.

We provide a historical perspective on water resources policy in Manitoba in the next chapter, with particular emphasis on the conservation district program, as it is currently designated as the institutional structure to realize IWRM objectives in Manitoba. The history of the conservation district program reveals the institutional challenge of successfully governing across land and water, which is, however, central to the IWRM challenge and, as the companion technical report to this report illustrates, essential given that land-use processes are the overwhelming influence on water budgets in Manitoba.

3.0

A History of Water Policy in Manitoba: The Long Road to Integrated Water Resources Management in Manitoba

3.1 Overview

The history of water policy in Manitoba is characterized by the hard severance of land and water issues that accompanies Manitoba's entry into Confederation, and sporadic attempts thereafter to reintegrate across the land-water divide. This analysis emphasizes the historical perspective because of the well-known phenomenon of path-dependency in policy dynamics. The range of policy options available at a given time is a function of institutional history and is usually fairly narrow (Howlett & Rayner, 2006).

Fundamentally, new policy directions are generally possible in the aftermath of significant new stresses on the domain of jurisdiction that provoke institutional reform or new institutional structures. The sustainability of these new institutional forms is dependant on long-cycle budgetary commitments.

This analysis identifies five major eras that span from an era where land and water were deeply integrated in the economic life of the fledgling Red River settlements to a speculative, nascent climate adaptation era where the rationale for re-integrating across the land-water divide is overwhelming.

The Pre-Confederation Era (pre-1870): Land and Water Connected

This era is characterized by the tight integration of land and water systems in a relatively simple agrarian society based on a river-lot settlement pattern, where the use of riparian corridors and rivers was fundamental to agricultural transportation and communication.

Drainage Era (1870–1959): Land and Water Severed

This era is catalyzed by the Dennis Plan survey, which fundamentally altered life in the Red River Settlement and set the political context for Manitoba's entry into Confederation. The Dennis Plan imposed a grid-iron section, township, municipality survey on the landscape, which subsequently facilitated a rectilinear model of agricultural land drainage. This era was propelled forward by federal settlement policies on the prairies, particularly the arrival of the railways and associated land clearing and drainage activities to accommodate agricultural settlers.

The logic of watershed-based planning and management periodically emerged to deal with local drainage problems. However, the requisite political commitment to the required institutional reforms never emerged.

The First Watershed Era (1959–1990): Conservation Districts Emerge

The First Watershed Era is initiated by the 1959 Conservation Districts Act, which is the first evidence of serious political commitment to a new institutional model for coordinating land and water management. The era is catalyzed by demonstrated technical advantage of integrated river basin management by New Deal institutions such as the Tennessee Valley Authority, and by the success of the conservation authorities in Ontario.

The Second Watershed Era (1990–2008): Sustainable Development and Lake Winnipeg

A new normative concept, sustainable development, emerges emphasizing integrated social, economic and environmental decision-making. Sustainable development resonates in Manitoba, as it represents a need for a more integrated approach to land and water issues and reinforces the logic of the conservation district program. The non-point source pollution of Lake Winnipeg also reinforces the role of the conservation districts, notably as delivery agents for Integrated Watershed Management and Planning (IWMP) under the 2006 Water Protection Act

The Adaptation Era (2009–)

We speculate that the next major era of water resources policy in Manitoba will be driven by the need to adapt locally to the impacts of climate change and will further propel the logic of IWRM. Projected climate change impacts, particularly increasing aridity, a shift in precipitation to earlier in the growing season and high-frequency extreme events, orient water resources policy toward watershed-scale approaches focused on rainwater harvesting and soil-moisture conservation.

3.2 The Pre-Confederation Era (pre-1870) Land and Water Connected

Water featured very prominently in the worldview of the First Peoples of Manitoba. The name for the province itself, "Manitoba," is rooted in the Assiniboine words "mini" and "tobow," which together mean "Lake of the Prairie" (Hamilton, 1978). The earliest European influence in the region was also defined by respect for its natural hydrologic features—the original Rupert's Land Charter ceded the entire Hudson's Bay Basin to the Hudson's Bay Company on May 2, 1670. The Hudson's Bay Company (HBC) would dominate economic life in Manitoba for about 200 years thereafter. The only major economic use of water resources during this period of Manitoba history was as transportation corridors allowing HBC to conduct is fur trading business. The first rumblings of change came in 1811 with the purchase by Lord Thomas Douglas, the Fifth Earl of Selkirk, of a huge tract of land in southern Manitoba—for the purposes of agricultural development and colonization. This sale represents the beginning of Manitoba's political subdivision across the natural boundaries of its watersheds formally under HBC control.

Lord Selkirk convinced the HBC to sell him 300,000 acres of land in the Red River Valley for the purposes of agricultural settlement, and the first settlers arrived the following year, provoking considerable tension with the First Nations and Métis peoples, and engaged in the fur trade in the Red River Valley (Whitcomb, 1982). The early settlers faced harsh winters, plagues of grasshoppers in 1818–1819 and a massive flood of the Red River in 1826. The growth of the Red River agricultural settlement was slow, and the economy continued to be dominated by the fur trade and the HBC monopoly over both the economy and the government of the region. Natural riverine features also continued to dominate the Red River colony economy.

A river-lot system prevailed in the Red River Colony, according to a plan made in 1813 by HBC surveyor Peter Fidler. Fidler acted on the instruction of Miles Macdonnell, governor of the colony, who was familiar with the river-lot systems of eastern Canada. Warkentin (1959) argues that the system of granting each household a lot with river frontage was the best possible land division for the pioneering colony, as it reflected the multi-functional economic and cultural use of the river by settlers who were not solely engaged in specialized agriculture:

> *The settlers farmed the lots in the hope of supplying the Company with produce, but they were also engaged in hunting and fishing, in trading and in working for the Company, so that the river at their front door represented something more than a convenient base for surveys. It was an essential element of the settlement as the very land they tilled, and therefore it was natural that everyone should desire to live along it.*

Historical anecdotes suggest that early settlement life was well-adapted to the harsh climate and climate variability and the vagaries of hydrology; Macleod (1947) relates a particularly poignant description of an early settler's experience with flooding in the Red River Valley and the use of traditional ecological knowledge to cope with extreme hydrologic events:

> *An old woman told me of the flood of 1852 when she was a child, a flood that did a great deal of damage. In March her grandfather, watching the signs so well known to these native people, informed the family there was going to be a flood. Selecting the highest spot on their land, he went away every day and, with help, began to build a house there. Between four well-branched trees, the largest he could find, he built a house big enough for the family to live in, and plastered and waterproofed it so it would float.*

The family then moved in with all their worldly goods. When the flood came, the house rose as the water rose, but it remained anchored safely between the four trees. The family lived there in comfort, coming and going in their dugout canoe. Every day the old grandfather went off and brought back firewood secured from the tops of trees in high places, and the members of the household never once missed Mass on Sundays! They went to the St. Boniface Cathedral of the poet Whittier's "turrets twain," which being on high ground, had water only to the doors. They tied their canoe at the church steps and each Sunday they watched the high-water mark there; and my informant told me of their joy on the first Sunday when they found it had lowered.

Toward Confederation

Water corridors and riparian rights would play defining roles in the next stage of Manitoba history, and the strong attachment to the river-lot system by the early settlers would eventually provoke a defining crisis in Manitoba's political history. In 1859 the first steamboat appeared on the Red River, linking the colony to Minnesota; the HBC began to import goods by railway via the United States instead of through the bay. The HBC charter also came up for renewal by the House of Commons in London, England, and was renewed only for the northern region, paving the way for Canada's acquisition of the prairies.

A decade-long political flux persisted as the HBC government's power declined and no new authority emerged to take its place. The Métis population was especially nervous about both their status as a people and their land titles if Rupert's Land was transferred to Canada. When Upper and Lower Canada resolved their constitutional problems through Confederation in 1867, the newly minted Canadian government negotiated with HBC and the British government for transfer of the vast HBC charter lands without any consultation with the roughly 10,000 settlers that already lived in the region. Rumours began to circulate in the settlement that the HBC and Selkirk land titles would not be honoured and would be declared invalid. The actions of the fledgling Canadian government keen to blunt American influence in the region did nothing to quash these rumors.

The new Canadian government surveyed the Red River Colony and lands and consulted with the surveyor-general of Minnesota for the transfer of Rupert's Land to Canada. They recommended a U.S.-style gridiron township and range survey system for the Canadian prairies, with slight modifications, which included an appropriation for public roads. The Dennis Plan (Colonel C.J. Dennis made the recommendations for this plan) was adopted by the federal government on September 23, 1869, (with subsequent revisions in 1971), resulting in a square mile, section-based township format, with each township comprising 36 sections (Warkentin, 1959).

Before any transfer of HBC land to Canada had officially taken place, the Dennis Plan was implemented, and the Canadian government sent land surveyors to stake out the land in one-square-mile sections—without consulting either local people or authorities and completely ignoring the existing land system of riverfront strips that had been occupied by some families now for several generations. The mile section system of townships and ranges represented the first major modification of the Manitoba landscape. An enraged group of 18 young Métis, led by Louis Riel, disrupted the survey and told the surveyors they had no right to survey the land without the permission of the people who lived on it. Thus, the struggle for the rights of the local inhabitants, for provincial status and for equality with the eastern provinces began, culminating in Riel and his supporters organizing a provisional government at Red River and the "Red River Rebellion" of 1869 (Whitcomb, 1982, p. 10).

3.3 Drainage Era (1870–1959) Land and Water Severed

In the aftermath of the Red River Rebellion, Manitoba did enter Confederation as the fifth province of Canada in 1870. Ottawa initially retained control of all of Manitoba's natural resources, including agricultural lands, mineral wealth, forests and rivers. The original four provinces all retained control of their natural resources when they entered Confederation, as did Prince Edward Island and British Columbia, which entered after Manitoba. Agriculture grew slowly at first; the first wheat export from the province took place in 1876. The first train arrived in St. Boniface from St. Paul, Minnesota, in 1878. With the arrival of the railway and the influx of goods and settlers (and export opportunities) it brought, the fortunes of the new province really began to prosper. The much-anticipated Canadian Pacific Railway (CPR) finally reached Manitoba in 1882. Between 1881 and 1885, the federal government issued a huge land grant to the CPR, amounting to 25 million acres along the railway's main line across the prairies (Martin, 1941). The CPR had perfected a monopoly model of its operations, so that it developed new tracks in new agricultural areas at a rate that maximized the net present value of that track—with revenues generated through increased rail traffic, driven by population growth and agricultural settlement (Lewis and Robinson, 1984).

The railway's presence made feasible the intensive agricultural settlement pattern based on the township and range system, and in turn necessitated a means by which to control the flow of water and remove it from farmland. Agricultural land drainage according to the grid-iron system represented the second major modification of the Manitoba landscape and defined much of subsequent Manitoba water policy.

As every train arriving from the east brought with it more and more settlers to the Great Plains, the Manitoba government grew concerned about the issue, especially the potential loss of immigrants to either the lands that would become Saskatchewan and Alberta or south to the United States. Thus, in 1880, the Manitoba government enacted the Drainage Act. Prior to this time, drainage on the Manitoba landscape was limited to several isolated provincial drains along the Assiniboine River and to drains associated with railway construction (Elliott, 1978, p. 14).

