
The Minnesota Water-Sustainability Framework: A Plan for Clean, Abundant Water for Today and Generations to Come

DEBORAH L. SWACKHAMER

University of Minnesota

Saint Paul, Minnesota

dswack@umn.edu

Minnesota, the land of nearly 12,000 lakes and 63,000 miles of rivers and streams, has more freshwater than any of the country's other contiguous forty-eight states. Water is part of Minnesota's identity and a defining force in our state's history, heritage, environment, and quality of life. At the headwaters of three of the largest river basins in North America, Minnesota receives 99% of its water from rain and snow—consequently, most of our water quality problems originate right here in our own state. While this means we are not forced to clean up water problems originating elsewhere, it also means we have a responsibility to take care of our waters for our sake and for all those downstream.

Minnesota has had a tendency to take this abundance of clean freshwater for granted. But this complacency could lead to our undoing. Over time, as Minnesota was settled, cleared, developed, and farmed, and our population grew, our lakes, rivers, groundwater and their related ecosystems have taken an unintended toll from the cumulative impacts of human-induced changes on the land. Minnesota's population will grow—an estimated 22 percent larger by 2035—and that increased population will result in ever-greater demands on our finite water supply and its quality, unless we make intentional and strategic changes now

It was in part due to Minnesota's love of water and concern for the environment that, in 2008, its citizens passed the historic Clean Water, Land and Legacy Amendment to the state constitution, dedicating a portion of a small increase in the state's sales tax for the next 25 years to create the Clean Water Fund to protect and enhance our water resources. This rare and unique opportunity allows Minnesota to do what no other state has done: to truly take action *now* for a sustainable water future.

The legislature directed the University of Minnesota Water Resources Center to construct a framework describing what needs to be accomplished and how to get it done. The legislature defined sustainable water use as that which *does not harm ecosystems, degrade water quality, or compromise the ability of future generations to meet their own needs* (Minnesota Laws 2009, Chapter 172). Aspects of water sustainability to be addressed included

drinking water, stormwater, agricultural and industrial use, surface and groundwater interactions, and infrastructure needs, and within the context of predicted changes in climate, demographics and land use. The result is the Minnesota Water Sustainability Framework. The 140-page report presents the ten most pressing issues of the day that must be addressed to achieve sustainable water use, presents strategies for what should be done, and provides recommendations for how to meet these challenges (Swackhamer, 2011).

It is important to acknowledge and celebrate the successes Minnesota has had with its water policies, while identifying and working on deficiencies. We have made strides in reducing and controlling point-source water pollution, and we have an active citizenry and buy-in from many levels of government. We have a strong program of farmers adapting best management practices. Unfortunately, these achievements have not been sufficient to protect our waters. Forty percent of the state's surface waters are estimated to be in violation of clean water standards; water extraction has lowered groundwater as much as 40 feet in parts of the state; and nitrate concentrations are increasing in surface and groundwater in much of the state, rather than decreasing.

A core team led by the University of Minnesota Water Resources Center collected, compiled, considered, and synthesized the knowledge, insights, and perspectives of hundreds of the best scientists and water-management professionals in the state and region, as well as the input of a wide range of citizens and interest groups. Initially, Technical Work Teams were formed to compile what is known and not known about water use for agriculture, industry and energy, domestic purposes, recreation and culture, and ecosystem services, and what problems would need to be addressed to make water use sustainable. In addition, teams assessed water-related education, state water policy, and economic issues. Each team produced a white paper that summarized their findings. The Water Resources Center produced three white papers that documented the current understanding of water use, water supply, and water quality in Minnesota. These white papers are available to the public (WRC, 2011).

The Framework process was also advised by two important groups—an external advisory committee called the Headwaters Council, and the Citizen and Stakeholder Advisory Committee. The Headwaters Council was made up of thirty thought-leaders from around the state and region who had lifelong careers related to water, from professors to farmers to CEOs. They did not act as stakeholders, but as water professionals with a wide range of perspectives, and their charge was to keep us thinking bold and on track. The Citizen and Stakeholder Advisory Committee was also made up of about thirty professionals who specifically represented non-governmental organizations, citizen groups, and others with vested interests to ensure that we heard from citizens of the state and also had a mechanism to reach out to them.

Finally, the Synthesis Team integrated the findings of the white papers and other information to help form the Framework. They consisted of a highly diverse team of water professionals known for their broad thinking and ability to integrate complex information.

