

WATER SOFT PATHS: PLANNING BEYOND DEMAND MANAGEMENT

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The dimensions of global water crisis, particularly in dry least-developed nations, are well known. Less well appreciated, perhaps, is that even water-rich nations face water stresses. Canada, said to contain 7% of the world's freshwater (Environment Canada 2007), faces threats to water availability due to a number of causes: maldistribution of water compared to location of population concentration; regional variability in endowment of precipitation and hydrology; competition between sectors of use; growing population and growing demand for water; and, uncertainties of climate change. There exists, therefore, considerable interest and necessity to find ways towards sustainable water futures.

Many analysts have demonstrated that the cheapest source of "new" water is that freed up from current water budgets by reduced demand. Conventional demand management strategies encourage water use efficiency using existing technologies and economic instruments (e.g., Brandes et al. 2005). Gleick et al. (2005) showed that a high efficiency scenario for California could result in a 20% decrease in total water use, without detriment to population, agriculture, or economy. Yet it is not clear that efficiency alone will succeed in averting crisis. Population and affluence growth will continue to demand more water even if productivity of use—per unit utilization—declines. Greater efficiency may, in a perverse way, allow such growth in demand, with a net effect of increased total use. There will be further competition between human and environmental needs. There will be competition between needs of water for urban populations and the needs of agriculture to feed those urban areas.

In last decade, a new paradigm—water soft paths—has emerged that goes beyond efficiency alone, by advocating strong conservation measures, changes in management institutions, and even changes in societal orientation towards water. The soft-path approach is both an analytical and a planning tool. It moves our thinking beyond demand management in several significant ways. This paper outlines the soft-path approach and illustrates it with the first ever national study.

Key Principles of Water Soft Paths

The soft path concept was developed in the United States as a response to the energy crises in the 1970s (Lovins 1977). The guiding principle was that the cheapest, and quickest, solution to shortage already exists in the energy already available that could be saved by both efficiency and conservation. Where conventional demand management approaches sought to answer the "how" question—how do we get more use per unit

energy—the soft path approach seeks to answer the "why" question—why do we use some sources of energy for particular services. The soft path approach seemed appropriate and promising for application to water (Gleick 2003; Brooks 2005).

The water soft path approach rests on five key principles (Brandes and Brooks 2007). First, environment considerations are fundamental. The common approach to solving water problems has sought access to new sources, then attempted to mitigate environmental impacts. A soft path approach would treat environmental goals as inviolable limitations to accessing new water for socio-economic systems. For example, environmental flows would be safe-guarded to preserve ecological quality and services. This concept may be expanded to preserve other socially desirable qualities of undiminished flows, such as recreation uses or spiritual values. Although our quantitative understanding of environmental flows and what is needed to preserve environmental health is yet meager, the water soft approach emphasizes that those flows are not some minimal residual after socio-economic desires have been satisfied. This recognition of environmental needs is a major step towards instituting sustainability practice.

Second, the soft path approach emphasizes that additional water for human purposes should be sought through demand management rather than construction of new infrastructure, through efficiency and reuse of local water rather than importation of water from elsewhere. That is, the emphasis is on conservation in conjunction with efficiency of use. In this way, the possibility that efficiency gains may lead only to expanded total use may be checked.

Third, soft paths change the concept of water from an end in itself to water as a means to an end, by focusing on the services desired from water. Beyond some minimum quantity necessary to sustain human life, the rest of our water use is discretionary and related to the quality and standards of our life-ways. For example, in North America, we want residential landscaping, which can be achieved in many ways without the water intensity to which we have become accustomed. Similarly, we want sanitary management of human wastes, for which we do not need large amounts of water. This principle encourages conservation and efficiency beyond that usually practiced in most North American municipalities.

Fourth, soft paths add water quality considerations to the usual focus on quantity, by matching quality of water needed for the services desired. Production and movement of potable water is expensive in terms of infrastructure and energy. Yet not all services require the highest quality water. Fire protection, disposal of human wastes, and much irrigation for landscaping and even agriculture, can utilize lower grades of water. Thus, this principle encourages a move away from the concept that water has a single-use after which it becomes waste. The productive use of water—the amount of services per unit water—increases, contributing to sustainability.

