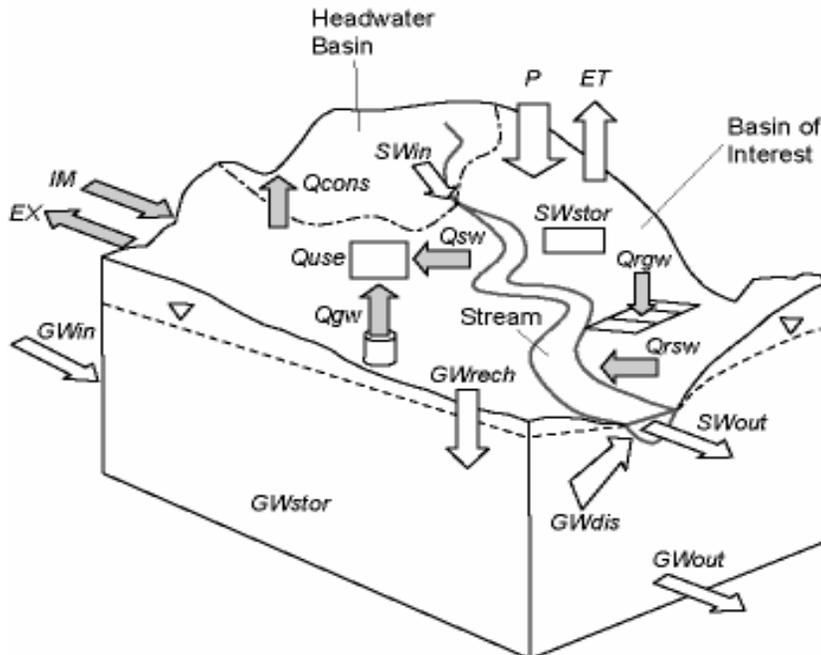


## APPENDIX A: THE HYDROLOGICAL CYCLE

In many places in the text of the SWRR report, there are references to the hydrological cycle and to a water budget approach to sustainable management of water resources. Figure A.1 illustrates components of the hydrologic cycle in a representative watershed (basin). The hydrologic components serve as a basis for several of the indicators described in Chapter 4. The level of detail given of components of the hydrologic cycle varies with the purpose and scope of the particular analysis. For example, the ground-water discharge term ( $GW_{disch}$ ) shown in the figure could be further divided to include discharges to streams, discharges to wetlands, or evapotranspiration losses directly from the water table. For this analysis, we group all ground-water discharge processes into a single total discharge rate.

**Figure A.1**  
**Water-budget components of a hypothetical watershed**



Source: Paul Barlow, US Geological Survey, 2005

### **Definitions**

P: precipitation; ET: evapotranspiration;  $SW_{in}$ : streamflow into the basin;  $SW_{out}$ : streamflow out of the basin;  $GW_{in}$ : ground-water flow into the basin;  $GW_{out}$ : ground-water flow out of the basin; IM: imported water (anthropogenic transfers); EX: exported water (anthropogenic transfers);  $SW_{stor}$ : storage in surface-water reservoirs, including human-built reservoirs, lakes, snowpack, etc.;  $GW_{stor}$ : storage in ground-water reservoirs;  $GW_{rech}$ : ground-water recharge other than from human sources;  $GW_{dis}$ : ground-water discharge other than to human withdrawal points;  $Q_{sw}$ : human withdrawals from surface-water sources;  $Q_{gw}$ : human withdrawals from ground-water sources;  $Q_{use}$ : human uses of water;  $Q_{reuse}$ : human re-uses of water;  $Q_{rsw}$ : return of water to the surface-water hydrologic environment after human use;  $Q_{rgw}$ : return of water to the ground-water hydrologic environment after human use;  $Q_{cons}$ : consumptive uses of water.

## Appendix B: Terms of Reference

The Sustainable Water Resources Roundtable has this Terms of Reference, which was approved by the members of ACWI at the 2003 Annual Meeting June 2, 2003

### I. Official designation and authority.

The Sustainable Water Resources Roundtable (SWRR) is a subgroup of the Advisory Committee on Water Information (ACWI) Hence, the Roundtable is part of the Water Information Coordination Program mandated by OMB Memorandum No. M-92-01, dated December 10, 1991. The Roundtable reports to the ACWI and operates under the Federal Advisory Committee Act (FACA), as outlined in this Terms of Reference.

