Sustainable Water Resources Roundtable (SWRR)
March 2 & 3, 2004, EPRI, Palo Alto, California
Proceedings

Day 1, Tuesday, March 2

Attendees:

Bill Alley, USGS;
Frank Arundel, Arundel Consulting;
David Berry, SWRR;
Carl Chen, Systech Engineering;
Jim Constantz, USGS;
David Czamanske, Sierra Club,
Theresa DeBono, PG&E;
Sean Eagan, USGS;
Larry Flowers, NREL;
Peter Gleick, Pacific Institute;
Bailey Green, Lawrence Berkeley Nat. Lab;
Ted Heintz, CEQ
Rhonda Kranz, ESA
Kelly McDonald, Defenders of Wildlife;
William Mills, Tetra Tech;
Robin Newmark, Lawrence Livermore Nat. Lab;
Timothy Parker, CA Dept of Water Resources;
Robert Rawson, Int. Wastewater Solutions Corp;
Sujoy Roy, Tetra Tech;
Jennifer Stokes, UC Berkeley,
Michael Warburton, Public Trust Alliance
Richard White, Lawrence Livermore Nat. Lab;
Cathy Wilson, Los Alamos Nat. Lab;

Julie Anderson, EPA Region 9;
Peter Beneson, Beneson Consulting;
Michael Cahn, UC Davis Extension;
Linda Cole, Valley Water Prot. Assn;
Jeff Crowe, EPRI;
Larry Dale, Lawrence Berkeley Nat. Lab;
Brock Dolman, OAEC;
Tim Eichenberg, Ocean Conservancy,
Paul Freedman, Limno-Tech Inc.;
Bob Goldstein, EPRI;
Robert Hartman, NOAA NWS;
Arturo Keller, UC Santa Barbara
David Layton, Lawrence Livermore Nat. Lab;
Norman Miller, Lawrence Berkeley Nat. Lab;
David Modeer, Tucson Water;
Toby O'Geen, UC Davis
Stephen Peck, Fleche
John Rosenblum, Rosenblum Envt. Engineering
Susan Stark, BP Consultant
Rick Swanson, US Forest Service
John Wells, MN Env't. Quality Board
Bob Wilkinson, UC Santa Barbara
Kent Zammit, EPRI

Opening, review of the purpose of SWRR and progress so far.

David Berry called the meeting to order and introduced Bob Goldstein, SWRR Co-chair, who welcomed the participants to EPRI and to the fourth meeting of the Sustainable Water Resources Roundtable. The majority of participants were attending their first meeting of SWRR so Rick Swanson, US Forest Service and SWRR Co-chair, outlined the origins of SWRR following the earlier Forest, Rangelands and Minerals Roundtables. The first three roundtables recognized that water sustainability issues were cross cutting across all natural resources and were too extensive to merely be a subgroup of each of the other roundtables. The SWRR was formed as an official subgroup of the Advisory Committee on Water Information, a Federal Advisory Group providing information to Federal Agencies. It works to develop criteria and indicators of trends in water resources and as a forum in which participants can discuss water research problems and opportunities for collaboration. Ted Heintz, White House Council on Environmental Quality (CEQ), explained how for many years assessments of the quality of the environment were made by teams of experts drawn from Federal Agencies and reports often drafted by contractors. Once a report was released, the teams would disperse and in subsequent years the process would start again without a consistent approach or consistent data sets from which to create the indicators. Economic indicators, Ted said, are based on standard measures and statistics and created regularly by established groups. Ted currently leads an effort at CEQ with participation of many Agencies to prepare recommendations to

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establish such a system for environmental and natural resources indicators for the US. The uses of such a set of indicators will be to support decision-making at various levels, to measure performance with respect to the environment and to provide feedback. The four resources roundtables provide input and support to CEQ development of this planned system of consistent and regularly reported environmental indicators.