The 1880 Drainage Act provided for a general survey of wetlands and the digging of ditches by rural municipalities. It also divided the province into three drainage districts (District 1, east of the Red River; District 2, west of the Red River and south of the Assiniboine River; and District 3, west of the Red River and north of the Assiniboine River) and set aside money for drainage works to be undertaken by Public Works Manitoba. As an added incentive to the drainage effort, parcels of wetlands—at the time owned as a natural resource by the federal government—were granted to the province on the condition that the latter undertake sufficient drainage to make the lands arable (Elliott, 1978). Then, in 1885, a federal act transferred all crown lands shown to be "swamplands" to the province. Thus, the province gained a vast land resource, but before these lands could be used, an extensive reclamation program was required (Ogrodnik, 1984). Various drainage works were undertaken over the next 15 years, but in a rather lacklustre and piecemeal fashion, as Warkentin summarized:

> *That year (1880) drainage plans were made, surveys undertaken, and some ditching commenced. The ditches were shallow and not very wide and thus rather ineffectual. This work continued for over a decade in widely scattered parts of the Glacial Lake Agassiz Region, but it gradually became apparent that a more vigorous and more comprehensive programme would have to be started if the land was going to be effectively drained and made ready for settlement. (Warkentin 1967, cited in Elliott 1978, p. 15)*

Although the drainage works of this era were not yet extensive, it was clear to observers of the day that these activities would not improve water quality; Dr. Niven Agnew (1884), searching for alternative water supplies for Winnipeg, remarked:

> *either the Red River or the Assiniboine might be depended upon to yield an inexhaustible supply for all time to come, but the duality is none of the best, and as towns and cities are built along the course of these streams, and the general drainage of the country as well as the sewage of cities is discharged into them, it cannot be expected to improve.*

The mostly ineffectual Drainage Act of 1880–1895 did, however, result in the transfer of extensive wetland areas from the federal government to the province in support of agricultural development—an important precedent for the later transfer of other natural resources to provincial jurisdiction. With historical hindsight, we also observe another, more ominous precedent—explicit government policy to drain and destroy valuable natural capital for the benefit of agricultural production.

In response to this need for a more comprehensive and coordinated drainage effort, the Manitoba government simultaneously repealed the 1880 Drainage Act and passed the 1895 Land Drainage Act—legislation that provided for large-scale and organized drainage works. The act provided for the creation of consecutively numbered drainage districts in order to make an area fit for occupation and cultivation, where the public would benefit. Once a drainage district was formed, the act provided ways for which funds could be raised to finance drainage works. Between 1896 and 1914, 21 drainage districts were created under the act; one was dissolved in 1916, and three smaller districts were added in 1928 and 1929. As the land in the Red River floodplain was drained, settlers quickly moved in and began to farm (Elliott, 1978).

While many voices clamoured for drainage works, conflict and dissenting voices over drainage arose almost as soon as the second Land Drainage Act was passed, in 1895. Two contentious and interrelated issues have plagued the drainage discourse from the outset: (1) who pays how much for drainage works? and (2) who pays for damage caused by "foreign water" (water draining from upland areas onto lowland areas)? In an effort to address these issues, the Manitoba government has since 1899 appointed four government commissions to study drainage questions.

Following the formation of Drainage District 1, in an area known as St. Andrews Bog, a petition was presented to the Manitoba government protesting the work, in particular alleged inequalities in taxation in the district. Thus, the government appointed the first royal commission, in 1899, to study the issue. At the heart of the matter was the fact that many landowners assessed to pay taxes to support the drainage works claimed that they would receive no benefits, and adjacent properties outside of the drainage district were not taxed, but were thought to derive benefits. After four years of study, in 1903, an order in council was passed that relieved over 40,000 acres in the district of assessment, leaving the province to make up the shortfall (Elliott, 1978, p. 21).

By 1915, many of the older drains were already operating at a very low level of efficiency. The Land Drainage Act was strengthened by granting the municipal commissioner the right to do anything necessary to enforce municipal maintenance. Consequently, municipalities were forced to finance maintenance from general revenues, which meant that lands within the municipal boundaries but outside of the drainage districts were responsible for helping to pay for maintenance on a drainage system from which they received no benefit (Ogrodnik, 1984, p. 25).

This first complaint proved to be just the tip of the proverbial iceberg. As more drainage districts were formed, the problems

became more pronounced and complex. Elliott, who published his report in 1918, undertook the next comprehensive look at the drainage issue. Elliott argued that the drainage system was under-performing due to technical limitations. He believed that the early system was inadequate, having been constructed more as an emergency measure to reclaim swampland when drainage conditions were imperfectly understood. Drains were constructed to correspond with the grid system (following the land survey technique first used by the federal government in the province). Elliott recommended that topographic surveys be conducted to determine watershed boundaries and ditches be constructed to more closely follow the natural contours of the land, even if fields had to be divided. Elliott also recommended that responsibility and control over maintenance of the drainage system be vested in one agency, such as Public Works, and that this agency conduct all the necessary maintenance work and then bill the municipalities. Finally, Elliott recommended that tax levies pay for drainage construction and maintenance costs be calculated based on assessed benefits (Ogrodnik, 1984, p. 23).

Following the 1918 Elliott Report, the Manitoba government appointed the Manitoba Drainage Commission, active from 1919 to 1921, to further investigate drainage issues in the province. Also known as the Sullivan Commission, the commission's responsibilities included determining inequalities in the distribution of taxation on the lands within the drainage districts, determining a more equitable method for assessing taxation, determining whether additional drainage systems were needed in the existing districts and studying the need and possible locations for new drainage districts in the province (Elliott, 1978, p. 21).

Two of the most controversial issues that the Sullivan Commission attempted to address were the ongoing questions of the boundaries of the drainage districts and the related issue of "foreign water." The Sullivan Commission felt that the 1915 amendment to the 1895 Land Drainage Act was unfair and recommended that the cost of maintenance be paid for by the district as a whole, regardless of municipal boundaries. In effect, the only way to eliminate inequities in taxation was to redefine the boundaries of the drainage districts to include all lands that benefited from drainage. With regard to the concept of "foreign water," the commission settled on a broad definition of "lands which benefited from drainage." They included upland areas that drained onto lowland areas, although the commission felt that a uniform levy would be unfair (Ogrodnik, 1984, p. 25).

Regarding the question of "foreign water" and taxation, the commission argued that:

> *if the people on the higher lands have the right to do as they please on their own property, then the same should be true of those who would have a right to dam against the waters from the higher lands and a Chinese wall along the west boundary of drainage districts No. 2 and No. 12, could do untold damage to those west of the district. (Sullivan, 1921, p. 24, cited in Ogrodnik 1984, p. 26)*

According to Ogrodnik, the Sullivan Commission was the first in the history of the province to view drainage from an explicitly regional perspective:

> *… contributors of foreign water should pay a nominal sum to allay the high costs of draining lowland areas since upland areas benefited from the opportunity to dump water on those downstream and indirectly damaged their lowland neighbours. Underlying this principle is the belief that lands which contribute foreign water to drainage districts, both benefit from work undertaken in that district and are a liability to that district. By subsidizing lowland drainage, more land could be brought into agricultural production and on to the tax rolls, ultimately making everyone better off. (Ogrodnik, 1984, p. 26)*

Four of the key recommendations of the Sullivan Commission were:

~ *the appointment of a permanent, independent board to administer the Land Drainage Act;*

~ *the extension of the boundaries of any drainage district to include all lands whose surplus water drains into the district and is carried by any artificial means through it to a natural outlet;*

~ *the equitable distribution of taxes on the basis of benefits received and relief from liability for damages; and*

~ *the government assumes responsibility for general maintenance of drainage ditches, charging the cost of the same to the respective drainage district. (Sullivan, 1921, p. 5; cited in Elliott, 1978, p. 22)*

Unfortunately, the government of the day ignored all but the fourth recommendation, which it only partially implemented. Consequently, the "drainage problems" persisted until ultimately the government was forced, by 1935, to appoint a third commission and simultaneously enact new drainage legislation in an attempt to finally address the concerns.

With historical hindsight, we can interpret some very progressive elements of the Sullivan Commission's report. First, Sullivan argued that watershed-based drainage management was inherently more logical than the grid-iron approach, and also argued for a variant of the polluter-pays principle[5] in his proposed compensation scheme between those benefiting and those suffering from drainage works. The converse of the polluter-pays principle is, of course, payment for ecosystem services, such as compensation to an upstream landowner for downstream flooding prevented.

Between 1895 and 1935, over $6 million had been expended on various drainage works, and the drainage system was successful in bringing some two million acres of inherently wet but fertile land under cultivation (Ogrodnik, 1984, p. 15). Despite this general success, the ongoing questions of responsibility for shouldering the costs of foreign water, especially perceived larger volumes of foreign water brought artificially into the districts, inequitable distribution of drainage levies, and drain locations and maintenance, continued to plague the province. Thus, in 1935, the government simultaneously appointed the 1935 Land Drainage Arrangement Commission, also known as the Finlayson Commission, and enacted the Land Drainage Arrangement Act.

On the question of "foreign water," the Finlayson Commission agreed with the Sullivan Commission that lowland areas should not be entirely responsible for maintaining and enlarging ditches to accommodate water from higher lands. The commission agreed with the lowlanders' (also known as flatlanders) perspective that

> *…this flow of water from outside areas has been accelerated since the formation of the district by the clearing of land formerly covered with timber, and by the construction of municipal roads and ditches. (Finlayson, 1936, p. 8, cited in Ogrodnik, 1984, p. 29)*

Nevertheless, the Finlayson Commission found that it was impossible to determine the proportion of water flow that was attributable to such development. The solution that the commission recommended was for the province to assume greater responsibility for both the outstanding debt and ongoing maintenance costs of the drainage districts. Also noteworthy is Finlayson's observation that landscape modification—specifically deforestation—was exacerbating drainage problems.

During the difficult economic situation in the 1930s, many of the drainage districts were finding it increasingly difficult to

[5]The polluter-pays principle indicates that the polluter should bear the cost of measures to reduce pollution according to the extent of either the damage done to society or the exceeding of an acceptable level (standard) of pollution (OECD definition. Available at http://stats.oecd.org/glossary/detail.asp?ID=2074).

raise sufficient funds to pay for drainage maintenance. Thus, the commission recommended that the province contribute one-third of the sum expended annually for maintenance and, where foreign water was a serious problem, the province should contribute one-half the annual expenditure (Elliott, 1978, p. 23). In addition, the commission ruled that the "flat rate" method of assessing tax levies was unfair. However, again because it was not possible to determine the proportion of benefits attributable to each piece of land, the commission recommended that the government assume responsibility for almost one-half of the outstanding debt accumulated by the drainage districts to date.

Finally, the Finlayson Commission recommended that the province establish a number of drainage maintenance districts, having boundaries generally the same as the original drainage districts, in order to oversee the maintenance of the existing drainage systems.

The province accepted most of the recommendations on drainage, but was not yet willing to adopt the recommended provincial financial commitments toward drainage maintenance. The province agreed only to contribute a small fraction of the annual capital expenditures made in any drainage maintenance district (Elliott, 1978). However, even this concession did mark a significant change in drainage policy: drain maintenance was no longer solely the responsibility of the municipalities.

The recommendations of the Finlayson Commission were implemented in the 1935 Land Drainage Arrangement Act. The act provided for the establishment of drainage maintenance districts, with the aim of limiting each maintenance district to one watershed. The act also provided the necessary authority to undertake the recommended financial adjustments.

Given the severe drought conditions between 1935 and 1940, not surprisingly there was little of the usual conflict between the municipalities and the province over the operation and maintenance of the drainage system. The province's contribution of less than one per cent of the annual capital expenditures made in any maintenance district actually translated into about one-third of the total expenditure for maintenance. The municipalities were happy with the province's contribution level (Elliott, 1978).