### II. Purpose, background, scope, and functions.

**A: Purpose:** The purpose of the Roundtable is to provide an open forum for exchanging ideas and information to foster collaboration on ways to manage water resources in such a way that the resource and its uses may be sustained over the long term. The Roundtable has adopted the Brundtland Commission (1987) definition of sustainable development as a starting point for discussions, with the full expectation that the many different dimensions of water sustainability will be a focal point of the Roundtable's activities:

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Roundtable participants are committed to interdisciplinary, inter-jurisdictional, and cross-ownership collaboration that identifies and supports national, state, and field-level activities to sustain water resources. Roundtable discussions and activities will focus in part on criteria, indicators, and methods for assessing the sustainability of water resources, as well as exploring, promoting, and improving how this information is used to promote sustainable water resource management.

**B: Background:** The Sustainable Water Resources Roundtable is one of a number of on-going efforts to develop ways of collecting, organizing, and using information on conditions and trends to promote sustainable development. The Roundtable grew from the Interagency Working Group on Sustainable Development Indicators, which published the report *Sustainable Development in the United States; an Experimental Set of Indicators*. The Roundtable has also benefited from the experience of similar Roundtables on forests, rangelands, and minerals and energy.

State governments, communities, corporations and nongovernmental organizations (NGOs) have also independently undertaken studies on the development of sustainability indicators. This Roundtable will discuss ways to coordinate and integrate the results of these various efforts so that the indicators and related data can be made accessible and useful to people in a wide range of contexts.

**C: Scope:** In practice, the scope of the Roundtable's activities and accomplishments will depend on the initiatives and priorities of the participants, as well as the availability of resources. Issues the Roundtable will likely explore include:

- Contributing to the development of a list of national-level ecological, social, and economic criteria and indicators along with measurement protocols that characterize water resources and their uses;
- Identifying existing data sets and measurement protocols that can be used to conduct assessments using the criteria and indicators;

- Contributing to the development of a national data inventory framework from which governmental and non-governmental agencies, tribes, other organizations, and universities collaboratively access and evaluate water-resources indicator data from across the United States;
- Identifying data-collection and research needs to characterize and improve the sustainability of the Nation's water resources; and
- Contributing to the development of a collaborative 2005 report on the sustainability of water resources and uses in the United States, utilizing the criteria and indicators.

However, the Roundtable is specifically charged with reporting to the Advisory Committee on Water Information and other interests by October 2005 on conditions and trends of the Nation's water resources that affect the long-term sustainability of these resources. The Roundtable may suggest research studies, policies, strategic objectives, and priorities considered potentially useful in inventorying or monitoring water-resource sustainability. The Roundtable also may issue periodic reports before and after October 2005 related to water-resource sustainability.

**D: Functions:** The functions and tasks of the Roundtable include the following:

- To serve as a national forum for sharing information and promoting responsibility and research for sustaining the Nation's water and related land resources. The Roundtable is not a decision-making body, but rather an opportunity to engage individuals representing diverse groups, organizations, interests, and backgrounds.
- To identify and describe criteria, indicators, and methods that characterize the sustainability of the Nation's water resources; to share information about data availability and quality, data gaps, and how best to acquire desired information; and to share perspectives about trends affecting the Nation's water and related land resources that have policy or other coordination implications.
- To produce products that will disseminate the work of the Roundtable (such as white papers, web listings, newsletter articles), as specified in a Work Plan, and accomplished depending on the availability of resources.
- To consult regularly with the forestry, rangelands, and minerals Roundtables about common considerations and programs.
- To conduct outreach activities to inform others about the findings, recommendations, and activities of the Roundtable and to provide an opportunity for interested groups to participate in the Roundtable.
- To report annually the progress of the Roundtable to the ACWI.

### III. **Implementation.**

**A: Roundtable Participation:** The Roundtable recognizes the importance of having a broad range of interests represented among its participants and will seek to achieve and maintain the diversity.

The Roundtable will consist of representatives of federal, tribal, and state agencies, as well as diverse national organizations, companies, and individuals committed to sustaining the Nation's water and related resources.

Participation in the Roundtable and any of its workgroups and functions is open to all interested parties and is intended to be inclusive of a wide range of interests.

**B: Roundtable Work Groups:** The Roundtable will accomplish most of its work through work groups that seek to assess existing information, define concepts in water-resources sustainability, research topics in water-resources sustainability, develop reports, and conduct outreach to key constituencies.

Work groups are established according to the interests of individuals who wish to undertake specific actions or activities; formation of work groups occurs either during regularly scheduled Roundtable meetings or by approval of the Steering Committee between meetings.

Roundtable participants may want to be part of specific work groups that develop as part of the Roundtable process. Participation in work groups would require ongoing, consistent involvement and representation.