Fifth, soft paths invert the usual planning methodology of extrapolation of current patterns into the future. The common practice is to identify water-use intensities and to multiply them by projected population (and economic) futures to produce forecasts of water needs. Soft paths instead utilize backcasting, planning backward from the future. In the soft path approach, a desirable future state is defined, and ways are sought to make them physically, environmentally, economically, and socially feasible starting from where we are now. The backwards-pointing arrows on the schematic representation

indicate the direction of the "casting", and the dashed lines suggest that there is no single soft path, but rather that a number of ways to achieve the desired future may be possible (Figure 1). The challenge in implementation is the need to abandon a priori judgments, based in the present, about feasibility of sustainability goals.

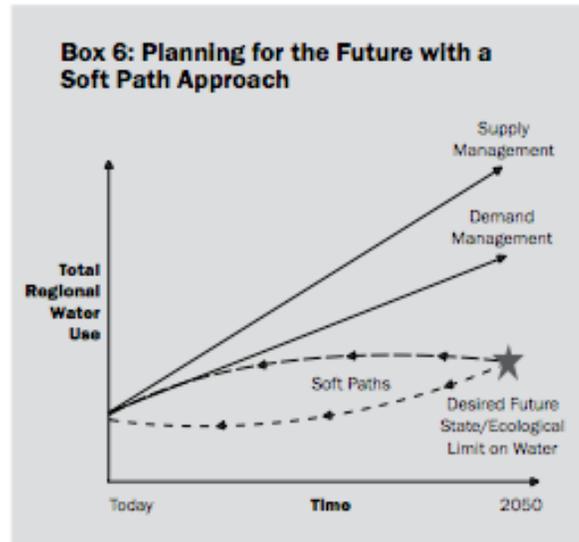


Figure 1. Schematic representation of forecasting and backcasting water futures. (source: Brandes and Brooks 2007)

The Canadian Study

The Canadian water soft path study was led by Friends of the Earth Canada, directed by Brooks, with major foundation funding. The original intent was to consider three provinces—Alberta, Ontario, Nova Scotia—as between them they contained representative water uses and intensities for all of Canada (with the exception of Arctic communities). A further rationale for the provincial focus lay in the political ecology of water governance in Canada. Canada's constitutional framework gives the provinces jurisdiction over natural resources within their boundaries. With respect to water, the federal government reserved to itself jurisdictional responsibility in only a few situations—e.g., First Nations reserves, federal lands, fisheries, navigable waters, and international waters. Thus, provinces are the principle governance level at which effective water policy should be made.

For a number of reasons, the project evolved from the three-province orientation to a study of scale. What is the most promising governance scale at which to contemplate implementation of soft-path approach as an analytical and planning tool? In addition to the provincial scale, the other (and smaller) geographical units studied were municipality and watershed. In all three studies, a business-as-usual scenario (BAU) was generated by extrapolating present water uses and intensities forward to a target date, using projected population and economic growth. Then a number of demand management scenarios were investigated using assumptions about uptake of efficiencies. Conceptually, it would

be possible to follow any one strategy forward through time to see how it moved the BAU closer to a sustainable use future; graphically, the result would be a series of Socolow wedges. A water-soft path scenario (WSP) then added conservation considerations to an intensive demand management scenario. Brief summaries of the studies are provided here; the full reports are available in the *Lexicon of Water Soft Path Knowledge* (<http://www.foecanada.org/WSP%20Lexicon/WSP%20Index%20web.htm>).

Municipal scale (Brandes and Maas 2007)

In an urban context, water use is primarily for residential and commercial purposes; industrial and institutional uses also occur but are of secondary magnitude. The Town of Oliver, located in the semi-arid Okanogan basin of British Columbia, provided a case study for a generic calculator, in which the effect on productivity and the rate of diffusion through society of various efficiency and conservation measures could be manipulated. By 2050, BAU water use would grow in parallel with anticipated 50% increase in population to approximately 68 million cubic metres (Mcm) per year.

Demand management included adoption of readily available efficient household appliances. The WSP scenario added adoption of composting toilets, waterless urinals, xeriscaping, widespread reuse, recycling and rainwater harvesting. With these additions, WSP offered water savings of almost 44 per cent compared to BAU (Figure 2). The goal of no new water until 2050 in the town is achievable, even with substantial population growth. Past urban water use patterns and habits need not dictate future requirements for investment in additional water supply.