However, the drought of the 1930s ended, and wet conditions returned in the early 1940s. Concomitantly, with the war effort moving into high gear, the cost of construction rose sharply. Thus, in the first half of the 1940s, the municipalities found themselves contributing an ever-increasing proportion of the total expenditures on drainage operation and maintenance in each successive year, such that by 1946 the provincial share had decreased to only about 12 per cent (Elliott, 1978). By the mid-1940s the problem had grown considerably, "with drainage maintenance boards claiming that they should not be shouldered with the cost of enlarging their drains to carry the 'foreign water' from higher lands outside the maintenance districts" (Elliott, 1978, p. 26). Therefore, once again, the intertwined issues of provincial financial assistance for drainage maintenance and the "foreign water" concern precipitated yet another commission (the fourth) to study drainage issues in Manitoba.

In 1947, the provincial government appointed the Lyon's Commission, 1947–1949, to work on a report entitled, *The Report on "Foreign Water" and Maintenance Problems*. The Lyon's Commission sought to understand in some detail the impacts such land-use changes had had on the natural flow of water in the province. After two years of study, the Lyon's Commission concluded that it was impossible to determine the effect of land-use changes in the highlands on the flow of water into the various lowland drainage districts. Nonetheless, the Lyon's Commission determined that the lowland drainage districts should not be required to provide for this additional water at their own expense. Thus, two of the main recommendations of the Lyon's Commission were:

- that the province pay two-thirds of the cost of all future maintenance and construction of drains that intercept, collect and carry "foreign water"; and
- that the province pay one-third of the cost of future maintenance and construction of all other drains (Elliott, 1978, p. 26).

These recommendations were accepted by the government of the day and became effective for the fiscal year 1952 in the Land Drainage Arrangement Act, 1952.

In the 1960s, yet one more royal commission was given the challenge, albeit indirectly, of examining the drainage issues in the province. In 1964 the Royal Commission on Local Government Organization, otherwise known as the Mitchener Commission, was appointed by the provincial government to undertake a comprehensive review of local government organization and finance. In general, the commission recommended that a clear-cut separation be required between local and provincial responsibilities, so that municipal councils would be clear on the exact extent of their functions. In relation to drainage, the Mitchener Commission recommended that the province assume complete control of and financial responsibility for the main system of trunk drains, and that the municipalities assume the entire cost and responsibility for the local drains, which serve mainly the land within their boundaries (Elliott, 1978, pp. 29–30).

The provincial government accepted this recommendation and in 1965 implemented the Provincial Waterways Policy, which devised an ordering system for rating all drains in each watershed. The provincial government assumed full responsibility for all waterways of third order or higher.[6] The introduction of this system precluded the need for the drainage maintenance districts, and these were disbanded in 1966 (Elliott, 1978).

Over the history of land drainage in Manitoba, from the first Drainage Act of 1880 to the Land Drainage Arrangement Act of 1952, a major flashpoint has been widespread disagreement over the fair distribution of costs for the drainage system. While it gradually became accepted that the upland areas should help to contribute to the costs of draining the lowlands of "foreign water," it was not possible to determine a fair individual tax levy based on sources of flow and level of benefits from drainage. Consequently, over the decades the province has assumed a greater responsibility for the costs of drain construction and maintenance. According to Ogrodnik:

[6]Manitoba's waterways are classified according to a "drain order" system, represented by numerous "Designation of Drain" maps, which define the scale of each waterway according to the area of land it drains and the relative size of its contributing watershed. Generally, municipal drains operate within order 1 and order 2, while provincial drains are level 3 and above. On-farm drainage generally occurs on land contributing to an order 1 drain.

Transferring an ever-larger share of the financial burden from the municipalities to the province had the effect of socializing the costs. ***A corollary effect was to absolve upland landowners of any responsibility to their lowland neighbours… despite the belief that upland areas were contributing to increased flows.*** *(1984, p. 38, emphasis added)*

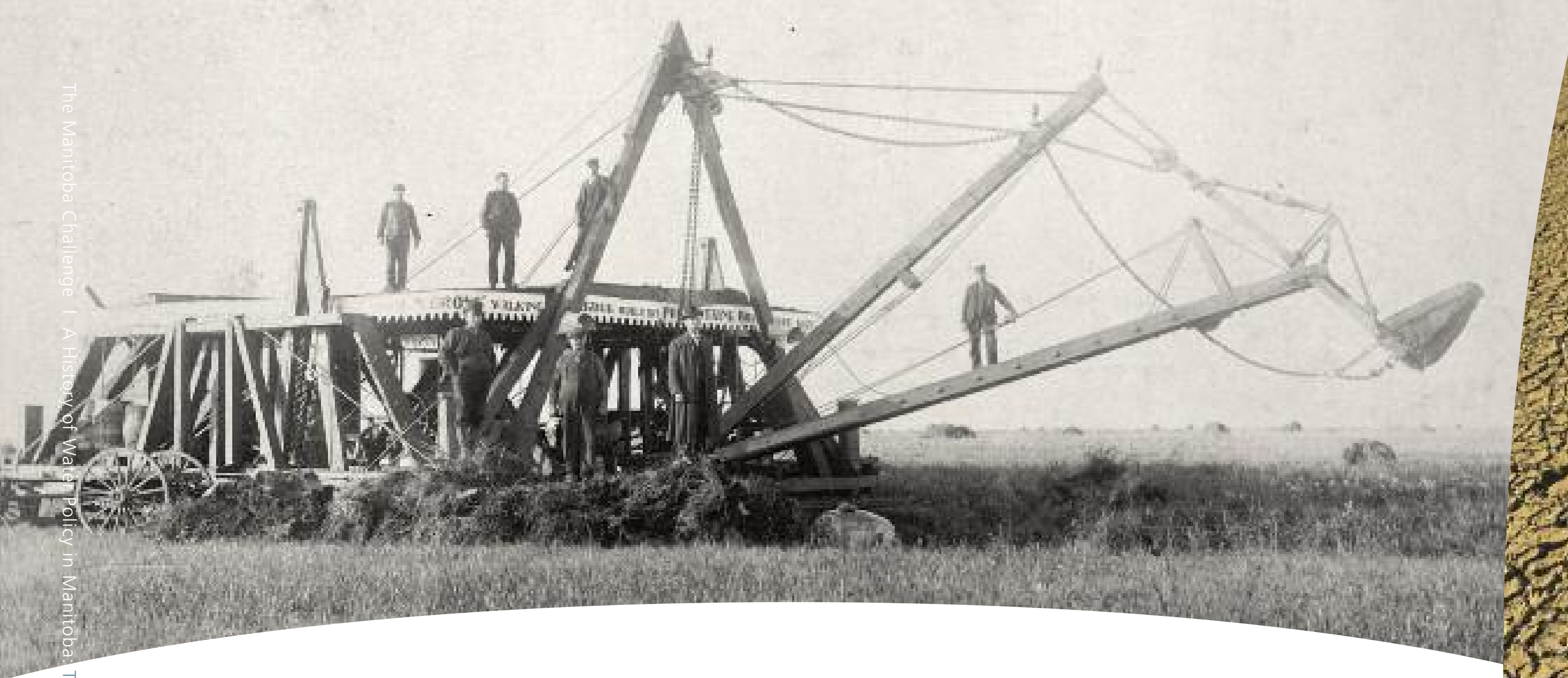
In sum, Ogrodnik observes two dominant and partially contradictory policy themes that emerged as the province attempted to address Manitoba's surface water management problems:

1) the transfer of most responsibilities for drainage from local rural municipalities to the provincial government (not always with requisite funding and staff resources); and

2) new institution-building by the province through legislation, which attempted to develop a more holistic approach to land and water management embodied within the (ultimately repealed) Watershed Conservation Districts Act of 1959 and the current Conservation Districts Act (which received Royal Assent in 1976).

The ever-increasing dependence on centralized funding supports the "socialization of costs," which Ogrodnik suggests can be interpreted as a kind of *perverse subsidy*, a subsidy that unintentionally creates or aggravates an environmental externality through the incentive created by the subsidy (Kent & Myers, 2001).

Another effect of the province increasingly underwriting drainage budgets was to undermine a basic governance principle of *subsidiarity*, the concept that decision-making power should be decentralized to the lowest (or most local) level at which it is still effective. In the modern natural resources management and sustainable development discourse, strong subsidiarity is generally regarded as a necessary condition of building adaptive and resilient governance networks (Munasinghe, 2007).



3.4 The First Watershed Era (1959–1990): Conservation Districts Emerge

As the provincial governments' economic and administrative responsibilities for drainage in the province continued to increase, the government soon recognized that a new administrative approach was required to maintain a coordinated system for drainage in the province. On the same September day in 1959 the provincial government enacted two pieces of legislation, which marked the beginning of a new, more integrated water management approach—and thus finally responded to key elements of the Sullivan and Finlayson commissions' recommendations.

The first of these was the 1959 Department of Agriculture and Immigration Act Amendment Act, which consolidated the administration of all matters concerned with water control, distribution, use and conservation under the now newly named Minister of Agriculture and Conservation. Prior to 1959, jurisdiction for water issues fell under four different departments: Mines and Natural Resources, Public Works (Land Drainage Arrangement Act), Agriculture and Immigration, and Industry and Commerce (Water Supply Districts Act), resulting in fragmentation and conflict over departmental mandates, especially between resource conservation and resource development branches (Ogrodnik, 1984). The act created a new Water Control and Conservation Branch under the new Department of Agriculture and Conservation; personnel were drawn from the Water Resources Branch in the Department of Mines and Resources and the Drainage Branch in the Department of Public Works. These two latter branches were subsequently abolished. This consolidation of water governance functions into one department foreshadowed a similar attempt at departmental coherence in the early 21st century, with the formation of the Department of Water Stewardship in 2003.

The second piece of legislation enacted in 1959, on the same day, was the Watershed Conservation Districts Act. Up to the late 1950s, water management efforts in the province had almost exclusively focused on removing excess surface water. The Watershed Conservation Districts Act represented a potentially profound shift in thinking, away from political boundary-based drainage to more holistic, watershed-based water and land management. The act provided municipalities the opportunity to coordinate their water management efforts through a single authority, the district board, through the establishment of a watershed conservation district, whose boundaries were to be coterminous with the watershed area (and not municipal boundaries) (Elliott, 1978, p. 39). The board was to have complete jurisdiction over all drains in the district, thereby eliminating the provincial-municipal and inter-municipal split in jurisdiction. The aims and objectives of the district board were:

> *…to promote the conservation and control of the water resources within the district and for that purpose, (the board) shall study, undertake, put into effect, operate or maintain, a scheme in respect of the district for the purpose of conserving, controlling, developing, protecting, restoring, or using,*
>
> - *the water resources within or available to the district; and*
> - *the land, forest, wildlife, and recreation resources within the district, as may be necessary or incidental to the achievement of those aims and objects. (Elliott, 1978, p. 40)*

The legislation appeared to be ahead of its time, as only two watershed conservation districts were formed under this act (Whitemud and Turtle River), and perhaps pushed the envelope, though it was certainly grounded in advances being made in other jurisdictions. Ontario's conservation authority legislation (which is watershed-based) was enacted in 1946, enabling the eventual formation of 36 local corporations, which today spend $158 million annually on watershed management (Conservation Ontario, 2006). The Ontario legislation was in turn based on American advances, notably the U.S. Flood Control Act in 1936 (Allee, 1987), and the apparent multipurpose success of the Tennessee Valley Authority. In the U.S., federal funding was made available to watershed-based projects for which "the benefits to whomsoever they accrue are in excess of estimated costs," and marked the beginning of watershed project evaluation (Galloway & Whelpdale, 1987).