Self-Introductions

David Berry asked participants to take a moment to introduce themselves, now that they understood the purpose of SWRR, to share with the group their interests, experience and commitments regarding sustainability of water resources in the context of SWRR's activities and goals. The participants spoke from a wide range of perspectives.

Panel: Presentations on Sustainability of Water Resources from various viewpoints. Moderated by Rhonda Kranz, Ecological Society of America.

Larry Flowers, National Renewable Energy Laboratory, DOE. Larry reported that there are currently 76,000 Megawatts of wind power generated in the US and that the cost for new wind capacity has dropped to 2½ to 3 cents per kilowatt hour compared to 4½ to 5 cents per kilowatt hour for new coal and natural gas generation. Wind is the fasted growing source of electrical energy but new distribution capability must be developed to make use of the sites where wind energy is most available. Larry pointed out that since energy from wind was intermittent, wind should be considered part of an overall energy system. Larry commented several opportunities for use of wind power in water processing such as a wind energy desalination plant in Hull MA and the use of wind for both energy and water pumping in Wales AK. Larry said that combining wind with hydro energy offset the intermittent problem associated with wind energy.

Tim Eichenberg, Former chair of the Clean Water Network and attorney for The Ocean Conservancy. Tim drew attention to information from EPA's National Water Quality Inventory and TMDL program, the Beach Watch and Mussel Watch Program, fish consumption advisories, the National Oceanic and Atmospheric Administration's (NOAA) National Status and Trends Program, (which looks at data from 350 sites and 25 coastal ecosystems), and the Coastal Condition Report which is a collaboration of the Environmental Protection Agency, NOAA, the U.S. Geological Survey and the U.S. Fish and Wildlife Service.

Summarizing some of the data, Tim said that 54% of estuaries in the US and 20% of ocean waters do not meet water quality standards. The biomass of San Francisco Bay was 90% invasive. Fish consumption advisories have been issued for 70% of the US coastline and include elevated levels of Mercury, PCBs, chlordane and dioxins. National shellfish advisories restrict harvest in 31% of the nation's shellfish beds, and include warnings about levels of fecal coliform, marine biotoxins and heavy metals. In 2002, 12,000 beach closures and advisories were issued by states because of inadequately treated sewage and runoff using fecal coliform and enterococcus as indicators.

Toby O'Geen, UC Davis, Using Digital Soil Survey Databases to Assess Water Resource Sustainability. Toby began by saying that soil surveys are a powerful tool to assess water resource sustainability. Toby used natural tracers (including chlorine and oxygen isotopes) and regional soil survey data to measure and scale ground-water recharge basin wide. Low chlorine levels indicated higher recharge rates and high chlorine levels were indicative of very low

recharge rates. Oxygen isotope signatures suggested that water was old in areas of low recharge.

The data illustrates that the variability in soil development controls spatial patterns in groundwater recharge. It was determined that ground-water recharge was lowest in areas of high rainfall and highest in areas of low rainfall. These observations contradict existing hydrologic models. Toby discovered that in areas of high precipitation soils are well developed, and as a result, have hydraulically restrictive soil horizons that retard the vertical percolation of water. In areas of low precipitation, soils are weakly developed, and as a result, lack restrictive horizons and are more permeable to water. These soil measures can help identify areas facing a rapid draw down of groundwater such as the example of eastern Washington State, which Toby presented.

Turning to water quality, Toby used the example of the hypoxic zone in the Gulf of Mexico caused by excess nutrients (nitrogen and phosphorus) that promote algal blooms that consume oxygen to the point that fish and shellfish die. It is believed that the source of these nutrients comes from agricultural runoff from midwestern farms. Toby used Soil Survey Data to demonstrate the spatial patterns between soils that contain perched water tables and their proximity in Mississippi and Ohio River watershed. Perched water tables influence nutrient transport pathways. Lateral flow of perched water freely transports nitrate to streams and irrigation ditches. Furthermore, saturated conditions caused by perched water slows water infiltration causing accelerated erosion, which is the primary mechanism through which phosphorus (normally non-mobile in soil) is transported to surface water bodies. Thus, Toby concluded, soil survey data provides excellent insights into the processes that link terrestrial and aquatic systems.