Participation in a Roundtable work group is voluntary and provides opportunities for participants to focus on high priority tasks important to the Roundtable, individual participants, or participating organizations.

**C: Guiding principles:** The Roundtable is a self-directed body that strives to conform to principles of operation rather than rigid rules of governance. However, in the course of conducting its activities, decisions will be governed by the following guiding principles:

**Consensus:** The Roundtable actions in general will be governed by consensus decision-making, indicating the general acceptance and/or support of participants.

**Diversity:** Fundamental to the Roundtable is the participation of individuals representing diverse interests and organizations. Hence, the Roundtable actions should reflect diverse participation to the extent feasible and consistent with the overall Roundtable composition.

**Consistency:** Actions, findings, and recommendations by the Roundtable should strive to build a web of consistency in thought and action.

**Scientific and Technical Accuracy:** The Roundtable will strive to incorporate the most current and scientifically accurate information and data on water-resource availability, use, and sustainability in its reports and other products.

**Feasibility:** Sustainable water resource plans require scientifically sound theory as well as realistic expectations for implementation. Hence, the Roundtable will focus on data-collection methods, scientific approaches, or actions that are considered feasible.

**D: Role of Co-chairs and Steering Committee:** The Steering Committee provides principal leadership for the Roundtable, insuring that the activities and accomplishments of the Roundtable progress adequately and conform to the Roundtable objectives, principles, and scope. The Co-chairs act as agents of the Steering Committee but in this regard must also provide additional leadership. The steering Committee and Co-chairs do not set the agenda of the Roundtable, but rather facilitate a process for the Roundtable to establish its own agenda and then facilitate and monitor the accomplishment of that agenda. Some of the overall roles and responsibilities include:

- Take an active role in leadership of the Roundtable, including personal initiative and encouraging involvement from the organizations that the individual represents.
- Act as advocate and spokesperson for the Roundtable promoting its agenda, accomplishments, and findings.
- Seek to broaden the participation in the Roundtable by active recruitment among those in government, business, environmental, public interest, academic, professional association, and other organizations.
- Develop and manage a budget, including solicitation of funding, to provide resources for the Roundtable operations. Identify services in kind that organizations may be able to contribute to Roundtable operations.

- Identify and work with organizations that can be local conveners of Roundtable meetings, in various parts of the nation.
- Develop an ongoing work program for the Roundtable, with support of the general roundtable participants and the supporting organizations. Monitor the progress of this program.
- Charter work groups of the Roundtable in response to Roundtable initiatives.
- Work to develop relationships with ongoing programs in other organizations that relate to sustainable water resources. Take an active role in creating positive and complementary actions that minimize duplication among programs.
- Participate in administrative decisions of the Steering Committee.

Co-Chairs of the Roundtable are normally drawn from the Steering Committee. Ideally, there should be chairs from the public and private sectors. They serve for one year, and this term may be renewed

#### **IV. Participation, Duties, and Guidelines:**

Roundtable participants are expected to contribute to the workings of the Roundtable by contributing in at least one of many different roles:

- Attend meetings where participants will have the opportunity to share information, ideas, and views with other Roundtable participants and to assist in documenting the discussions.
- Participate in conference calls to plan or discuss Roundtable and/or work group activities.
- Share information internally with the participating organization and externally with appropriate constituency groups.
- Carry out activities and report results, prepare presentations, and otherwise disseminate information.
- Help prepare, edit, or review written reports by the Roundtable and workgroups.
- Contribute resources in staff, money, or materials in support of the Roundtable.
- Actively recruit new members and supporters for the Roundtable.
- Participants may serve on the Steering Committee or as a Co-chair.
- Participants of the Roundtable will receive no pay, allowances, or benefits by reason of their service on the Roundtable