Allee (1987) points to the early management concepts advanced by Gilbert F. White (1957) as the first "pure doctrine" of integrated watershed planning, management and development—citing three ideas (multi-purpose storage projects, basin-wide programming and comprehensive regional development) and two concepts (articulated land and water programs and unified administration), which all together characterize an effective watershed approach. By the early 1960s, natural scientists had embraced the Integrated Water Resources Management (IWRM) paradigm and also recognized "the watershed" as a sensible framework within which to address interrelated problems such as water quality and contamination. The approach of "taking the whole watershed into account" emerged as an efficient and practical means of tackling these issues with the support of science. In tracing this evolution, Heindl (1972) notes two pervasive concepts founding the discipline:

1) the watershed is a closed system that integrates the physical forces which act upon it; and
2) the knowledge and experience gained through the study of one watershed is transferable and, thus, may be applied extensively elsewhere (and a concentrated, small-basin study is applicable to larger ones).

The 1970 Resource Conservation Districts Act supplanted the 1959 Watershed Conservation Districts Act. Its enactment likely reveals the political tension of the conservation districts usurping municipality jurisdiction. On the surface, the two acts appeared identical; however, the new act contained several important and fundamental differences. The first was in its definition of the term *resource*. Where the 1959 act stated the aims and objectives of the district board were to "promote the conservation and control of the *water resource* within the district," the new 1970 act proclaimed the aims and objectives of the district board were to "promote the conservation and control of the resource within the district." In other words, the meaning of *water resources* was changed to include land resources. As well, land use was inclusive of water (Elliott, 1978, p. 40). The revisions contained within the new act were still compatible with the principles of IWRM, except that the shift in emphasis from water management to multiple-use resource management also entailed that the boundaries of the resource conservation districts coincide with municipal boundaries, and not the watershed area (Elliott, 1978). Ogrodnik (1984) interprets this reliance on municipal boundaries as an attempt to allay municipal councils' fears over the erosion of municipal control if watershed boundaries were used instead. Barg and Oborne (2006) consider the 1970 act and its eventual repeal in 1976 symptomatic of the general political turmoil of the era. Only the Turtle Mountain Conservation District was formed under the 1970 act.

Faced with a lacklustre response to either the 1959 or 1970 acts, the provincial government consolidated these two acts into the 1976 Conservation Districts Act. In the initial years following the 1976 act, provincial conservation district responsibilities were coordinated by the Water Resources Branch of the provincial Department of Mines and Natural Resources. The branch was a powerful, heavily staffed organization focused on water planning and management—charged with the delivery of several major federal/provincial projects at a time. A small annual budget was administered by the branch on behalf of the conservation districts and their partner municipalities. Drain maintenance and improvement projects were the major focus, while local input and governance was fairly limited. The conservation district program budget was increased in 1984, which resulted in significant funding improvements for the initial five districts.

Under the 1976 act, the provincial cabinet could create conservation districts through an order in council. This may be done following an application from a municipality or municipalities, or it may be initiated by the provincial government. According to Section 7(7) of the current act (Manitoba Statutes) the order in council establishing the district must state:

- *(a) the boundaries of the district;*
- *(b) where applicable the boundaries of sub-districts into which the district may be divided;*
- *(c) the name of the district which shall be substantially in the words "The - - - - Conservation District";*
- *(d) the works to be excluded from the jurisdiction, authority or control of the board;*
- *(e) the co-ordinator;*
- *(f) the schedule;*
- *(g) the effective date of the formation of the district; and*
- *(h) such other matters relating to the district as may be appropriate.*

In the legislation, the coordinator is defined as "a civil servant designated by the minister for the purpose of coordinating all services and administrative assistance to conservation districts." This is normally the manager of the province's conservation districts program. The legislation defines the schedule as:

> *An Order in Council setting out:*
>
> *(i) the upper and lower limits of the amount of money that a board may annually assess an included municipality, and*
>
> *(ii) the limitations of the borrowing powers of the board.*

The 1976 act further attempted to resolve the institutional tension between the conservation districts and the rural municipalities through a province–rural municipality partnership model. The districts would implement programs that met both local and provincial needs—focusing on soil conservation and water management. The new act provided "for the conservation, control, and prudent use of resources through the establishment of conservation districts; and to protect the correlative rights of owners" (Elliott, 1978, p. 43). The merging of the two previous acts was evident in the new act's definition of "resources" as "the lands and waters within or available to a district, whether used for wildlife, recreation, agriculture, forest production or any other use" (Elliott, 1978, p. 43). In anticipation of province-wide acceptance of the conservation district concept, the act created a conservation districts commission to advise the minister, provide advice and guidance to any district board, and provide a vehicle for provincial overview to ensure uniformity with respect to interpretation of the act by individual conservation district boards. The act envisioned that a conservation district would be managed by the local people, supported by the necessary technical staff, such as engineers, biologists and agriculturalists, and supplied by the province. The governing body of the district was to be the conservation district board. While the district itself would adhere to municipal boundaries, it was to be divided into watershed-based sub-districts, and each sub-district committee was responsible for studying and making recommendations on the conservation needs of the sub-district. The total cost of operating the conservation district was to be shared between the board and the province (Elliott, 1978).

Conservation District Commission and the Lake Winnipeg Stewardship Board

Since the earliest version of the Conservation Districts Act in 1959, the Conservation Districts Commission (CDC), an interdepartmental advisory body to a designated cabinet minister (currently the minister of water stewardship), has been in existence. The CDC provides guidance on policy and financial matters, including recommending annual provincial budget contributions for each district and the program as a whole. The key policy-setting/recommending role played by the CDC is very important, as it represents the only real source of long-term planning (as well as documented historical reference regarding many policy decisions) for the conservation districts program. The need and importance of this function was recognized as early as 1959, has been strengthened over time and remains in place to this day. In its initial form, the CDC was composed of director-level representatives from rural-related provincial departments such as natural resources, agriculture and highways.

Today, the CDC is chaired by the deputy minister of Manitoba Water Stewardship and comprises deputy ministers from four additional departments (agriculture, conservation, intergovernmental affairs and transportation). It also includes representatives from the Association of Manitoba Municipalities and the Manitoba Conservation Districts Association, and a public appointee. Recent legislation has also been enacted to increase this public representation by an additional person.

By this means, through the advisory role played by the CDC, the government controls the financial and administrative capacity of conservation districts. The CDC also provides policy guidance to all conservation districts through a series of policy directives approved by the minister of Manitoba Water Stewardship and coordinated by the conservation district program secretariat with staff support.

While most of these policy directives concern the administration of the conservation districts and their members, some programmatic directives address issues such as the licensing of small dams, water quality testing and the sealing of abandoned wells. Though these issues are not comprehensive from a watershed management standpoint, they are compatible with the water soft path approach.

An interesting recent development is the seeming overlap between the role of the CDC in the management of the conservation districts and the implementation of watershed management goals and the similar role of the Lake Winnipeg Stewardship Board (LWSB) as described by the ministerial announcement in February 2007 (details in Section 3.3.2). The CDC is composed of interdepartmental deputy ministers and representatives from conservation districts and organizations such as the Association of Manitoba Municipalities and is by mandate (Conservation Districts Act) responsible for the administration of the conservation districts.

The LWSB is a multistakeholder, non-governmental advisory committee to government. According to the February 2007 ministerial announcement, the LWSB's main mandate "will now be to co-ordinate development of a basin-wide watershed management plan in co-operation with regional authorities led by conservation districts." This expanded mandate may overlap with that of the CDC. However, the roles and priorities of these two committees may not be incompatible. Some further clarity on divisions of mandates and respective roles will be important.

In 1981, a seven-member Conservation Districts Authority (CDA) was established within the Department of Natural Resources, with strong political support and direct reporting authority to the assistant deputy minister. Unlike the CDC, which continues to provide budgetary and administrative direction, the CDA focused on providing a full range of planning support to existing conservation districts, coordinating required government technical assistance, assisting with budget planning and purchasing and establishing new conservation districts.

A central element of this new program delivery system involved the recognition by key personnel that local control was critical to ultimate conservation district success and this local governance capacity should be fostered with strong support and encouragement. From 1985 to 1990, the presence of an active assistant deputy minister (Derek Doyle) strongly supported the role of conservation districts as the IWRM solution provider, with decision-making capacity and adequate resources to address local soil and water management problems a major evolutionary factor in the program. Doyle championed a vision of highly autonomous conservation districts with the latitude and autonomy to define local priorities. Conservation district boards that had largely come to view "planning" as a bureaucratically imposed barrier to actually completing management solutions on the landscape began to embrace community-level conservation district management planning. Most initial plans were fairly general, although they were very holistic in orientation and considered the interrelated importance of conservation issues.

Later iterations of watershed plans increasingly focused on key local issues such as flooding, later integrating related issues such as soil conservation, water quality and wildlife habitat. However, these later plans appeared to be less technically rigorous, owing to decreased levels of federal and provincial staff participation in their development. Also, a possible lack of municipal commitment to some later plans has been identified as a problem, recognizing the importance of education, awareness and capacity building. Only one new conservation district joined the program during the 1980s (Pembina Valley, organized in 1989). This limited program expansion progress is attributed largely to the fact that only limited additional funding was available for new conservation district budgets and activities.

The older, watershed-based conservation districts have always devoted a significant portion of their annual budgets to drain maintenance and road-crossing activities, notably Whitemud and Turtle River. Due to the nature of its low-lying landscape and the dominance of agriculture in the area, Cooks Creek formed largely on the basis of drainage need. Alonsa (organized in 1978) assumed a degree of drain maintenance and crossing responsibilities through several agreements with the provincial water resources branch. Turtle Mountain (organized in 1973 under the 1970 act) does not have provincial drainage responsibilities, given its initial formation as a resource conservation district. Pembina Valley and all subsequent conservation districts were established without responsibility or authorities associated with the provincial drainage system.

By 1990, a flexible suite of conservation district programs had developed—with each conservation district delivering several activities in common with other districts in the program, and typically one or two programs somewhat unique to their own district. All conservation district budgets and a detailed list of planned program activities were reviewed annually—for ministerial recommendation—by the CDC. Beyond the complexities of drainage and water management, the range of conservation district programming by 1990 included programs in the general categories of:

- soil and water conservation;
- wildlife and habitat protection; and
- education programs.

While not all conservation districts offer all of these programs, soil and water conservation could include creek/gully stabilization, creek maintenance, grassed waterway seeding, road allowance seeding, rotational grazing management, stone crossing installation, water quality testing and tree planting/shelterbelts. The wildlife and habitat programs included conservation corridor programs, fisheries enhancement programs, habitat acquisition and land donations. The conservation district–based education programs include conservation in the classroom, the conservation family award, a youth speaking competition and agroforestry.

A general ebbing of enthusiasm and support for the conservation district program can be traced to the departure in 1989 of the assistant deputy minister of natural resources (Doyle) responsible for the conservation district program. In 1990, the executive director of the CDC, Dr. Ian Dixon, assumed another position in another agency, and this leadership position was never filled. The CDA was gradually dismantled. Two remaining staff were transferred to the Department of Municipal Affairs, and in 1998, all budgetary authority for the conservation district program was transferred to the re-named Department of Rural Development (later known as Intergovernmental Affairs), under the auspices of the Manitoba Water Services Board—a coordinating body for federal/provincial funding for water-related municipal projects.

At this point, the conservation district program began a long period in which significant program funding was provided from the provincial government to the individual districts. However, provincial program staff were limited in terms of supporting individual district needs related to policy, technical support and capacity building—the role formerly played by the CDA. The ramifications of this decision are still being felt today, although the situation has improved somewhat with the establishment of a dedicated program support office.

3.5 The Second Watershed Era (1990–2009): Sustainable Development and Lake Winnipeg

At a time when bureaucratic commitment to the conservation district program seemed to be ebbing, two external influences have rejuvenated the logic of conservation district–led integrated watershed management and planning. The first influence was sustainable development's emergence as a normative governance concept closely linked to IWRM. The second, more recent and proximal influence is public concern regarding the ecological condition of Lake Winnipeg.