The resulting Framework offers a step-by-step roadmap toward water sustainability, identifying problems in a holistic way and offering concrete solutions and action steps

based on current science and best practices. It is the only water plan of its kind that addresses water quality and quantity, surface water and groundwater, and human and ecosystem use of water in an integrated way.

Several cross-cutting themes emerged during the development of the Framework, and they are reflected throughout the plan. These include:

- systems thinking—groundwater and surface water are one system and should be managed that way;
- science-based decision-making—knowledge of this system should provide the underpinning of decisions;
- decision-making in the face of uncertainty—one must make decisions on a weight-of-evidence approach;
- adaptive management—decision-making should be flexible enough to allow new knowledge to improve policy over time;
- watershed-based approach—water should not be managed based on political boundaries;
- outcome-based approach—all actions taken should have clearly articulated outcomes;
- accountability—state government, business, local units of government, and citizens need to be responsible and accountable for their actions;
- compliance with existing regulations—local capacity should be supported to ensure compliance with existing law and rules;
- transboundary stewardship—Minnesota must work with its state and international neighbors on boundary waters and share responsibility to effect change, and also provide leadership on protecting the headwaters of the Mississippi River, the Great Lakes system, and the Red River of the North.

The Framework provides a long-range plan that frames major water sustainability issues and provides strategies and recommendations for addressing those issues. It is *not* a specific spending plan for the Minnesota Clean Water Fund, nor should it be limited by the availability of Clean Water Funds; rather, it includes recommendations for investments that may come from sources beyond the Clean Water Fund (other state funds, private funds, *etc.*), as well as recommendations that require little or no investment by the state.

THE MOST PRESSING ISSUES

The Framework identifies ten major issues that present the challenges and solutions to those challenges that must be addressed if water sustainability is to be achieved in Minnesota. These issues are not independent at all, but are highly interdependent. These issues (labeled A–J) fall within the three areas that define sustainability: environmental, economic, and social (UN, 2005).

The Strategies (“what should be done”) to address the Issues are described in Tables 1A and 1B, along with declarations in terms of the corresponding Desired Minnesota Future:

**TABLE 1A. ISSUES, STRATEGIES AND DESIRED OUTCOMES
IDENTIFIED IN THE FRAMEWORK.**

Desired Minnesota Future	Issue	Strategy
A water supply that is protected for all future generations, that is of high quality, and that is sustainable for all uses of water.	A. The need for a sustainable and clean water supply	A.1: Determine the state's water balance and improve water appropriations permitting. A.2: Improve privately supplied drinking-water quality. A.3: Plan for water re-use.
The "Land of Unimpaired Waters," where we have met all of our water standards for nutrients and solids, we are not contributing to eutrophication problems beyond our borders, we can safely eat local fish.	B. Excess nutrients and other conventional pollutants	B.1: Reduce excess nutrient and conventional pollutant loads by strengthening policies to meet clean-water standards and require implementation of pollutant load reductions by all sources. B.2: Establish a farmer-led, performance-based approach to meeting clean-water standards. B.3: Address "legacy" contaminants.
A society that has embraced green manufacturing and chemistry so as to eliminate new toxic contaminants, and where drinking water, recreation water, and food are free from harm from microbial contaminants.	C. Contaminants of emerging concern	C.1: Enact Green Chemistry Act. C.2: Develop a framework for managing contaminants of emerging concern. C.3: Address beach pathogens to improve recreation.
A society where all of our land-use decisions and plans are inextricably linked with sustainable water use and planning.	D. Land, air, and water connection	D.1: Require integrated land and water planning; integrate water sustainability in permitting.
A society where healthy ecosystems are considered the foundation on which human well-being is based, and that all damaged ecosystems have been remedied and all ecosystems are protected while maintaining a healthy economy. Changes to the hydrological system are minimized and historic changes have been addressed to achieve water quality and aquifer recharge needs.	E. Ecological and hydrological integrity	E.1: Enact Ecosystems Services Act. E.2: Prevent and control aquatic invasive species. E.3: Improve management of hydrologic systems. E.4: Preserve and encourage land set-aside programs.