Keynote Speaker: **Dr. Peter H. Gleick,** President and co-founder, Pacific Institute, Oakland, California. Peter began by reminding the group that there is no consensus on moving from scientific data and knowledge to policy and programs. Indicators can serve as a basis for public dialog and public policy but there is no standardization of water indicators. Traditional indicators of water quality and scarcity do not provide adequate information to support decisions with respect to non-traditional global and local water problems. Peter says indicators may not be the real issue since the public and policy makers don't often use the indicators we have. Water is not integrated with other resource issues or with policy decisions. Critical water issues include:

- Basic human needs for water: 1.1 billion people lack access to adequate drinking water and 2.4 billion lack adequate sanitation. These problems lead to 2 - 5 millions deaths per year.
- Basic ecosystem needs for water
- Conflicts over water: Water scarcity per capita leads to stress within and among countries. Many countries are dependent upon imported water. In some regions of the world several nations are dependent upon the same watersheds for water.
- Climate change issues related to water: The indicator of CO_2 levels in the atmosphere over Hawaii is a powerful indicator of climate change as are the changes in global surface temperatures. The runoff from April through July in rivers dependent on snowmelt is another indicator of possible climate change, as snow pack is greatly affected by temperature. Warmer winters will mean less snow and more rain, leading to changes in the timing of runoff.

- Water and economics: Water withdrawals have been declining in the US as a percentage of GDP so efficiency is improving. Looking at water use per capita or water use per $ of GDP can be valuable indicators.

The keys to good indicators on water are data integrity, clear data sources, and clear representation of the data. Ultimately the argument should be about alternative policies and not about the indicators.

Keynote Speaker: Robert C. Wilkinson, Lecturer Bren School of Environmental Science and Management and Environmental Studies Program, UC Santa Barbara. **Water/Energy Nexus:** Bob stated that indicators for water resources should reflect both specific water-related concerns (e.g. quantity, quality, etc.) and processes and impacts which are integral to water systems (e.g. energy systems). Developing indicators in this larger context allows for a better understanding of whole systems, and these indicators may in turn facilitate the development of *integrated strategies* (policy, investment, planning) that tap *multiple benefits*. In the parlance of economics, these indicators provide input that can improve the allocation of scarce resources on a whole-system basis or "Multiple Benefits" concept. Bob presented examples of water sustainability in the California context stating that every major water supply system in California is over allocated. He gave examples of the nexus between water and energy issues as a key aspect of this whole-systems approach. He closed with a case study on storm water management.

Presentation by Criteria & Indicator Group: Rhonda Kranz, Ecological Society of America & **John Wells**, Minnesota Environmental Quality Board made a presentation of the draft criteria completed after the last meeting and the corresponding indicators prepared by the C & I subgroup.   The group argues that the sustainable development offers a multi-dimensional way of thinking about the interdependencies among natural, social, and economic systems and forms of capital in the use of water that:
•Involves policies, plans, and activities that improve equality of access to water
•Recognizes that there are limits and boundaries of water use beyond which ecosystem behavior might change in unanticipated ways
•Requires consideration of interactions occurring across different geographical ranges - global, national, regional, and local
•Challenges us to look to the future and to fully assess and understand the implications of the decisions made today on the lives and livelihoods of future generations, as well as the natural ecosystems upon which they will rely.

At its June 2003 meeting, the SWRR agreed to use the Bellagio Principles, a set of guidelines developed by leading indicator practitioners at a conference at Bellagio Italy. The principles call for the practical assessment of progress toward sustainable development by seeking to
•Understand environmental, social and economic system "states" and their direction and rate of change
•Understand interactions between system parts
•Reflect positive and negative effects of human activity on people and ecosystems
•Account for equity and disparity today and between present and future generations

Rhonda and John then presented a set of draft criteria and sub-criteria, preliminary indicator categories and a list of indicators collected by the C & I group prior to giving guidance for the breakout sessions.