According to a publication from the province, prior to the 1980s water was often approached in a reactionary manner addressing only short-term benefits, and water quality was virtually ignored (Government of Manitoba, 1999). A discernable shift in attitudes can be traced to the publication of *Our Common Future* by the World Commission on Environment and Development (WCED) in 1987. Generally known as the Bruntland Report, the WCED report introduced to the world the transformative concept of "sustainable development," or a "sound balance of environmental management, economic development and social well-being factors to ensure benefits for future generations" (Manitoba Conservation, 2001, p. 2). By the end of the 1980s there was growing public awareness and concern about the environment along with the recognition that environmental management, conservation and economic development are interdependent and mutually reinforcing (Government of Manitoba, 1999). This shift in thinking has had a profound impact on water policy in Manitoba since 1987.

In the latter half of the 1980s, the Government of Canada's primary institutional response to the challenge of sustainable development was the creation of the Round Tables on the Environment and Economy (Doering, 1993). The Province of Manitoba followed suit, establishing the Manitoba Round Table on Environment and Economy (MRTEE) in 1988. In 1989, Manitoba began preparing a strategy that would comprehensively address the management and development of land and water resources. Water was selected as the first resource to address, since its management affects all other resources (Government of Manitoba, 1999). The MRTEE drafted a set of comprehensive Manitoba water policies, followed by extensive public consultation and review. At the end of this process, the revised policies were submitted to and adopted by Manitoba as Manitoba's Water Policies, 1990, to guide sustainable water management in the province (Manitoba Round Table on Environment and Economy, 1990).

Manitoba's water policies (1990) covered seven main objectives: (1) water quality; (2) conservation; (3) use and allocation; (4) water supply; (5) flooding; (6) drainage; and (7) education (Government of Manitoba, 1999). In the same year (1990) the Government of Manitoba published *Towards a Sustainable Development Strategy for Manitobans*, a framework for a sustainable development strategy for Manitoba. Based on this framework, the MRTEE engaged in several more years of extensive public consultation, resulting in the 1994 publication of the *Sustainable Development Strategy for Manitoba*. A multi-stakeholder consultation process known as COSDI (Consultation on Sustainable Development Implementation) was then initiated to make recommendations to government on implementing sustainable development principles (Government of Manitoba, 1999).

The year 1990 also saw a return to wetter-than-normal years in Manitoba that again exposed shortcomings in Manitoba's agricultural drainage network. Simultaneously, a glut of low-cost feed grain caused by the demise of a federal rail transportation subsidy known as the Crow Rate sparked the expansion Manitoba's food processing and livestock (cattle and hog) industries. Livestock industry growth stressed water supplies in some locations and highlighted the need for water quality monitoring and management, primarily over manure runoff concerns (Manitoba Conservation, 2001, p. 4).

Likely influenced by a concurrent consultation process in 1998 and 1999 on land drainage, water usage and allocation, and water legislation (Manitoba Conservation, 2000; Manitoba Natural Resources, 1998), COSDI recommended that Manitoba make its environmental, land-use, and resource allocation decisions in the context of large area plans based on naturally definable areas, such as watersheds. COSDI advocated that such large area plans encompass all aspects of sustainable development, i.e., land, water, other resources, economics, social, health, environment and culture. COSDI also envisioned a consensus-based planning process driven by local/regional multistakeholder committees and supported by government staff and resources (Manitoba Conservation, 2001, p. 2). In 2001, Manitoba published a discussion document, *Building a Sustainable Future, Water: A Proposed Strategic Plan for Manitoba, a Discussion Paper* (Manitoba Conservation, 2001), which proposed a four-point strategic water plan for Manitoba based on:

- a provincial water strategy that encompasses issue-specific provincial strategies;
- the development of watershed management planning initiatives and guidelines;
- a legislative review resulting in a legislative framework that is more comprehensive; and
- a plan for the financial underpinnings of the strategic plan.

From this process evolved the Manitoba Water Strategy, 2003 (advanced jointly by Manitoba Conservation and Manitoba Intergovernmental Affairs). The 2003 strategy was based on the 1990 Manitoba Water Policies, but focused on six policy areas: water quality, conservation, use and allocation, water supply, flooding and drainage, and emphasized the importance of water education in each policy area.

The prominence of water quality issues in the 2003 strategy can be explained by the Walkerton, Ontario, *E. coli 0157* outbreak in May 2000. In June 2000, Manitoba established the Drinking Water Advisory Committee to review drinking water systems, testing and regulation in the province. This committee published its recommendations in November 2000 (Manitoba Health, 2000), which led to the passage of the Drinking Water Safety Act, 2002, one of the most comprehensive pieces of drinking water legislation in North America.

The 2003 Water Strategy outlined a three-pronged implementation approach, including: the development of an integrated water planning and management system, the review and consolidation of water legislation, and the development of the mechanisms for financing water management and planning. The 2003 strategy identified conservation districts as the most logical delivery agent for a renewed focus on watershed planning and management, for a range of water-related sustainability solutions.

Two major governance initiatives emerged from the 2003 Water Strategy. First, in November 2003 a new Department of Manitoba Water Stewardship was created. The conservation district program was transferred to the new department under the auspices of the Planning and Coordination Branch, reporting to the assistant deputy minister. The second major initiative occurred in March 2004, with the first reading of the Water Protection Act in the Manitoba legislature. The Water Protection Act, which received final assent in January 2006, essentially provides the legislative foundation for key IWRM principles and includes provisions:

- to allow, establish and implement water quality standards, objectives and guidelines;
- to establish water quality management zones and to regulate activities within those zones;

- to prohibit and otherwise regulate harmful non-native species;
- to allow water conservation programs to be established;
- to require the preparation of watershed management plans for adoption in local development plans; and
- to allow for the declaration of a serious water shortage, and for taking action to address such shortages.

The Water Protection Act identifies conservation districts as logical lead entities to coordinate the operation of "local water planning authorities" and their development of watershed plans and management implementation priorities.

The Lake Winnipeg Action Plan (LWAP) was the third major initiative under the 2003 strategy. Released in February 2003, the LWAP comprised a six-point plan to reduce nutrient loads in the lake and was a response to the increasing public perception that the lake did indeed face unprecedented threats. A key element of the lake action plan was the formation of the Lake Winnipeg Stewardship Board (LWSB), an appointed board reporting directly to the minister of water stewardship. The LWSB was originally mandated solely to develop recommendations for reducing nutrient loads on the lake; its final report, in 2006, contained recommendations in 37 areas of water resources management, with a total of 145 specific recommendations. The LWSB emphasizes the "total nutrient management" concept, which would incorporate watershed-based nutrient management through a process of integrated water resources management.

In February 2007, the LWSB received a significantly expanded mandate that implicated the conservation district program for delivering water quality objectives. According to the government announcement:

> *The board will take on additional responsibilities to provide advice to government on the health of Lake Winnipeg and its basins. The main mandate of the Lake Winnipeg Stewardship Board will now be to co-ordinate development of a basin-wide watershed management plan in co-operation with regional watershed authorities led by local conservation districts.*

> *While the board will continue to identify and assist in implementing actions to reduce nitrogen and phosphorus to pre-1970s levels, its mandate will be expanded to provide advice to government on other measures needed to restore health to Lake Winnipeg, such as the identification of pollutants entering the lake. It will be additionally tasked with examining issues impacting the management and ecological sustainability of the lake's fisheries.*
>
> *The renewed terms of reference will also mandate the board to prepare periodic "state of the lake" reports, through contact with lake users, communities, scientists and others. These reports will be presented to government and will include information on the status of government action in implementing the board's recommendations and the status of progress toward reaching nutrient reduction targets. (Government of Manitoba, 2007)*

The February 2007 announcement indicates that the conservation districts will be the operational entity for nutrient management and watershed planning and management, which is a policy direction completely consistent the IWRM principles. The key operational question is simply: can the modestly funded conservation district program deliver on this vast mandate? We review the evidence in the next section.

Conservation Districts Case Studies

CASE STUDY 1 > The Whitemud Watershed Conservation District

Whitemud Watershed conservation district, the first district established in Manitoba (1972), was formed on actual watershed boundaries, involving parts or all of 15 rural municipalities. Its formation was based on the 1959 watershed version of the Conservation Districts Act. Whitemud is responsible for the management of all high-order provincial drains and is now coordinating the review of all on-farm drainage proposals (for those private landowners who choose to develop drains in a legal manner) on behalf of the province.

Due largely to its original formation in 1972 on watershed boundaries, combined with its responsibility for provincial drains (and solid relationships with its member municipalities that manage their own drains), the Whitemud Drain Licensing Pilot Project has resulted in a marked increase in the percentage of on-farm drains being reviewed, has reduced licence review times (from six months to six weeks) and offers real hope for clues in developing a workable surface water management framework—which many conservation districts and their member municipalities would like to see.

The Drain Management Program process centres on the concept of building and maintaining solid local partnerships among neighbouring farmers, rural municipalities, provincial regulators and other community stakeholders. Whitemud is demonstrating an ability to legally fulfill the on-farm drainage needs of many farmers, while its member municipalities work cooperatively with the conservation district in planning municipal-level drainage works. Whitemud's original mandate included responsibility for provincial drainage works and stream crossings, necessitating its preparation of a detailed surface-water management plan, the only such plan that currently exists for any conservation district.

Whitemud also demonstrates *adaptiveness*, evidenced by the Drain Management Program. It was never foreseen that a conservation district would manage the drain licensing process, and Whitemud is now doing this effectively. In most other conservation districts, drain licensing is managed by the province and remains the focus of many complaints and frustrations. A key innovation is the "open consultation" involving all stakeholders at one meeting, at the actual proposed drainage project site—with a reasonable comment period before the proposal proceeds to the provincial government for final approval.

Spending any effort to find solutions to Manitoba's surface-water management challenge only makes sense within the context of watersheds, where decision-making authority and capacity to assist are in place. Most conservation districts do not have either, and only one has both of these criteria in place: Whitemud.

CASE STUDY 2 > Boundary Realignments along the Souris River, 2001–2005

Since 1976, the conservation district program has not mandated watershed-based administrative boundaries. By 2001, it became clear to many local ratepayers that two separate rural municipalities in two separate conservation districts (Cameron in West Souris River Conservation District and Arthur in Turtle Mountain Conservation District) were each partially located within a conservation district that was not ideal for their needs, and even less for promoting soil and water management solutions.

After reviewing the situation and recognizing that provincial program objectives would (likely) one day return to being watershed-focused, the boards for both West Souris River and Turtle Mountain decided to proceed with an innovative boundary realignment. The process began with initial meetings with both affected rural municipalities.

In 2003, the realignment occurred based on river boundaries—with each affected municipality bisected by the Souris River, and half of each municipality joining the conservation district in operation on each side of the river. Some minor administrative adjustments were required, specifically in relation to slight differences in relative taxation rates. However, local ratepayers were pleased with the result.

In a related development the following year (2004), West Souris River initiated a watershed planning process within three sub-watersheds in its district and invited upstream residents and other stakeholders in Saskatchewan to participate.

In 2005, as watershed planning efforts began in Saskatchewan, those same upstream partners invited West Souris River stakeholders to participate in their process. This transboundary watershed partnership is now evolving to include the sharing of water quality test results and other data. While not truly watershed based (in that it uses the river as the boundary), the boundary realignment efforts of West Souris River are indicative of the Manitoba conservation district program's flexibility. The Conservation Districts Act specifically provides for boundary amendment. Two neighbouring conservation districts recognized the logic of redrawing their boundaries and requested that the provincial government make the change.

The fact that this watershed-based relationship has been built across a provincial boundary is significant, particularly when such partnerships, even across municipal boundaries, are often quite difficult in Manitoba.