## Appendix C

### Matrix of candidate SWRR Criteria & Indicators

#	CRITERION	CATEGORY	Sub-CATEGORY	Indicators
	<b>SOCIAL CRITERIA</b>			<b>SOCIAL RELATED INDICATORS</b>
1	Social well being resulting from the use of water and water-related ecological resources	Human health	Waterborne Disease Outbreaks	Annual violations of health-based standards (EPA)
2			Chronic morbidity/ mortality by population and age group	Waterborne human disease outbreaks – drinking/ recreation/lake vs. pool
3			Cancer outbreaks	Coliform violations of treated water
4			Recreational exposures	Vector-borne diseases
5				Organochlorine pesticides and PCBs in bed sediment and whole fish from U.S. rivers and streams
6				Living in high risk areas – acid mine drainage, radon, fish consumption (subsistence or others with fish-dependent diets)
7		Water use	Domestic water use by type and region/scale	Percent of households served by private wells
8				Rates of withdrawal vs. long-term renewable rates sustainable over long term, including resilience to droughts
9				Interior vs. exterior water use per capita
10				Energy to water use ratio
11				Water supply per capita
12				Water use per capita
13			Community capacity and opportunity to grow	
14		Recreation	Number of visitors to major water sites	Number of boats (motorized/non-motorized)
15				Number of boating days available
16				Number of public access sites
17				Value in dollars per year represented by visitors to major water sites
18			Lost recreational opportunities (or “access lost”)	Number of days closed due to water quality problems
19				Number of beach closings (EPA)
20			Swimming pool/water park usage	Consumptive use and loss of water from pools/water parks
21			Value of recreational activities related to water	Percentage of economy from water recreational activities
22			Recreational activities from surfing to fly fishing, bird watching/hiking	Fishing/hunting licenses obtained
23			Fishing and hunting activities	Number of beach closings
24				Percentage of population engaged in fishing or

#	CRITERION	CATEGORY	Sub-CATEGORY	Indicators
				hunting
25			Festivals held around water ways	
26			Value of riparian business development (e.g. riverside restaurants, etc.)	Percentage of economy from riparian business
27		Human water infrastructure	Population served with water that meets drinking water standards and wastewater that meets effluent limits and in-stream water quality standards	Percent of utilized water supply capacity
28			Adequacy of community water and sanitation systems	Percent of communities nearly maxing out their water and wastewater treatment systems capacity
29				Percent of population served safe drinking water (also percent by income and ethnicity)
30				Percent of population served by adequate wastewater treatment facilities
31			Affordability of water and sanitation	Water and wastewater treatment costs (as a percentage of household income?)
32			Gap between estimated water infrastructure need (future) and supply	
33			Efficiency/measured losses of water	Amount of wastewater reused
34				Assimilative capacity (used?)
35				Percent of water and wastewater treatment plants needing major investments or recently having undergone such improvement
36				Number of new state or federal road projects or major upgrade projects within an 8-digit HUC within the last 15 years
37				Percent of population served by small drinking-water systems (systems that serve less than 3,200 people)
38				Percent of WWT plants needing major investments or recently having undergone such improvements
39				Percent of water treatment plants needing major investment
40				Proportion of wastewater receiving secondary treatment
41				Number of desalination or reverse osmosis plants built
42				Percent of desalination plants with feed water from the ocean versus mineralized ground water
43				Number of aquifer storage and recovery (ASR) projects approved and/or in operation
44		Cultural	Culturally distinct connections to the environment (traditional use areas)	Non-white population cultural values
45				Capacity to support subsistence fisheries and other aquatic resources
46				Change in critical local fish, seafood, wildlife or

#	CRITERION	CATEGORY	Sub-CATEGORY	Indicators
				plants stocks
47				Existence value to individuals of high quality ecological water resources
48				Community pride/celebrations (e.g., walleye, shad, shrimp fests, catfish fry's)
49				Consumption of fish and seafood
50				Percent of population that feels water has a spiritual value
51				Aesthetic aspect of drinking water: taste and odor
52				Aesthetic aspect of water bodies (bank and water): trash, foam, smell, look, oil, scum, color
53				Amount of personal contributions in watershed and water quality organizations
54				Publications about the importance of water quality, water system integrity
55				Significance communities place on the aesthetic value of water
56			Understanding of water conservation as an ethical value by sector	Percents of population using conservation techniques by sector (including individual/municipal/business)
57				Municipal regulations that encourage domestic water conservation
58				Cost of water (relative to true full cost)
59				Willingness to modify water use based on understanding of full cost (percent of population)
60				Incentives for water conservation measures
61			Ecological literacy	Knowledge level of citizenry
62				Activities by individuals
63				Educational activity by governments and institutions
64				Sustainability research
65				Activities of landowners and businesses (including farms)
66				Number of volunteer monitors in a watershed
67				Number of high school students trained in the hydrologic cycle, watershed, and geographic elements of water issues
68				Percentage of population that knows what watershed they live in
69				Number of publications dedicated to education about ecological literacy
70				Organizations dedicated to water and ecological education
71				Number of watershed organizations in a state/region promoting water stewardship
72				Percent of population using conservation techniques for yard care
73				Municipal regulations that encourage domestic water conservation
74			Intergenerational equity	Changes in water use by type over time
75				Change in water quality/flow over time
76				Water use versus (projected) water sustainability
77				Adequacy of time horizon of governmental planning efforts
78		External dependence	Interbasin transfers of water	
79			Other "out of area"	Extent of state and federal subsidies of resource