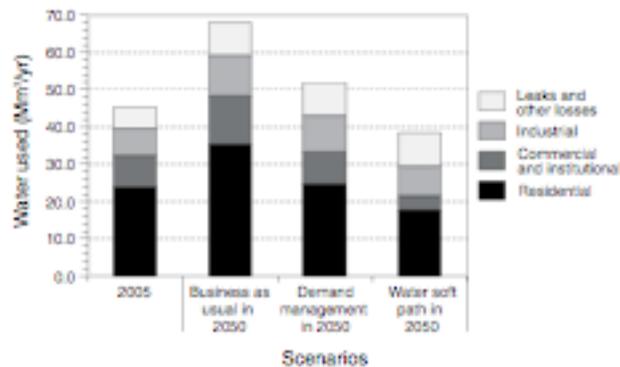


Figure 2. Scenarios for Oliver BC, an example of municipal scale analysis. (source: Brandes and Maas 2007)

Watershed scale (Daborn and Isaacman, 2007)

The Annapolis Valley is one of the Nova Scotia's most significant agricultural districts and is generally perceived as a cohesive cultural and geographic area. Total annual water supply (both surface and ground water) averages 1500 Mcm. Assuming 75 per cent of surface and 50 per cent of groundwater need to remain *in situ* for ecosystem services, about 500 Mcm/yr could theoretically be withdrawn sustainably. Current total annual water use seems well below sustainable yield, but there are significant disparities between low rainfall and high water use in the summer months. Withdrawals have

exceeded the sustainable take in 12 of the last 40 years during the summer and three times on an annual basis. Agriculture is the largest water using sector (over 36% of total withdrawals) followed closely by the residential sector (34%). Although golf courses account for only 2% of use on an annual basis, they account for almost two-thirds of summer withdrawals.

The BAU scenario projects total water withdrawals would be nearly 45% over the present level. Summer withdrawals, however, would grow by about 80%. The highest growth in water use (more than 100%) is expected for crop production, with much lower increases (7 to 35 per cent) in most other sectors. These projections indicate that both surface and ground water sources will frequently be inadequate for demand.

The WSP scenario projects an annual demand 54 per cent below current summer demand and only one-third of the BAU (Figure 3). The likelihood of staying within sustainable limits of water supply is all but assured. The scenario assumed widespread adoption of demand management measures, and significant uptake of one or more of the following in each sector: waterless technologies and practices (e.g., toilets, cooling systems, industrial cleaning); rainwater and runoff storage (e.g., for crop and golf course irrigation, livestock, cleaning, industrial processes); and water and wastewater recycling/reuse (e.g., industrial, dairy, and greenhouse processes and cleaning).

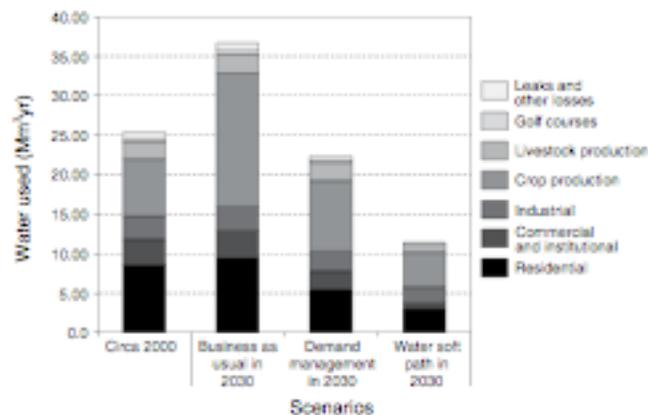


Figure 3. Scenarios for Annapolis Valley NS, an example of watershed scale analysis. (source: Daborn and Isaacman 2007)

Provincial scale (Kay et al. 2007)

The provincial scale analysis proceeded by estimating scenarios for the major sectors of municipal, agricultural, and industrial uses (Figure 4). Ontario's population is highly urban; about 92% of the estimated 12.34 million people in 2004 lived in municipal entities of at least 1000 population. Population is forecast to grow by 32.6% by 2031 (middle projection), with only 54 of Ontario's 309 municipalities expected to lose population; some municipalities are targeted to grow by as much as 50%. Economic activity is expected also to expand, although due to aging demographics, models suggest a slowdown in growth by 2031.

Municipal water data comprises residential, commercial, institutional, and municipal uses, plus non-revenue uses (leakage, losses, and other unaccounted water).