**TABLE 1B. MORE ISSUES, STRATEGIES AND DESIRED OUTCOMES
IDENTIFIED IN THE FRAMEWORK.**

Desired Minnesota Future	Issue	Strategy
A society in which energy policy and water policy are aligned.	F. Water/energy nexus	F.1: Understand and manage water and energy relationships.
A society in which water is considered a public service and is priced appropriately to cover the costs of its production, protection, improvement, and treatment, and the economic value of its ecological benefits.	G. Water pricing	G.1: Include the value of ecological benefits in the pending water-pricing schemes. G.2: Provide for shared resources between large- and small-community water supplies.
A society that maintains and protects its infrastructure for drinking water, wastewater, stormwater, and flood protection in a manner that sustains our communities and our water resources and maintains and enhances ecosystems; and reuses water where appropriate to conserve our sustainable supply.	H. Infrastructure needs	H.1: Determine a long-term strategy for funding new, expanded, and updated infrastructure and its maintenance. H.2: Incorporate new technologies and adaptive management into public-water infrastructure decisions.
A resilient society that values, understands, and treasures our water resources, and acts in ways to achieve and maintain sustainable and healthy water resources.	I. Citizen engagement and education	I.1: Ensure long-term citizen engagement. I.2: Ensure youth and adult water literacy and education.
Governments, institutions, and communities working together in implementing an overarching water-sustainability policy that is aligned with all other systems policies (land use, energy, economic development, transportation, food and fiber production) through laws, ordinances, and actions that promote resilience and sustainability.	J. Governance and institutions	J.1: Provide a governance structure to ensure water sustainability. J.2: Ensure that the Water Sustainability Framework is reviewed and updated regularly and informed by current, accessible data and information.
























THE FRAMEWORK IN SUMMARY—A TEN- AND TWENTY-FIVE-YEAR PLAN




























The following “dashboard” presents the complete list of Recommendations in the Framework that are needed to implement the Strategies listed above for addressing the ten important Issues. It provides the following information:

- *Individual recommendations* (the “how”)—recommendations are grouped by the issue they address (identified by A–J), and in relationship to a specific strategy (identified by number). For example, A1a indicates Recommendation “a” for Strategy 1 under Issue A. The most critical recommendations are shown in italics.
- *Who should implement*—if funding is appropriated by the legislature, this indicates whether a given recommendation would be implemented by the legislature, the executive branch, or others.
- *Research task*—this column contains an R if the recommendation is a research task rather than an implementation or management task.
- *Implementation phase*—the phases refer to the general timeline for initiation of a given recommendation’s implementation. Phase 1 corresponds to the first two years (2011–2012), Phase 2 corresponds to the next three years (2013–2015), Phase 3 corresponds to years 6–10 (2016–2020), and Phase 4 corresponds to years 11–15 (2021–2025). The Ten-Year Plan contains recommendations in Phases 1–3, while the Twenty Five-Year Plan contains all recommendations from all Phases. The timeline for implementation does not always correspond to how critical the action is relative to others; rather, it reflects Minnesota’s readiness to implement the action (*i.e.*, “low hanging fruit”), the urgency of starting the action, and/or the fact that outcomes from the action will take significant time (a decade or more).
- *Level of benefit to water resources*—this gives an indication of each recommendation’s potential impact on improving or protecting water quality and quantity for future generations. The scale is given as one to three drops, with three drops indicating maximal benefit and one drop indicating modest benefit.
- *Multiple benefits*—this indicates whether the recommendation as implemented would benefit other state-defined natural and human resources, including wildlife, fisheries, forest resources, air, recreational resources, or human health.

As shown in the “dashboard,” it is evident that most (about two-thirds) of the Framework recommendations should begin in the first five years (Phases 1 or 2). Phase-1 recommendations relate to issues A, B, D, and J (need for a sustainable and clean water supply; excess nutrients and conventional pollutants; land, air, and water connection; and governance and institutions). With few exceptions, these will provide high levels of benefit to water resources, and most provide multiple benefits to natural and human resources. Phase 2 recommendations relate to strategies within all of the issues except Issue F (water/energy nexus). These recommendations will provide good-to-excellent benefits to water resources, and again, most would provide multiple benefits to natural and human resources. Phase 3 recommendations are less urgent and, though important, do not need

TABLE 2. THE “DASHBOARD” OF RECOMMENDATIONS IN THE FRAMEWORK.