#	CRITERION	CATEGORY	Sub-CATEGORY	Indicators
			resource transfers	transfers
80				Interbasin transfers
81				Discharge/withdrawals/use across boundaries
82		Commercial		Commercial fishery receipts
83				Native American whaling
84				Percent of households dependent on commercial fishing
85		Domestic		
86	The social capacity for the management of water and related land resources for sustainability, including human health and well-being	Legal	Water rights	Number of states going to a permit system
87			Water markets	Between sector water trades
88			Environmental justice	
89			Comprehensive water resources planning	Number of states active in statewide comprehensive water planning
90			Extent that legal structures reflect inter-connectedness of water resources	
91		Institutional	The capacity and performance of government and agencies	
92			The capacity and performance of NGOs	
93			The inter-relationships between government and NGOs	Extent of cooperation and leveraging of resources
94			Political commitment to water resources sustainability	
95		Socio-technical capacities	Education and human capital	
96			Research	
97			Physical infrastructure	
98		Political commitment		Number of moratoria on development
99		Disaster readiness and hazard mitigation	Preparedness (readiness prior to threat)	
100			Resistance (defense during onslaught)	
101			Resilience (ability to recover)	
102		External dependence		

#	CRITERION	CATEGORY	Sub-CATEGORY	Indicators
	<b>ECONOMIC CRITERIA</b>			<b>ECONOMIC INDICATORS</b>
103	Capacity to make water of appropriate quality and quantity available for human uses	Water availability	Precipitation	Daily, monthly, and annual rates
104				Quality of atmospheric deposition
105			Snow pack	Storage in perennial snowfields and glaciers
106				Quality indicators?
107			Evaporation	Daily, monthly, and annual rates
108				Quality indicators?
109			Transpiration (agriculture and natural vegetation)	Daily, monthly, and annual rates
110				Quality indicators?
111			Streamflow	Annual and periodic (5- to 10-year) summaries by the 352 river-basin hydrologic accounting units
112				Assessments of long-term trends, including changes in low flows, high flows, and timing of flows; number and duration of dry periods in streams and rivers; deviations from average conditions of the volume and timing of streamflow
113				Bacteriological contaminants
114				Total dissolved solids
115				Nitrogen concentrations, including nitrate
116				Phosphorus concentrations
117				Chemical contaminants
118				Temperature for intended use
119			Lakes	Total storage in large lakes (and trends over time)
120				Bacteriological contaminants
121				Total dissolved solids
122				Nitrogen concentrations
123				Phosphorus concentrations
124				Chemical contaminants
125				Harmful algal blooms
126				Temperature for intended use
127			Wetlands	Total acreage, by location (Nation, State, County)
128				Bacteriological contaminants
129				Total dissolved solids
130				Nitrogen concentrations
131				Phosphorus concentrations
132				Chemical contaminants
133			Reservoirs	Total available storage
134				Construction and removal activity
135				Sedimentation rates
136				Bacteriological contaminants
137				Total dissolved solids

#	CRITERION	CATEGORY	Sub-CATEGORY	Indicators
138				Nitrogen concentrations
139				Phosphorus concentrations
140				Chemical contaminants
141				Harmful algal blooms
142			Ground water (fresh and saline)	Ground-water-level indices for a range of hydro-geologic environments and land-use settings
143				Changes in ground-water storage due to withdrawals, saltwater intrusion, mine dewatering, and land drainage for major aquifer system
144				Availability and quantity of saline ground water
145				Bacteriological contaminants
146				Total dissolved solids
147				Nitrogen concentrations
148				Phosphorus concentrations
149				Chemical contaminants
150			Ocean desalinated water	Quantity of available desalinated ocean water
151				Quality indicators?
152			Wastewater reuse	Quantity of (1) available wastewater for reuse and (2) amount that is actively used
153				Bacteriological contaminants
154				Total dissolved solids
155				Nitrogen concentrations
156				Phosphorus concentrations
157				Chemical contaminants
158			Imported/transferred water	Quantity of (1) available imported water and (2) amount that is actively used
159				Bacteriological contaminants
160				Total dissolved solids
161				Nitrogen concentrations
162				Phosphorus concentrations
163				Chemical contaminants
164			Gross availability	Total available sources of water (by spatial and temporal measurement units)
165		Watershed condition	Land cover: vegetation type, human structures (including impervious surfaces), rangeland, and so forth	Percentage of land surface (in a given area) that is impervious
166				Percentage of land surface overlying (prime) aquifer-recharge areas covered by development
167			Land uses and practices, including water-quality indicators	Identifying specific pollution sources, which could include: (1) the number of permitted withdrawal sites where ground water is contaminated, (2) the number of Superfund sites, (3) number of water bodies listed as impaired under section 303(d) of the Clean Water Act; (4) water bodies that do not meet State WQS listed in State 305(b) reports under the Clean Water Act
168				Alteration of timing and flows
169				Chemical constituents in highway runoff
170				Impact of mine waste and contamination
171			Land form and alterations (topographic, including drainage	Number of reported cases of subsidence or sinkhole development