CASE STUDY 3 > Ecological Goods and Services Programming in Little Saskatchewan Conservation District, 2004–2006

Of growing interest in public policy is the use of economic incentives and instruments as a complement or substitute for regulatory and voluntary instruments. This innovation involves measures such as environmental taxes, tax incentives and tax shifting, and non-tax measures such as tradable permits, subsidies, user charges and resource pricing. Incentives have proven to be more flexible than command and control approaches. They can promote technological innovation and reduce costs of pollution control when compared to certain regulations (Environment Canada, 2007).

This concept of using tax or income incentives presents significant opportunities and a framework for expanding conservation programming with a focus on sustainable land management. This approach is particularly relevant within the agriculture sector, where new income (and cost reduction) opportunities are constantly desired.

In 2004, the Little Saskatchewan River Conservation District was approached by the Delta Waterfowl Foundation (Delta, a charitable wildlife conservation organization) and Keystone Agricultural Producers (KAP, Manitoba's general farm lobby organization), to participate in a pilot project to test the potential for applying ecological goods and service (EGS) incentive payments to private agricultural landowners—as a means of promoting sustainable land management decisions.

The conservation district struck a committee to explore the concept and assist with the development of a proposal to the federal and provincial departments of agriculture. The pilot project evolved into a significant federal-provincial initiative, with substantial private sector support via Delta, in addition to $120,000 of funding from one of the conservation district's municipal partners—the Rural Municipality of Blanshard, where the project was implemented. The conservation district is also providing valuable GIS and local project management support; the conservation district will also likely play a key role in administering the program, in partnership with a provincial crown corporation, the Manitoba Agricultural Services Corporation.

The initiative is successfully providing incentives for the creation of upstream storage systems, flood protection and nutrient management through wetlands and riparian zone management—critical elements of the WSP approach to water management. This conservation district has demonstrated its adaptive capacity for using its flexible delivery structure to provide local conservation programming using economic incentives.

Major weaknesses of the ALUS program that illustrate its mis-alignment with IWRM principles include:

- no monitoring of water quality benefits;
- no prioritization and ranking of beneficial management practices on a watershed basis; and
- lack of a watershed basis.

3.6 Synthesis

The 19th and 20th century of *de facto* Manitoba water policy centred on modifying the natural landscape with artificial drainage channels to remove excess water—a sensible enough approach when rainfall is adequate to support crop growth and land-use practices do not overload receiving water bodies with excess nutrients. The 21st century will challenge these early assumptions; a serious policy response to the scientific consensus around climate change should orient Manitoba water policy toward rebuilding natural landscapes, which are resilient to increasingly variable precipitation and increasing aridity and can reduce nutrient loading.

Periodic calls for a more integrated approach to land and water management date back as early as the Sullivan Commission in 1919, but were largely unheeded until 1959, when latent political will for a new approach coincided with a scientific and engineering consensus around the logic of integrated watershed development.

The 1959 Resource Conservation District Act captured the vision of watershed-based IWRM led by conservation districts; however, local institutional issues obstructed the act's objectives. The 1959 legislation marked the first major disjuncture in the history of Manitoba water policy and created the institutional and legal space for ecosystem-based governance, which is at the heart of IWRM. However, only two conservation districts (Whitemud and Turtle River) were ever created under the original 1959 legislation, and only they conform to watershed boundaries; only they have comprehensive responsibility for maintaining both municipal and provincial drains and stream crossings.

The deprecation of the watershed-focused 1959 legislation in the Resource Conservation Districts Act (1972) and ultimately the Conservation Districts Act (1976) led to a framework wherein conservation districts observed municipal boundaries and the responsibility for drainage was transferred from the province to rural municipalities. Although the earliest conservation districts were established along watershed boundaries, and some conservation district boundaries have recently been adjusted to conform to watershed boundaries, the majority are still based upon municipal boundaries.

Historically, nonconformity with watershed boundaries has impeded IWRM, as noted by the conservation districts mandate study (Ft/ecologistics, 1998): "comprehensive watershed management planning is not being widely employed as a means of dealing with land and water interrelationships." In most cases, the "functional area" on which most conservation districts are administratively designed is not consistent with the natural systems the conservation districts are trying to manage effectively. Most conservation districts do not have authority over all of the contributing headwater areas—or all collecting waterways downstream—of their existing administrative boundaries. As a result, many more stakeholders than necessary must be engaged for any effective surface water management plan to be effective.

According to Barg and Oborne (2006), conservation districts are frustrated that more progress has not occurred toward effective surface water management in Manitoba. Even with fairly clear provincial policy regarding on-farm drainage, it has been estimated by several conservation district managers that approximately 90 per cent of all new drainage within many conservation districts being undertaken by private landowners is occurring without required provincial review or licensing. Therefore, much on-farm agricultural drainage occurring in Manitoba (including wetland drainage) is illegal.

From a sustainable development and climate change adaptation viewpoint, excessive drainage is problematic. Rapid drainage results in a decrease in the infiltration of surface water into wetlands and groundwater—and thus less potential to draw on these water-supply buffers in times of water scarcity. In the

context of climate change adaptation and the projections that a greater fraction of annual precipitation will occur before the growing season, maintenance of supply buffers and thus a re-naturalization of drainage becomes ever more of a policy priority. In more steeply sloped areas, quick drainage can result in a higher risk of flooding and infrastructure losses downstream. Increased streambank erosion and sedimentation can also result, increasing downstream drain maintenance costs.

However, agricultural drainage is a fundamental need in much of the province, particularly in the relatively flat Red River Valley, as well as in many other southern areas where highly productive soils are inherently wet. Unfortunately, substantial wetland drainage and loss has also occurred in Manitoba, and Manitoba conservation districts have been relatively powerless to stop it—a dichotomous and difficult challenge to reconcile when conservation districts may have both drainage and conservation responsibilities. In addition to associated wildlife habitat and biodiversity losses, wetland drainage reduces natural water retention/flood control capabilities and eliminates an impressive range of water quality services provided by these ecosystems.

Increased rates of drainage (while desirable from a short-term agricultural production perspective) also tend to increase the flow of pollutants and nutrients—mainly from agricultural runoff—into downstream rivers and lakes. This is especially a problem for Lake Winnipeg, which is heavily stressed from agricultural runoff, among other sources. Individual conservation districts repeatedly express concerns about maintenance on provincial (larger-capacity) agricultural drains, many of which are channelized former natural waterways. In most cases, rural municipalities are responsible for local municipal drains (which lie between on-farm and provincial drains in size and drainage capacity). This creates a patchwork of responsibilities and authorities for water management across the province, both within conservation districts and beyond them.

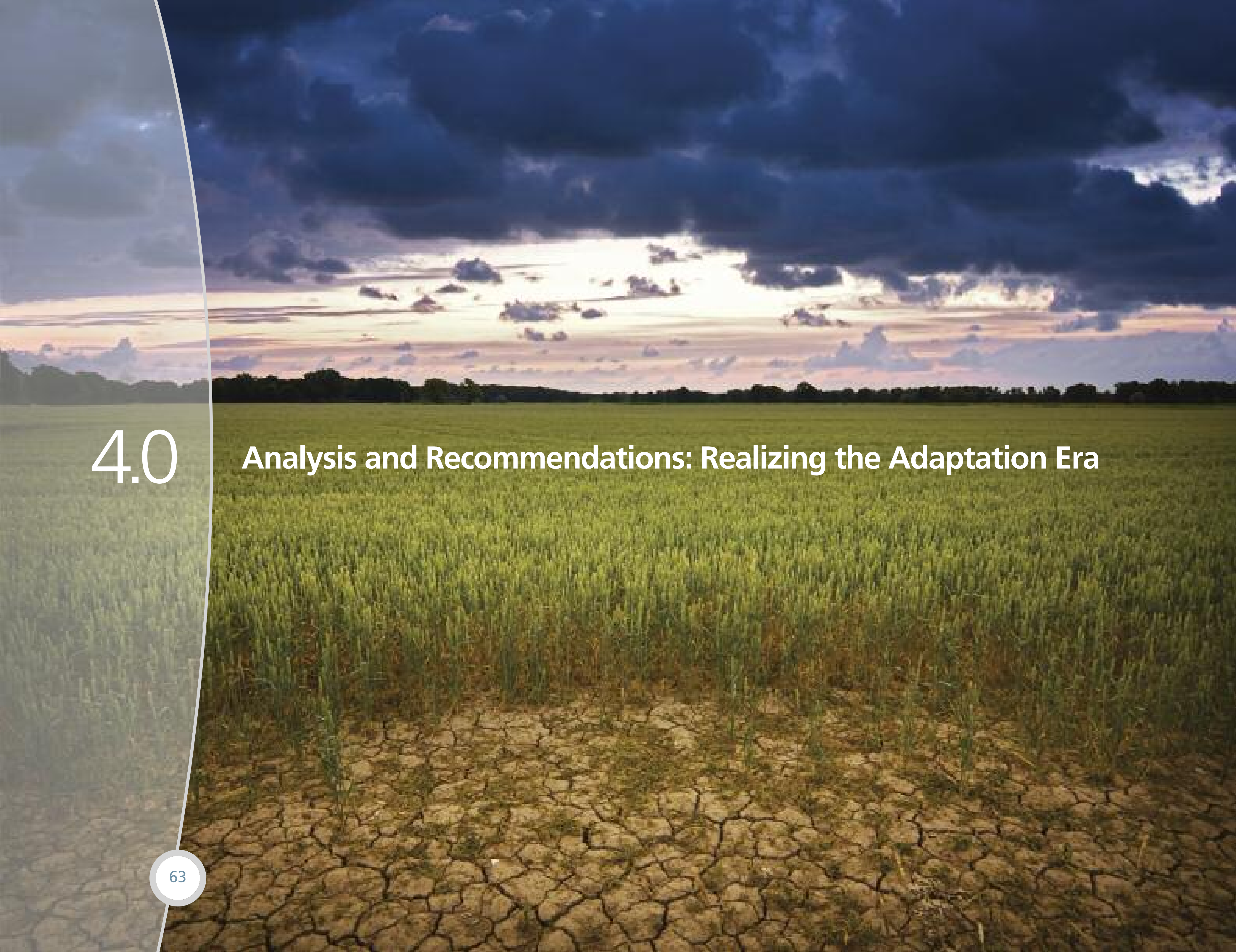
Heavy precipitation events in recent years have generally reinforced the longstanding and widely held perception among many farmers that the ability to remove excess water rapidly is the fundamental right of private agricultural landowners. According to Barg and Oborne (2006), of the estimated 10 per cent of actual drains that are being reviewed and approved by provincial inspectors (within many conservation districts), landowners will generally flout conditions imposed under provincial legislation, as they're not concerned about provincial enforcement.

Scant resources for implementation, monitoring and enforcement are common themes. Nonetheless, some progress is being made. Several conservation districts have recently embarked on watershed planning exercises, the results of which are helping to suggest what a province-wide surface water management framework could look like; licensing, enforcement and the promotion of beneficial management practices are very common themes. Given the cultural bias toward ad hoc drainage measures on the part of landowners, we suspect that incentive programs to maintain and enhance naturalized drainage features will be an important implementation mechanism to compensate for the perceived loss of agricultural benefits.

Current legislation, particularly the Water Protection Act, expresses a long-term vision of integrated land and water planning and management—the political will to adequately resource the process, however, is uncertain. Water quality, particularly the health of iconic Lake Winnipeg, prominently features as a public and urban concern. Resolving the nutrient loading issues is largely a rural issue, however, as two-thirds of the phosphorus loading on Lake Winnipeg generated within Manitoba comes from agricultural watersheds. The conjunction of urban and rural interests could generate the political will to adequately resource the IWRM paradigm correctly identified in policy and legislation as the joint resolution of water supply and water quality issues. Adequate resourcing of the conservation district program, which is charged with delivering IWRM, is essential.