Recreational water use is usually undifferentiated within these categories. Municipal water use was about 1880 m³/yr in 2001 (Environment Canada 2005). The BAU scenario projects municipal water use to grow at the same rate as population, to about 2500 m³/yr in 2031. In the WSP scenario, efficiencies and conservation outweigh the effect of growth. Residential indoor use is about half, and outdoor use is three-quarters, of today's amounts. Industrial and commercial use declines markedly, due to outdoor landscaping, and indoor efficiencies. Loss of water to leakage is about two-thirds of today's amount. Total use is reduced by nearly half from the present.

Agriculture is Ontario's second largest economic sector, and accounts for 20% of total consumptive use in Ontario. The BAU scenario shows agricultural water use increases from 174 to 230 Mcm/yr. We assumed no changes in the types of agriculture, but significant expansion of irrigation to cope with growing demand, shrinking land base to urban expansion, and climate change. The modal mixture of irrigation types was not changed, but efficiencies were improved. Livestock uses (washing, cleaning, cooling) were also improved. Total water use in the WSP scenario was 17% *above* the current amount, but 14% below the BAU scenario. If irrigation does not expand, or if societal preferences changed away from water-intensive discretionary crops such as sod for lawns, total water use in 2031 could be about current total.

Ontario accounted for one-half of the national total industrial intake of water, and more than one-third of national industrial consumptive use in 1996 (the last available data). Water consumption in industry in 2001 was estimated to be 233 Mcm. The BAU scenario, with both economic and economic expansion, projected consumption to be two to three times larger than now. Many industries have deployed efficiency measures to reduce process water use and enhance recirculation use, with the result that recirculated water is a greater component of gross use than is fresh intake. If the improvements continued, the WSP scenario projects industrial consumption about 16% above current values—but markedly less than the BAU projections.

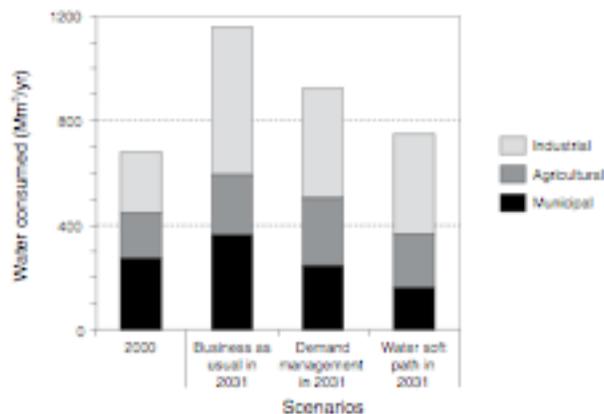


Figure 4. Scenarios for Ontario, an example of provincial scale analysis. (source: Kay et al. 2007)

Conclusions

The numerical results of the Canadian water soft path project must be seen as indicative rather than definitive. All study components were hampered by the absence of complete and up-to-date data on water use. The absence of materials balance tables, which would allow modeling economic and structural changes arising from changes in water uses, meant that the backcasting exercise could only focus on the major water-related sectors without sectoral interactions. The lack of detailed data also meant that quality matching to end use could only proceed in a general way. We also lacked information on the cost effectiveness of efficiency and conservation measures.

Nevertheless, the results at all three scales show that the goal of living within our water means without limiting population or economic growth is realistic for 30–50 years into the future. In terms of the detail required for full implementation of water soft path as a planning tool, the appropriate scale for analysis would be small, either municipality or watershed. At these scales, it is possible to identify the full range of water uses, to identify the status of efficiency, and to create realistic pathways of uptake of enhanced conservation approaches. The role of the province should be to formulate sustainable policy for water, and to create enabling structures for implementation at these smaller scales. This conclusion is consistent with the subsidiarity principle, that water management should be at the lowest appropriate level.

Water soft paths have some likely subsidiary extensions. If adopted as a strategy, they would shift long-range planning from "policy by neglect" (as in Ontario, where it is said that policy can be inferred from the legislation that exists) to "policy by design" providing guidance towards a sustainable future. The shift to sustainability planning would be much more powerful, and more likely to produce success, than the current view that measures our shortfall from extrapolations and attempts to close the gap. Although we were cognizant of the implications of climate change for water futures, we did not explicitly attempt scenarios that included climate-related changes in hydrology. It is possible to imagine that such work might proceed. Soft path as a planning paradigm would create social resilience with respect to water resources, which would be an important adaptive strategy in the face of uncertain climate change.

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