#	CRITERION	CATEGORY	Sub-CATEGORY	Indicators
			networks, channelization, wetland areas, soil losses, and so forth)	
172			Human population, including transient populations such as tourists and migrant workers	
173		Water withdrawals, use, and consumption		Total withdrawals for all uses, in gallons per day
174				Withdrawals by source (surface water or ground water), in gallons per day
175				Withdrawals by type (freshwater or saline water), in gallons per day
176			Offstream uses of water	Public supply, in gallons per day
177				Non-public supply, in gallons per day
178				Domestic, in gallons per day
179				Irrigation, in gallons per day
180				Livestock, in gallons per day
181				Aquaculture, in gallons per day
182				Industrial, in gallons per day
183				Commercial, in gallons per day
184				Mining, in gallons per day
185				Thermoelectric power, in gallons per day
186			Instream uses of water	Hydroelectric power, in gallons per day
187				Transportation, in gallons per day
188				Recreation, in gallons per day
189				Wastewater assimilation, in gallons per day
190				Consumptive uses, in gallons per day, by offstream use (includes water incorporated into products that are exported from a basin)
191				Applied use, in gallons per day
192				Conveyance loss, in gallons per day
193				Reclaimed wastewater (is this the same as water reuse?), in gallons per day
194			Use/benefit ratios	Population size (number of people)
195				Per capita use of water (gallons per day per person)
196				Industrial employment (number of employees)
197				Per employee water use (gallons per day/ per employee)
198				Number of irrigated acres
199				Per acre irrigation application rates (acre-feet per acre)
200				Amount of thermoelectric or hydroelectric power generated (kilowatt hours)
201				Withdrawals per power generated (kilowatt-hour of generation per gallon used)
202				Water-use in relation to measures of water availability (renewable rates)
203				Net availability: Total available sources of water less total uses, which include withdrawals for human uses, ecosystem uses, uses to meet legal

#	CRITERION	CATEGORY	Sub-CATEGORY	Indicators
				requirements, and so forth
204				Water withdrawals by unit area
205		Human infrastructure	Potable water systems	Total withdrawal (gallons per day), storage (gallons), and delivery (gallons per day) capacity of each system
206				Number and percentage of population served by public-water systems
207				Number and capacity of ground-water supply wells and artificial recharge facilities (including aquifer storage and recovery systems)
208				Number of water-supply systems needing major investments or recently having undergone such improvement
209				Population served by small drinking-water systems (less than 3,200 people)
210			Water-treatment facilities	Acre-feet of water treated
211				Percentage of total wastewater treated
212				Number of water-treatment facilities needing major investments or recently having undergone such improvement
213			Wastewater Reuse	Acre-feet of water treated for reuse
214				Percentage of total wastewater treated and reused
215			Irrigation systems	Acre-feet of irrigation capacity
216			Energy production systems	Number and generation capacity (kilowatt-hours) of thermal and hydroelectric power plants
217				Acre-feet of applied water required
218			Transportation systems	
219			Wastewater-treatment facilities	Number and capacity (gallons per day) of wastewater treatment plants
220				Capacity of wastewater treatment facilities as percentage of total wastewater generated
221				Number of wastewater-treatment facilities needing major investments or recently having undergone such improvement
222				Proportion of wastewater receiving secondary treatment
223			Desalination systems	Number and capacity (gallons per day) of surface-water and ground-water desalination systems
224				Acre-feet of surface-water and ground-water desalinated
225			Inter-basin transfers	Acre-feet conveyed
226			Energy use	Kilowatt-hour per acre-foot for conveyance, distribution, end-use pumping and thermal (heating and cooling), and wastewater treatment
227			Flood Prevention	Number of dams, canals, levees, and pumping stations constructed to divert water or manage flooding
228		Water conservation	Supply infrastructure (by category, i.e. municipal, irrigation, and so forth)	Acre-feet saved through conveyance system improvements (such as canal lining)
229				Miles of lined canals
230				Miles of unlined canals
231				Water use by type of irrigation technology (such as flood irrigation or drip irrigation)