At a political level, Manitoba has embraced climate change mitigation as a legitimate political issue and embraced the logic of applying economic instruments to reduce greenhouse gas emissions—including through modifications of the agricultural landscape. Climate change adaptation should be embraced with equal political fervour. Manitoba's economic opportunities, realized by embracing climate mitigation, could be easily outweighed by the costs of not adapting to the impacts of climate change. The water and agricultural sectors are clearly high priorities for adaptation. Many of the same economic instruments being developed for climate change mitigation can, with moderate extension and modification, be used for climate adaptation.

Our analysis and recommendations for realizing the Climate Adaptation Era as the next era of IWRM in Manitoba are presented in the next chapter.



4.0 Analysis and Recommendations: Realizing the Adaptation Era

Overview

An important strategic orientation for the next evolution of water resources policy in Manitoba will be toward climate adaptation. The rising prominence of climate change as a key governance issue is clearly evident in Manitoba and within the federal government. The communiqué of the September 2007 joint federal-provincial meeting of resource and environment ministers (hosted by Manitoba Conservation and Manitoba Water Stewardship) states that "adapting to climate change will be a policy priority," including a specific commitment to develop "a work plan on water that will consider adaptation strategies to protect and manage our water resources in the face of a changing climate" (Canadian Intergovernmental Conference Secretariat, 2007). The first federal funding announcement in support of this political commitment was made at the UNFCCC COP 13 meeting in Bali, Indonesia. Environment Minister John Baird announced $85 million in federal funding, including $15 million for research to improve climate change scenarios and $35 million for risk management tools for adaptation and to support the development and implementation of regional programs (Environment Canada, 2007).

Orienting water resources policy in Manitoba toward climate change adaptation is a strategic opportunity to reintegrate management across land-water resources issues, a critical priority given the nature of climate change impacts. New federal and provincial funding mechanisms for climate change adaptation and mitigation are now in development that can logically be linked to advancing IWRM. The companion technical analysis to this report documents that the overall hydrologic budget in Manitoba is overwhelmingly dominated by agroecological processes; well over 90 per cent of available precipitation is evaporated or evapotranspired, and only 8 per cent is available as runoff. Climate change is projected to further decrease the fraction of the water budget available as runoff, given increased evaporative demands. Furthermore, projected runoff will be more seasonal and episodic, driven by the greater fraction of annual precipitation projected to occur in the early part of the year and by higher-frequency extreme rainfall events. Since climate change will impact water quantity and water quality, Lake Winnipeg stewardship issues can and should be considered as part of broader adaptation issues, particularly as federal scientists have correlated the size and duration of algal blooms to increasing summer temperatures.[8] Lake Winnipeg will continue to have a galvanizing influence on policy-makers to forge ahead with progressive water policy.

The value of the water soft path concept with respect to climate change is, first, with respect to its emphasis on small-scale distributed supply management—watershed-based IWRM in this context (analogous to distributed renewable energy in the energy soft paths). Second, the soft path concept remains useful for its explicit emphasis on natural resource governance models consistent with sustainability, again highly compatible with the vision of adaptive and integrated water resources management. Third, the soft path approach is very compatible with climate change adaptation through its use of scenarios to envision a desirable future state of water resources management.

The demand-side technological aspects of the water soft path concept are less valuable from a provincial policy perspective when the direct anthropogenic water use is a minute fraction of the overall provincial water budget. From a provincial perspective, overall water scarcity will arise from climate change–affected agroecological process rather than from direct human consumption. The water soft path paradigm is better suited to the municipal context, where aggressive demand-side approaches can be used to defer infrastructure investments.

[8] Climate change is projected to further decrease the fraction of the water budget available as runoff, because of increased evaporative demands. Furthermore, projected runoff will be more seasonal and episodic, driven by the greater fraction of annual precipitation that is projected to occur in the early part of the year, and by higher-frequency extreme rainfall events. Since climate change will impact water quantity and water quality, Lake Winnipeg stewardship issues can and should be considered as part of a broader adaptation agenda, particularly as leading scientists have begun to link the impact of increasing global temperatures and reduced summer stream flows to increased eutrophication of prairie lakes and rivers (Schindler & Donahue, 2006).

Developing the capacity of municipalities to apply demand-side management options is also an important policy direction.

This analysis is oriented toward watershed-based agroecological measures to buffer the influence of climate change, which has scientific, financial and institutional implications. At a broad scale, the scientific issues are clear: resilience to climate change will be increased with utmost attention to soil moisture conservation, use of water-efficient crops, and ecological goods and services programming for runoff interception, nutrient retention and flood regulation (Gan, 2000; Pyke and Andelman, 2007).

An optimal portfolio of adaptation practices will be watershed-specific and will be refined through a process of adaptive management, but the broad policy direction is clear and consistent with:

- the International Water Management Institute's recommendation that agricultural watersheds be managed for multiple ecosystem services (as noted in Chapter 2); and
- the IPCC Fourth Assessment Report observation that IWRM will reduce climate change vulnerabilities.

The fundamental near-term challenge to implementation is that the institutions designated as responsible for IWRM are properly resourced and empowered within the bureaucracy, hence our focus on the history of conservation district programs in this study. The fundamental medium- to long-term challenge is that the mandate of the designated IWRM institution be extended to formally include agroecological extension, which is fundamental to water sector adaptation to climate change in Manitoba and is consistent with the spirit of the 1959 legislation that created the conservation district system.

An important strategic opportunity exists with respect to existing agricultural extension programming within Manitoba's Department of Agriculture, Food and Rural Initiatives. Manitoba is the last prairie province to conduct agricultural extension, as this on-farm function is generally regarded as having been supplanted by agribusiness sales representatives in other provinces. Re-titling and reorienting existing agricultural extension functions as "ecosystem services and adaptation programming" and focusing on IWRM support may be a logical way to preserve existing institutional capacity.

Financial Issues

At the request of the Alberta Minister of Environment, the Rosenberg International Forum on Water Policy (based within the University of California) convened an expert workshop to review Alberta's Water for Life strategy in June 2006. The report of this workshop is illuminating; the foremost recommendations are: first, increase the participatory component of the process and, second, widen the scope of managing scarcity from simply demand management to innovative storage approaches—such as watershed-scale landscape management.

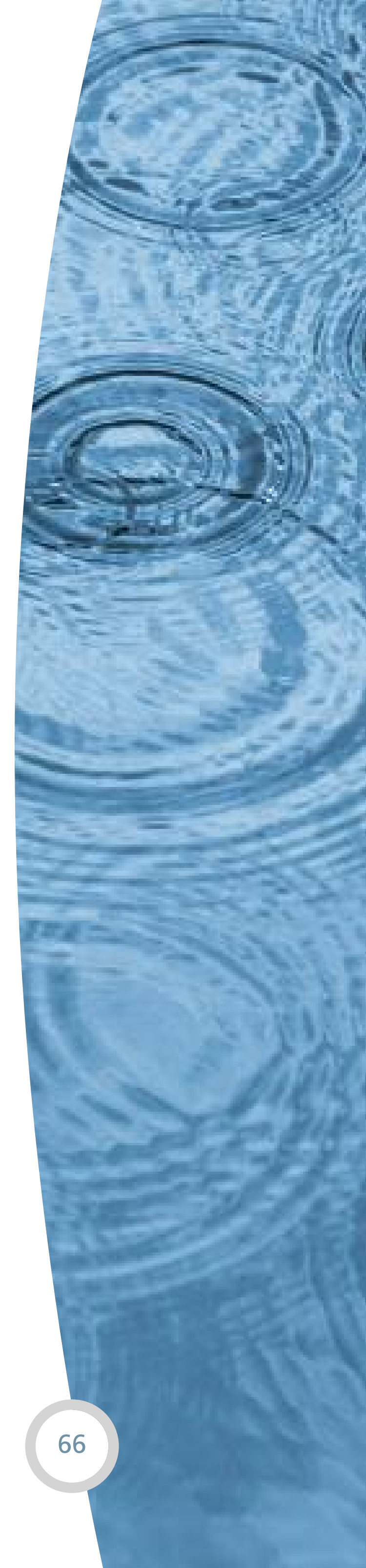
The third of 10 key recommendations focused on financial resources—observations that are very salient in the Manitoba context as well. The Rosenberg report noted that:

> *there are numerous examples in the world of well-designed strategic plans that have failed because of inadequate organizational and fiscal support. Most similar state-level strategies fail to deliver on all but short-term objectives due mainly to conflicts in priorities of participating agencies. Those few strategies that have succeeded have all gone beyond standard budgeting and appropriation approaches to make long cycle fiscal commitments, supported by legislative instruments to secure the funding.*

The Rosenberg forum recommended that:

> *legislation authorizing budgetary and fiscal support sufficient to realize the Water for Life strategy's immediate and medium-term objectives should be an urgent priority. Such legislation should also include time-limited provisions for review and commitment to emerging long-term objectives.*

In the very headlands of the Lake Winnipeg watershed, declining snow pack in the Rockies will provide a self-evident indicator of water resource stress in Alberta and will likely sustain public pressure and therefore the political will to appropriately resource the Water for Life strategy.



At the bottom of the watershed, Lake Winnipeg's evident risk of eutrophication will sustain public visibility and therefore the political commitment to water resource management in Manitoba. Channelling this political will into adequately resourcing IWRM is the fundamental financial challenge—and essential, given that two-thirds of phosphorus loading to the lake derives from non-point source watershed sources.

The budgetary priorities of the provincial government do not yet recognize the centrality of integrated land and water resources management. Of a total 2006–07 provincial budget of $10.35 billion, about 4.4 per cent ($453 million) was spent on agri-environmental and municipal programming, and only $5.19 million (0.05 per cent) was spent on IWRM, principally through the conservation districts program. The provincial government has not yet made large long-cycle budgetary allocations to IWRM, though water resource allocations are generally increasing in profile.

With respect to the lack of serious treasury allocations to the Alberta Water for Life strategy, the Rosenberg report argues that more attention should have been paid to aligning existing economic instruments with key objectives of the strategy, and the authors encouraged Alberta Environment to develop new and innovative economic instruments. Within the current Manitoba context, strategic engagement with the climate change issue is again critical. New economic instruments for climate change mitigation targeting the agricultural landscape are now in development, led primarily by the Climate and Green Initiatives Branch with the Department of Science, Technology, Energy and Mines. Agriculture produces 30 per cent of Manitoba's GHG emissions and is the second-largest GHG emitting sector after transportation.

The provincial policy priority to develop climate mitigation instruments emerges in part from the Task Force on Emissions Trading and the Manitoba Economy, chaired by Dr. Lloyd Axworthy, which reported to the premier in January 2004. IISD coordinated the task force and helped develop its recommendations. Among the recommendations put forward was to develop instruments with climate change mitigation and adaptation co-benefits, primarily through watershed-based ecological goods and services co-benefits. The political and practical logic is straightforward; addressing a global environmental issue such as climate change should be aligned with local environmental issues such as sound watershed management, particularly when our water resources are vulnerable to climate change impacts (Manitoba Task Force on Emissions Trading and the Manitoba Economy, 2004).