Ecosystem Criterion #1: Capacity to make water of appropriate quality and quantity available to support ecosystems:
Indicator Categories:
- Water quality indicators
- Water quantity indicators
- Human infrastructure indicators

Ecosystem Criterion #2: Integrity of ecosystems
Indicator Categories:
- Water quality indicators
- Water quantity indicators
- Water use indicators
- Biological indicators
- Landscape indicators

Social Criterion #1: Social well being resulting from the use of water resources
Indicator Categories:
- Human health indicators
- Water use indicators
- Recreational indicators
- Human infrastructure indicators

Social Criterion #2: Social well being resulting from the use of water-related ecological resources
Indicator Categories:
- Native American cultural indicators
- Recreational indicators

Social Criterion #3: Legal, institutional, community and technical capacities for the management of water and related land resources for sustainability
Indicator Categories:
- Legal indicators
- Institutional indicators
- Human infrastructure indicators

Economic Criterion #1: Capacity to make water of appropriate quality and quantity available for human uses
Indicator Categories:
- Water use indicators
- Human infrastructure indicators
- Water conservation indicators

Economic Criterion #2: Economic well being resulting from use of water and related land resources
Indicator Categories:
- Economic value indicators
- Recreational indicators
- Water hazard indicators

Economic Criterion #3: Economic well being resulting from the use of water-related ecological resources
- No indicator categories … yet

Breakout groups were identified, rooms assigned and directions given for identifying and discussing issues and ideas relating to the preliminary criteria and indicators put "on the table" by the C & I Group.

Report back from breakouts on Criteria & Indicators of Water Sustainability Participants found the assignment to be complex and requested that materials be sent out further in advance of future meetings. The three categories of criteria were considered reasonable if defined as

categories rather than "criteria" but there was some confusion on terminology like "capital", "criteria" and "phenomena" and on connections and cross-links among indicators such as between water and land uses. Participants agreed that categories should not reflect direction or trends and that historical trends were needed to give meaning and context to current data.

The discussion groups came up with a wide range of specific suggestions, including the concepts of ethics, ecological literacy, "keystone species," scale, hazards to people and ecosystems, water restoration, watershed self-reliance, intergenerational equity and the intrinsic value of biodiversity. A number of new indicators or indicator categories were suggested, including frequency of inter-basin transfers, watershed percent impervious surface, watershed integrity, water budgets, landscape fragmentation, nutrient cycling, status of anadromous fisheries, timing, percentage of "no-net-runoff" developments, sales of waste products from firm to firm, and reliability of water sources.

In summary, one goal of the SWRR effort should be to help people and governments understand issues and the implications of their behavior, and thus lead to improved decision-making. They should be able to use indicators to see new opportunities and quantify the benefits of the choices they face.

The group suggested the categories and indicators be refined based on the input from this meeting and that a longer work session take place in June to move the indicators forward.

Day 2, Wednesday, March 3

Research Panel: Bob Goldstein, EPRI moderated the presenters from Government Agencies and the corporate sector:
Robin Newmark, Lawrence Livermore National Laboratory. Robin pointed out that many agencies are involved in water resources and none is responsible for increasing the efficiency of the water supply system. Research dollars are tight and water competes with other issues. Water use more than doubles when its use in energy production is considered and multilab participation is needed to address relevant technology, energy and water security issues. Technologies for efficiency and quality are needed, as are predictions for the impacts of climate change and the development and management of diagnostic tools. Demands for competing water use is political and gains are needed in the quality of water supply and releases, the efficiency of water uses and to manage and balance multiple goals.

William M. Alley, Chief, Office of Ground Water, USGS. Bill gave some general information about the USGS water-use program. Bill said the report Estimated Use of Water in the United States in 2000 would be released about March 11 (Note: The report, USGS Circular 1268, now can be found on the web at http://pubs.water.usgs.gov/circ1268 or by going to the USGS water-use web site: http://water.usgs.gov/watuse) . In 2000, Americans used 408 billion gallons of water per day, a number that has remained fairly stable since 1985 and a sign that conservation is working. The main water uses are power generation, agriculture and public water supply. Personal use of water is rising, but not faster than population change indicating improvements in efficiency particularly with irrigation and power generation.