#	CRITERION	CATEGORY	Sub-CATEGORY	Indicators
232				Investment in agricultural water-conservation measures
233			End-user equipment	Number of ULF toilets installed
234				Percentage of ULF toilets installed relative to total
235				Metering
236		Water-use policies and practices	Policies to support efficient end-user practices	Incentives for efficient water use
237				Voluntary versus mandatory measures
238				Monthly water billing (versus quarterly)
239			Water price	Tiered rate structures
240				Full-cost basis for pricing (such as include environmental externalities)
241				Life-cycle cost basis for pricing
242				Pricing by season and water availability
243	Economic well being resulting from use of water and affected land resources	Economic-value indicators: for each economic use of water (municipal, industrial, agricultural, energy production, transportation, recreation and tourism, mining) the following indicator sub-categories will be needed:		Value of goods and services produced by use of water; or, value of goods and services produced per gallon of water used; or, value of goods and services produced by use of water relative to cost of water used
244				Total employment and wages (payrolls) derived from water use in each economic sector/activity
245				Tax revenues (including fees such as at recreational facilities) generated from water use in each economic sector/activity
246				Trade balance?
247		Recreational revenue	Bodies of water available for recreational use	Lakes of appropriate quality - summer
248				Rivers of appropriate quality - summer
249				Lakes of appropriate quality - winter
250				Rivers of appropriate quality - winter
251				Coastal water of appropriate quality
252			Facilities available for recreation on the watershed	Restaurants on water bodies
253				Outfitters on water bodies (such as for rafting, boating, fishing, and so forth)
254				Hiking/biking trails on water ways
255		Economic costs of water-related hazards	Floods	
256			Droughts and other	

#	CRITERION	CATEGORY	Sub-CATEGORY	Indicators
			water shortages	
257	Capacity to gain economic value from use of water-related ecological resources	Capacity to support aquatic species of economic value	Commercial	Value of commercial harvest of given species, or aggregate value, measured by sales
258				Value of investment in fleets, gear, and supplies
259				Employment/income within commercial fishing sector
260			Sport	Value of sport harvest of given species, or aggregate value, measured by expenditures
261				Recreation revenue data
262				Employment/income within sport fishing sector
263		Capacity to support non-aquatic species of economic value	Commercial	Population trends, harvest data
264				Value of commercial harvest of given species, or aggregate value, measured by expenditures
265				Value of investment in gear and supplies
266				Employment/income within sector
267			Sport	Value of sport harvest of given species, or aggregate value, measured by expenditures
268				Recreation revenue data
269				Employment/income within sector
270	Value of investments to maintain or enhance the quality and quantity of water	Agriculture	Investment in reduction of non point pollution sources	Governmental research and grant investment
271				Non-governmental research and grant investment
272				Agricultural producer pollution abatement investment
273		Energy Production	Value of investments in improvements in efficiency of water	Governmental research and grant investment
274				Non-governmental research and grant investment
275				Energy producer retrofit or replacement investment
276			Value of investments in improvements in quality of water	Governmental research and grant investment
277				Non-governmental research and grant investment
278				Energy producer retrofit or replacement investment
279		Industrial land use (current and past; includes retail)	Investment in reduction of point sources of pollution	Governmental research and grant investment
280				Non-governmental research and grant investment
281				Water-treatment investment

#	CRITERION	CATEGORY	Sub-CATEGORY	Indicators
282				Pollution abatement investment
283			Capacity to manage drainage and impermeable surfaces	Public investment
284				Private (industry) investment
285		Municipal land use (current and past)	Investment in reduction of point sources of pollution	Governmental research and grant investment
286				Non-governmental research and grant investment
287				Water-treatment investment
288				Pollution abatement investment
289			Capacity to manage drainage and impermeable surfaces	Public investment
290		Transportation	Value of investments in reduction of pollution sources	Governmental research and grant investment
291				Non-governmental research and grant investment
292				Private investment
293		Recreational (including parks, forests, water-fun parks, lakes)	Value of investments in improvements in quality of water	Governmental research and grant investment
294				Non-governmental research and grant investment
295				Private investment
296		Water-Resources Planning		
	<b>ENVIRONMENTAL CRITERIA</b>			<b>ENVIRONMENTAL INDICATORS</b>
297	Capacity to make water of appropriate quality and quantity available to support ecosystems at multiple spatial and temporal scales	Measurements of water quality	Measurements that describe the physical properties of the water	temperature
298				water clarity
299				TSS
300			Measurements that describe chemical composition of water	dissolved oxygen DO
301				total nitrogen TN
302				total phosphorus TP
303				salinity
304				Cl chlorine
305				BOD biological oxygen demand
306				Toxicity - total; water; sediment (by toxin- PCBs, pesticides, metals)