Summary and recommendations

Manitoba's water resources—notably including Lake Winnipeg—are vulnerable to the impacts of climate change. Ecological watershed management is a major opportunity to address the province's climate change vulnerabilities and its pressing challenges related to nutrient management in Lake Winnipeg. Further, it is essentially synonymous with an innovation agenda for Manitoba's agricultural zone and rural communities. Climate change adaptation through Integrated Watershed Management and Planning (IWMP) should therefore be a major provincial policy priority. We base this conclusion on two key observations:

1. The results of a companion technical study have demonstrated that only a minute fraction of the surface water budget in the populated region of Manitoba is directly consumed by human activities (irrigation, livestock production and municipal consumption). The water budget for agro-Manitoba is overwhelmingly dominated by watershed-based processes, which are influenced by water and land management practices. Evapotranspiration accounts for 92 per cent of the agro-Manitoba water budget, with runoff accounting for the remaining 8 per cent.
2. The results of climate change impact studies for western Canada and Manitoba reviewed in this report (Section 2), including relevant sections of the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC, 2007) and the Prairie Chapter of the National Climate Impacts and Adaptation study (Sauchyn & Kulshreshtha, 2008) clearly outline Manitoba's future water management challenges. The general findings of these studies include higher overall aridity, increased frequency of extreme precipitation events, shifting seasonal precipitation patterns with earlier spring runoff, higher-frequency agricultural and hydrological drought, and negative impacts for aquatic ecosystems and water quality, primarily associated with more intense and episodic nutrient-loading events and a longer duration of low-flow periods.

The rationale for a climate change adaptation strategy focused on watershed-based agroecological management is logically three-fold:

- Given the results of the water budget analysis, from a provincial perspective the most appropriate lever to regulate water supply is through watershed-based processes.
- The clear consensus from international assessments—including the IPCC Fourth Assessment Report—is that it is imperative to manage the hydrologic effects of climate change through integrated water and land management.
- Ecological watershed management addresses critical climate change vulnerabilities associated with the loss of ecological goods and services, has the significant co-benefit of reducing nutrient loads on Lake Winnipeg, and should be viewed as an opportunity for solutions and as part of an innovation agenda.

Adapting to climate change through integrated water and land management in Manitoba poses a key institutional challenge, particularly around issues of agricultural land drainage. Climate change impacts, specifically the higher frequency of extreme precipitation events and the projected shift in the seasonality of rainfall patterns, will exacerbate longstanding tensions over agricultural land drainage because of the increased need to conserve runoff for use later in the growing season. The history of water policy in Manitoba is characterized by the hard severance of land and water issues that accompanied Manitoba's entry into Confederation, and sporadic attempts thereafter to reintegrate across the land-water divide. Resolving this divide poses a key adaptation challenge for Manitoba and

may be best addressed through a rural innovation agenda. We identify the major eras in the history of Manitoba water policy below:

- *The Drainage Era, from 1870 to 1959.* Land and water management issues are effectively severed by the imposition of a grid-iron settlement pattern. This era is propelled forward by federal settlement policies on the prairies, particularly the arrival of the railways and associated land clearing and drainage activities to accommodate agricultural settlers.
- *The First Watershed Era, from 1959 to 1990.* The creation of conservation districts is the first evidence of serious political commitment to a new institutional model, the conservation district program, for coordinating land and water management. The 1959 legislation envisioned the creation of watershed-based entities to address agro-Manitoba's water management challenges. The 1976 legislation saw most conservation districts formed on the basis of rural municipal boundaries.
- *The Second Watershed Era, from 1990 to 2009.* Sustainable development and concerns about the health of Lake Winnipeg resonate with Manitobans. The need for a more integrated approach to land and water issues develops, reinforcing the original watershed-based logic of the conservation district program. The non-point source pollution dynamics of Lake Winnipeg eutrophication also reinforce the role of the conservation districts, notably as delivery agents for integrated watershed management and planning (IWMP), Manitoba's version of IWRM.

We propose that Manitoba is now on the cusp of a new era of water policy (the Adaptation Era), where the nature of climate change impacts makes the rationale for reintegrating across the land-water divide obvious. Increased awareness that climate change exacerbates Lake Winnipeg eutrophication will reinforce high-level political commitment to an integrated response. Significantly increased budgetary resources and new economic instruments will be required to support the institutions responsible for IWRM. Linking economic instruments for ecological goods and services within the agricultural sector to IWRM is a logical way to address key adaptation issues, particularly those concerning agricultural land drainage. Coherent ecosystem goods and services policy is a necessary condition, but not likely the sufficient condition for implementing an adaptation agenda. The deeper challenge of realizing the Adaptation Era lies in overcoming fractured governance and programming at the water-land interface, repurposing existing resources for watershed management and governance, and designing new instruments to support and strengthen watershed management and governance.

The Adaptation Era will not arise without legislative commitment. A review of water-sector strategic plans conducted by the Rosenberg Forum on Water Policy at the University of California concluded that most strategies fail because of conflicts in priorities among the participating agencies—essentially due to the invalid premise that interagency collaboration will be sustained without reliable funding or through a well-resourced new institutional model. The few strategies that succeed go well beyond reliance on standard budgeting and appropriations to long-cycle fiscal commitments, supported by legislative instruments. In the absence of such support, watershed governance and management innovations will succumb to short-term, expedient responses to climate shocks, sapping resources and undermining longer-term goals. Typical examples include discretionary budget allocations for drainage projects, flood protection and disaster assistance in the aftermath of flood events—resources that might have a much higher and longer-term benefit if invested in watershed management.

Harnessing the political will for the necessary long-term commitments required to realize the Adaptation Era will be much easier if those commitments are cast as a rural innovation agenda, stressing the co-benefits of resilient agriculture, vital rural communities, improved water quality and Lake Winnipeg stewardship—and centred on the technological and institutional requirements for effective watershed management and governance.

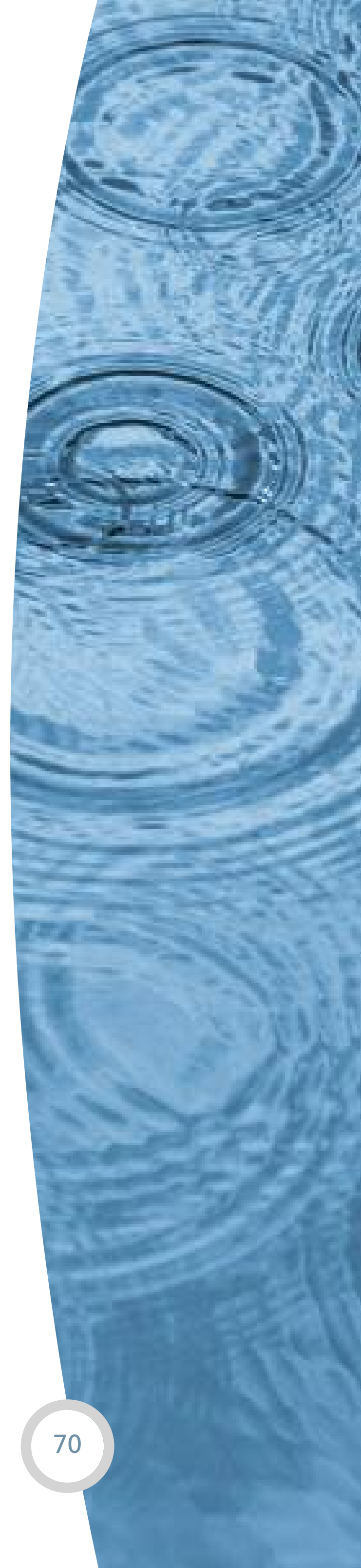
Our key recommendations to the Government of Manitoba are therefore:

Position climate adaptation internally and publicly as an opportunity to link Manitoba's responses to increased drought and flood resilience and Lake Winnipeg stewardship, through a rural innovation agenda centred on the technological and institutional requirements for watershed management and governance.

Build internal and external technical capacity on climate change impacts and adaptation responses. The Government of Manitoba should commission a structured analysis of climate change scenarios for the agricultural region of Manitoba and conduct workshops on the role of watershed-based IWRM in reducing the impacts of climate change.

Conduct reviews of water sector climate change adaptation programs undertaken in other jurisdictions, with particular emphasis on ecosystem-scale programs in water conservation, nutrient management and peak-flow management. This review should include the role of economic instruments to reinforce adaptation policy priorities.

Develop a legislative framework that makes long-term fiscal commitments consistent with the necessary institutional reform: a rural governance model strongly oriented toward ecological watershed management.



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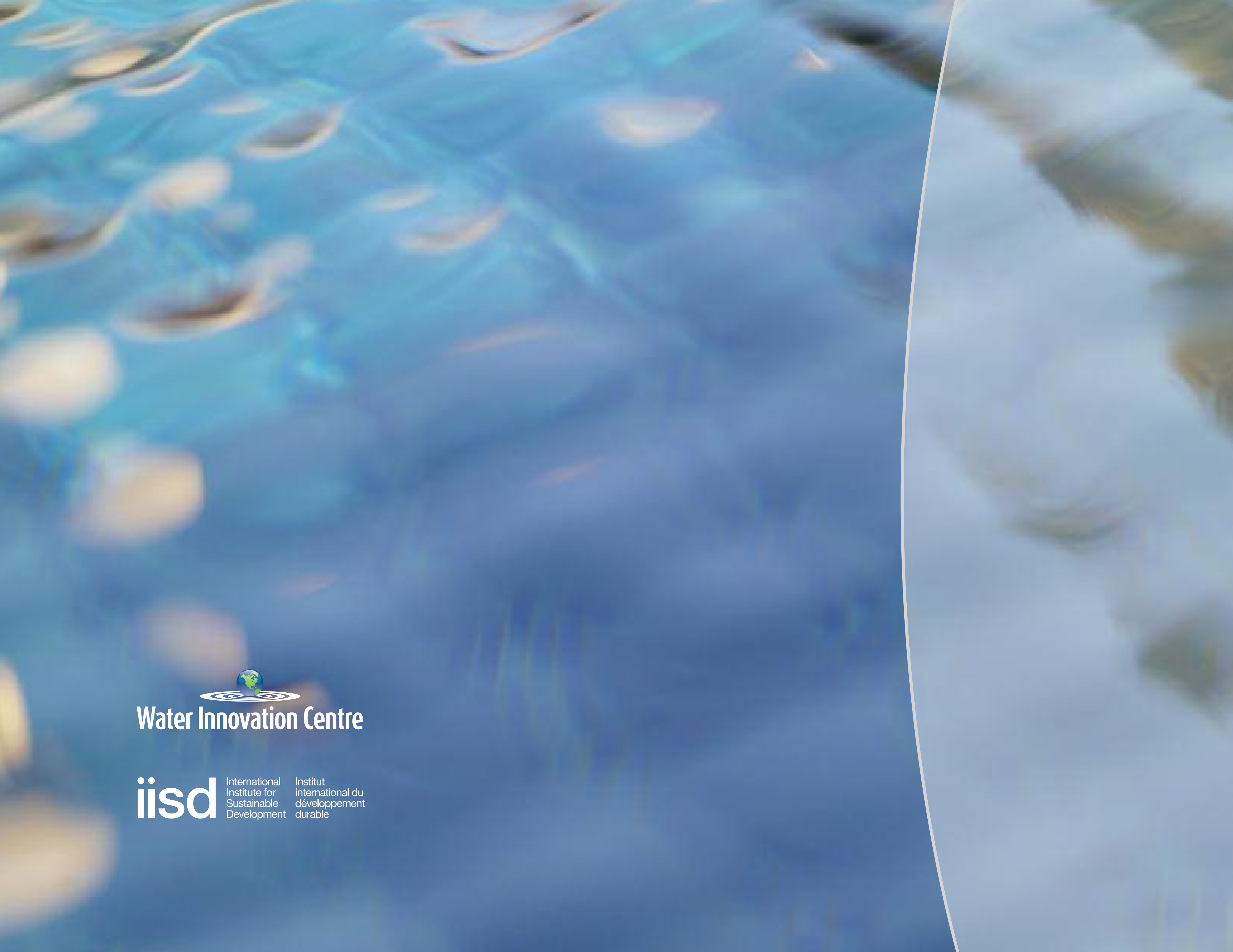

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