There is no water use program funded by Congress, the work is carried out with general funds, and thus it is increasingly difficult for USGS to undertake the 5-year water-use compilations.

Research needs to focus on consumptive uses of water and SWRR can encourage that.

Sujoy Roy; Tetra Tech, Inc**. An Approach to Developing Large-Scale Estimates of Water Resources Sustainability Using Available Data.** Sujoy focused on a large-scale evaluation at the national level in the US using available data on population, temperature and precipitation, water use, electricity generation and endangered aquatic species. His team then estimated future conditions using available forecasts, extrapolating from current rates of changes and assuming no change in conditions. Finally they examined future water demands assuming rates of water use per unit of activity at both current levels and rising efficiency rates.
Sujoy showed a number of graphics for the nation and then summarized his findings:
•Publicly available data do provide a basis to evaluate sustainable water use
•Data on water use was especially valuable
There are some unmet data needs including a better representation of regulatory limits on water withdrawals, or an estimate of environmental flow requirements, are needed, data on intra-annual use could be important in highlighting scarcity in the driest months of the year and a more uniform assessment of water quality impairment.

Kent Zammit, EPRI: Kent gave a presentation on EPRI's advanced cooling program for power plants highlighting the improvements in efficiency possible even at very large scales. Technological improvements include spray enhancements for dry cooling (reduces efficiency and capacity penalties) and updated water quality guidelines for cooling towers (allows for higher cycles of concentration and use of degraded water sources – gray water). Other research projects are on the verge of receiving funding and many worthwhile projects are being developed.

Carl Chen, Systech, Inc., San Ramon, CA. Carl outlined the ZeroNet project which is a joint LANL EPRI and PNM project on sustainable water and power supply, sustainable water quality, innovative technologies for gray water, a market approach for trading & banking and stakeholder involvement. Carl said that the ZeroNet module would be added to WARMF to provide road maps for the planning of drought, water rationing, water banking (time shifting of demand), water trading (agriculture vs. cities, reclaimed vs. fresh), new or renewable energy, vegetation management. New input dialogs for sustainable alternatives for water and energy and new outputs for decision variables will be developed. Carl outlined water management options:
o Water rationing: a % reduction of water usage.
o Water banking: allows a water user to divert less for a dry year & to reclaim it in other years.
o Water trading: allows farmers to sell water to cities, and cities to trade reclaimed water with freshwater of power plants for tiered uses.

William Mills, Tetra Tech *Vulnerability of Electrical Power Generation to Water Availability: Framework Development and Case Studies.* Bill's presentation outlined a variety of data sources on water availability and water uses. He then looked at ratios such as total water withdrawn to water consumed for thermoelectric power production. His PowerPoint presentation showed the data for the whole US by watersheds on a HUC8 scale. Summarizing, Bill said the major water issues for the southeast are environmental pressures and long term water supply; for the Midwest recirculation of high water temperatures; and for the southwest, arid climate and availability of irrigation water. He concluded that data available through the Internet and publicly available reports provided all data needs for 2 of 3 case studies that he examined.

Action steps for research work group. Following the presentations on research, the participants discussed priority common concerns and how SWRR member organizations could best collaborate on research or research funding. It was agreed that SWRR would put links to participant research work on its website and that conversations on research continue. Paul Freedman volunteered to support strengthening the research aspects of the SWRR website. Arturo Keller of UC Santa Barbara offered the work of a graduate student to support SWRR.

Closing Session: The meeting closed with brief reports of the SWRR work groups on Outreach and Funding. It was agreed that the June meeting be a one-day session in Washington focusing on indicators. The Wilderness Society has offered to donate space for the meeting.