#	CRITERION	CATEGORY	Sub-CATEGORY	Indicators
307				Ammonia, Oxides of Nitrogen NH3/NO2/NO3
308				pH
309				conductivity
310			Measurements of specific organisms inferring water quality conditions required to thrive	algae
311				invertebrates
312				vertebrates
313				fecal coliform/pathogens
314		Measurements of water that show the amount that is in storage and is available for use	Measurements of the water available from aquifers	Availability = amount withdrawn (discharge rates); renewing groundwater (recharge rate); sustainable yield (discharge/recharge ratio)
315				Storage = volume (aquifer capacity); level
316				total gaining & losing reaches over time (between surface water and the aquifer)
317				hyporrbeic storage
318				Groundwater (base flow contributes to minimum stream flow)
319			Lakes and reservoirs - Measurements of water available in lakes and impoundments	Storage = volume; level; timing of release
320				areal extent
321				interbasin transfers
322			Coasts	change in volume that reaches the ocean
323				change in sea level
324			Streams and Rivers	Flow: minimum instream flow to support fish and wildlife habitat; flood stages
325				hyporheic storage
326			Estuaries	areal extent (natural vs. managed)
327				volume
328				temporal dynamics
329			Wetlands	storage
330				areal extent (natural vs. managed)
331			Precipitation and snow pack	volume
332				areal extent
333				permanence of snowpack and glaciers
334		Potential human causal factors	Land use	extent in length and width of riparian vegetation
335				percent of impervious surface
336				composition and configuration of land use
337				structure & relationship of land use, e.g. storm water placement of impervious surfaces
338				NPDES (location, load) number & location of permitted discharges
339				non-point sources surface area (animal, mining)
340				population density
341				number of stream crossings

#	CRITERION	CATEGORY	Sub-CATEGORY	Indicators
342				area of NPS (agric, animal feedlots, industry, residential, parks, golf courses)
343			Discharge and withdrawals	number & location of dams, wells, water and wastewater treatment plants, stormwater outfalls, surface water intakes
344				percent of separated stormwater/sewer systems
345				number & location & efficiency of OWS (such as private septic systems)
346				number & location of superfund sites, LUST, etc
347				toxic release inventory – releases to water bodies (land, SW, GW)
348				landfills (#, loc, size, condition)
349			Structural modifications of hydrological systems	number of stream miles that are ditched and/or channelized
350				percentage of stream miles that are ditched and/or channelized
351				number of dams, canals, and pumping stations constructed to divert water or manage flooding
352				dredging for navigation (extent – miles, volume)
353				BMPs (#, loc, size, conditions)
354				constructed ditches
355			Water conservation measures	percent of total water
356				industrial, agricultural and domestic water use in conservation practice
357				xeroscaping
358	Integrity of water-dependent ecosystems at multiple scales	Material and energy-flow	Productivity & Energy Flow	Primary productivity
359				Secondary Productivity
360				Net Ecosystem Productivity
361			Material fluxes & cycles	Nitrogen and Phosphorus
362				Trace elements (e.g. Si, Hg)
363				Sulfur
364				Atmospheric influence
365				Pollutant loading
366		Biotic Integrity	Organism Condition	Disease
367				Metabolic state
368			Species/Population Condition	Population size
369				Population demographics (population structure and dynamics)
370				Generic diversity
371			Community/Ecosystem Condition	Indices of Biotic Integrity for various assemblages
372				Community size and composition
373				Physical habitat (change) (state + change)
374				Non-native species
375				Threatened/endangered species
376		Landscape Condition	Extent & Condition of Habitat Types	extent of habitat (wetlands, reservoirs, and aquifers)
377				spatial connectivity
378				diversity of w-d habitats: patch; biological
379			Landscape Structure	Extent of terrestrial & aquatic landscapes

#	CRITERION	CATEGORY	Sub-CATEGORY	Indicators
				(connectivity, composition)
380				Presence and amount of each part (or patch) within the landscape
381				Physical distribution or spatial arrangement of patches within the landscape
382		Disturbance Regime	Disturbance	Frequency
383				Magnitude
384				Extent
385			Eco-Stability	Resilience
386				Resistance