Recommendation	If funded, who should implement	Research task	Implementation phase	Level of benefit to water resources	Multiple benefits
<i>A1a i, ii, iii: accelerate water-balance mapping needs and implement hydrologic-monitoring network</i>	Executive		Phase 1		
<i>A1a iv: design and complete the water-balance hydrologic models</i>	Executive	R	Phase 1		
<i>A1b i, ii: develop a web-based screening permit system</i>	Executive		Phase 1		
A1b iii: restrict water exports from state	Legislative		Phase 3		
<i>A1b iv: develop eco-based thresholds for minimum flows</i>	Executive	R	Phase 1		
A2a: improve quality of private drinking water	Other		Phase 2		
A3a: plan for water reuse	Executive		Phase 4		
A3b: develop reuse standards	Executive		Phase 4		
<i>B1a: require compliance of pollutant load reductions by all sectors</i>	Legislative		Phase 1		
B1b: strengthen approaches to stormwater pollution	Executive		Phase 3		
B1c: strengthen shoreland rules	Executive		Phase 3		
B1d: increase capacity for local land-use compliance	Legislative		Phase 2		
B1e: strengthen rules managing septic-treatment systems	Executive		Phase 3		

Recommendation	If funded, who should implement	Research task	Implementation phase	Level of benefit to water resources	Multiple benefits
B1f: research cyanotoxin sources	Other	R	Phase 2		
<i>B2a: establish farmer-led performance-based approach to meeting standards</i>	Legislative		Phase 1		
B2b: establish agricultural sustainable water certification	Executive		Phase 3		
B3a: address contaminated sediments	Executive		Phase 2		
B3b: evaluate coal-tar sealant alternatives	Executive		Phase 1		
B3c: further eliminate mercury sources	Executive		Phase 1		
<i>C1a: enact Green Chemistry Act</i>	Legislative		Phase 1		
<i>C2a: develop framework for managing contaminants of emerging concern</i>	Executive		Phase 1		
C2b: expand MDH Contaminants of Emerging Concern program	Executive		Phase 3		
C2c: prioritize facilities' needs for advanced treatment technologies	Executive		Phase 3		
C2d: develop comprehensive policy for pharmaceutical disposal	Legislative		Phase 2		
C3a: establish state policy for pathogens and beaches	Legislative		Phase 3		
C3b, c: research pathogen indicators and sources	Other	R	Phase 2		
<i>D1a: require comprehensive land and water planning</i>	Legislative		Phase 1		

Recommendation	If funded, who should implement	Research task	Implementation phase	Level of benefit to water resources	Multiple benefits
D1b: integrate sustainability in land use permitting	Legislative		Phase 1		
D1c: increase local enforcement and compliance capacity	Legislative		Phase 2		
D1d: monitor effectiveness	Executive	R	Phase 1		
E1a i: enact Ecosystems Services Act	Legislative		Phase 3		
E1a ii: determine ecosystem services and their economic value	Other	R	Phase 1		
E2a: develop statewide policy for aquatic invasive species	Legislative		Phase 1		
E2b: research control measures for aquatic invasive species	Other	R	Phase 1		
E3a: accelerate watershed hydrological characteristics and response landscape model application	Executive		Phase 1		
E3b: model drainage from field scale to watershed scale	Other	R	Phase 3		
E3c: require multi-benefit drainage-management practices with new or replaced tile drainage	Legislative		Phase 1		
E3d: expand cost-share program for retrofitting existing tile drainage	Executive		Phase 1		
E4a: preserve and encourage conservation land set-asides	Executive		Phase 1		
E4b: work to ensure next Farm Bill has strong conservation elements	Executive		Phase 1		
F1a: understand and quantify the water/energy nexus	Other	R	Phase 3		

Recommendation	If funded, who should implement	Research task	Implementation phase	Level of benefit to water resources	Multiple benefits
F1b: review energy policy for water sustainability	Legislative		Phase 3		
F1c: encourage renewable energy that minimizes water impacts	Executive		Phase 3		
G1a: include ecological benefits in water pricing	Legislative		Phase 2		
G1b: include other economic incentives in water pricing	Legislative		Phase 2		
G1c: transition business to more equitable pricing	Executive		Phase 2		
G1d: research and model value of water ecological benefits	Other	R	Phase 1		
G2a: provide for shared resources between small and large community water supplies	Executive		Phase 3		
H1a: create a standing advisory committee on new technologies	Executive		Phase 2		
H1b: address water reuse	Legislative		Phase 4		
H1c: adopt Effective Utility Management program	Other		Phase 1		
H2a i: determine long-term funding strategy for public water infrastructure	Executive	R	Phase 1		
H2a ii: implement long-term funding strategy for public water infrastructure	Executive		Phase 3		
I1a: ensure long term public engagement support	Executive		Phase 2		
I2a: ensure child water literacy	Other		Phase 2		

Recommendation	If funded, who should implement	Research task	Implementation phase	Level of benefit to water resources	Multiple benefits
I2b: ensure adult water literacy	Other		Phase 2		
J1a: <i>review statutes and laws for water sustainability</i>	Legislative		Phase 1		
J1b: enact Water Sustainability Act	Legislative		Phase 1		
J1c: re-establish the Legislative Water Commission	Legislative		Phase 1		
J1d: create Water Sustainability Board	Legislative		Phase 2		
J1e: form Watershed and Soil Conservation Authorities	Legislative		Phase 3		
J2a: create interagency data and information portal	Executive		Phase 1		
J2b: maintain Framework as “living” document	Legislative		Phase 3		

to be initiated in the first five years. Phase 4 recommendations, most related to water reuse, are not urgent. Non-urgency should not be interpreted to mean a recommendation is non-essential. In some cases, the Phase 3 or 4 recommendations cannot be initiated until the recommendations in the earlier phases have been instituted, yet are essential to sustainable water resources in Minnesota. The most important actions are shown in italics (see below for explanation).

The dashboard also demonstrates that three-fourths of the recommendations have multiple benefits to other natural resources and public health. Many of the remaining one-quarter are positively linked to economic benefits.

THE ESSENTIAL TOP FIVE ACTIONS

The Framework is comprehensive in its recommendations and at first glance may seem like a daunting challenge on many levels, including financial. The quality and diversity of knowledge and perspectives that contributed to the final form of these recommendations cannot be overemphasized, and implementation in their entirety provides the best assurance of water sustainability. However, in the expert view of the Framework's authors, five overall actions—encompassing eight recommendations—are most critical. In fact they are considered essential to achieving water sustainability and their implementation will take us closer to water sustainability than any other limited combination of actions. These five actions can be grouped into two parts: (i) Protect and restore water quantity and quality and (ii) Address the interconnected nature of water. They are all Phase 1 actions, of high impact to water quality and have multiple benefits. They are shown in the “dashboard” in italics.

- Protect and restore water quantity and quality through comprehensive, integrated, and informed management and policy.
 - Revise water appropriations permitting (Recommendation A1b), and model the state's water balance (A1a).
 - Comply with water-quality standards through implementation plans for reducing pollutants (B1a) and bring farmers to the table to be part of this solution (B2a).
 - Address future contaminants (C1a, C2a).
- Address the interconnected nature of water by integrating and aligning planning and policies.
 - Integrate water- and land-use planning (D1a).
 - Align water, energy, land, transportation policies for sustainability (J1a).

A MODEL FOR THE NATION

The Framework addresses the most important issues that have been identified for Minnesota. However, several national studies have been conducted (*e.g.* NAS, 2001, 2004; USGS, 2007) in the past decade that have articulated the most important water challenges facing our nation as a whole, and these issues mirror those faced by Minnesota.

In other words, Minnesota is representative of water issues and problems across the nation. Therefore, the Framework can serve as a model for what the entire nation needs to consider. The United States does not have a federal water policy *per se*, but delegates implementation responsibilities of the federal Clean Water Act and Safe Drinking Water Act to the states, and allows each state to manage its own water rights and water withdrawals. This recognizes the diverse needs and cultures of the states, but leads to a patchwork approach to water management and does not address the multijurisdictional nature of water. It does not serve the nation's best interests in terms of water quality and quantity. Should the nation decide to provide an overarching, holistic framework to guide state water policy, the Minnesota Water Sustainability Framework could serve as the model for a national framework.

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Deborah Swackhamer is professor and Charles M. Denny Jr. Chair in science, technology, and public policy in the Hubert H. Humphrey Institute of Public Affairs, and co-director of the University's Water Resources Center. She also is professor in environmental health sciences in the School of Public Health. She received a BA in chemistry from Grinnell College, Iowa, and MS and PhD degrees from the University of Wisconsin-Madison in water chemistry and limnology & oceanography, respectively. After two years postdoctoral research in chemistry and public and environmental affairs at Indiana University, she joined the Minnesota faculty in 1987. She has studied the processes affecting the behavior of, and exposures to, toxic chemicals in the environment.

Dr. Swackhamer serves as chair of the science advisory board of the Environmental Protection Agency, and on the science advisory board of the International Joint Commission of the United States and Canada. She is appointed by Governor Pawlenty to serve on the Minnesota Clean Water Council, is a member of the editorial advisory board for the journal *Environmental Science & Technology*, and she chairs the Editorial Advisory Board of the *Journal of Environmental Monitoring*. She is the 2010 recipient of the University of Minnesota's Ada Comstock Award.