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In Hot Water:

Water Management Strategies to Weather the Effects of Global Warming

Principal Authors

Barry Nelson

*Natural Resources
Defense Council*

Monty Schmitt

*Natural Resources
Defense Council*

Robert Wilkinson

*University of California
at Santa Barbara*

Ronnie Cohen

*Natural Resources
Defense Council*

Noushin Ketabi

*Natural Resources
Defense Council*

Contributing Editor

Theo Spencer

*Natural Resources
Defense Council*



The world's climate is warming—by an average of 1.3 degrees Fahrenheit in the past century. Unless current trends are reversed, global warming pollution is projected to keep increasing rapidly, raising temperatures by as much as 11.5 degrees Fahrenheit by the end of this century and compromising our water supply, flood management systems, and aquatic ecosystems. Experts predict that rising temperatures will lead to less alpine snowpack, earlier and larger peak streamflows, potential reductions in total streamflows, greater evaporative losses, declining ecosystem health, sea level rise, more extreme weather events—including both floods and droughts—and hotter, dryer summers. We're already seeing evidence of these trends around the West.

Water managers—including water districts and local, state, and federal agencies with water-related resource management responsibilities—play a key role in Western communities by identifying potential water-related problems and pointing the way to solutions. As stewards of one of the West's most valuable—and scarce—resources, water managers can lead the response to ongoing climate changes and help stave off further damage.



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Water Management in a Changing Climate

Global warming presents challenges regarding water supply, water quality, ecosystem protection, and flood management—issues that water managers face every day. NRDC has created a blueprint for action, including a set of specific strategies water managers and other decision makers can use as they incorporate climate change issues into management decisions.

Action 1: Evaluate the Vulnerability of Water Systems to Global Warming Impacts

- **Conduct agency assessments of climate change impacts on water supply.** Assessments should analyze water supply and other impacts from projected climate change effects, including reductions of snow pack and earlier peak stream flows, as well as from projected increases in temperature, which may result in greater environmental protection requirements and higher urban and agricultural water demand.
- **Work with other water managers to evaluate regional vulnerability.** Regional analyses can help water managers understand the common challenges they face and lay the groundwork for cooperative responses. They are especially important for water agencies in large watersheds and regions facing similar climate change–related challenges.

The Impacts of Climate Change on Water Management

Global warming is not an issue that we can afford to address with a “wait and see” approach. We must take action immediately or we are at risk of irreversibly damaging some of the West’s precious water resources:

- For every rise of one degree Celsius (1.8 degrees Fahrenheit) in the West, researchers predict that snow levels will retreat upward by 500 feet in elevation.
- Extreme weather events such as floods and large storms could increase in size and frequency, straining the limits of flood control systems and exposing some floodplains and low-lying coastal regions to damage reminiscent of Hurricane Katrina.
- The IPCC predicts that sea level will rise by 7 to 23 inches by 2100, affecting water supplies, eroding wetlands, diminishing coastal protection from storms, and exposing residents to severe flood damage. This projection assumes no acceleration of ice flow in Greenland or Antarctica. A new study, published after the deadline for consideration by the IPCC, projects that sea levels will rise by 20 to 55 inches this century based on recent observations.
- The stability of levees in the Sacramento-San Joaquin Delta, which provides a portion of the water supply for more than 20 million Californians, will be threatened by rising sea levels.
- Higher temperatures will decrease salmon, trout, and other fish habitat, thereby increasing conflicts over water resources. Scientists estimate that up to 38 percent of locations currently suitable for coldwater fish could become too warm to provide habitat by 2090.

Action 2: Develop Response Strategies to Reduce Future Impacts of Global Warming

- **Consider the impact of climate change on future water management tools.** Water management tools will be affected significantly—but not equally—by climate change. In general, climate change will make increases in efficiency more effective and reduce the yields from traditional surface storage and diversion projects. The table on the next page shows which water management tools will be most helpful in a climate-altered world.
- **Put conservation first.** Increased investments in water efficiency represent a sound and basic “no regrets” water management approach to future climate change impacts. Cost-effective water conservation investments can generate significant benefits for water supplies and aquatic ecosystems, as well as reduced energy consumption and greenhouse gas emissions.
- **Incorporate climate and energy issues into statewide water planning.** State-level planning efforts should incorporate climate change vulnerability analyses, global warming impacts on management tools, and the energy implications of water management decisions.
- **Consider integrated regional water management strategies.** Water managers should carefully consider an integrated regional water management approach to climate change response. A robust climate change response strategy should include:
 - Analysis of potential climate impacts on existing systems, as well as future water supply strategies
 - Multiple benefits (e.g., supply, water quality, energy, flood management, and ecosystem benefits)
 - An examination of unique regional conditions
 - Potential partners to assist in financing and implementation (e.g., energy, stormwater, wastewater, and land use agencies)
 - Institutional strengths and responsibilities
 - A full range of potential water supply and demand strategies
 - A full range of flood management options
 - “Efficiency first” investments
 - A clear “with and without” project analysis for major infrastructure investments
 - Stronger, enforceable environmental protections, such as flow and temperature requirements for protected species
 - Economic analysis and “beneficiary pays” financing
 - Clear objectives and performance standards
 - Educating the public and decision makers about climate change

Performance of Water Management Strategies After Considering Global Warming Effects

More effective	Not affected	Less effective
Landscape conservation	Wastewater reclamation	Traditional river diversions
Conservation rate structures	Interior water conservation	Traditional groundwater pumping
Agricultural water conservation	Groundwater cleanup	Traditional surface storage facilities
Water marketing		Ocean water desalination*
Urban stormwater management		
Saltwater groundwater intrusion barriers to protect coastal aquifers		
Water system reoperation		
Interagency collaboration and integrated water management strategies		
Floodplain management		

*Given existing energy requirements.

- **Collaborate with energy utilities.** Water conservation generates substantial water and energy savings, and thus reductions in greenhouse gas emissions. Water agencies should work with local energy utilities to develop joint programs, such as rebate offers, to encourage customers to conserve water and energy.

- **Consider climate change when making commitments about future water deliveries.** In particular, agencies should avoid promising increased water deliveries based solely on current hydrology, without consideration of future climatic conditions.

- **Factor in flood management.** For agencies with flood management responsibilities, an awareness of climate change should be integrated into future management decisions. Managers should investigate opportunities such as the reoperation of existing facilities, floodplain restoration, groundwater recharge, and flood-compatible agriculture. To reduce future damage, floodplains should be managed with an awareness that they will be inundated more frequently. This suggests placing an increased emphasis on land use issues.

- **Protect and restore aquatic ecosystems.** Degraded aquatic ecosystems result in the loss of species and create endangered species conflicts. Healthy aquatic ecosystems will be more resistant to climate impacts, help reduce conflicts, and provide other benefits to water quality, recreation, and flood protection.

Action 3: Prevent Future Impacts by Reducing Greenhouse Gas Emissions

- **Support policies including mandatory caps on emissions.** The IPCC found with at least 90 percent certainty that the current global warming trend is caused primarily by greenhouse gas emissions—particularly carbon dioxide—released through the burning of fossil fuels. Enforcing a mandatory national cap on the pollution that causes global warming is the single most important step in controlling and reducing the future impacts of global warming. While caps would be most effective at the federal level, local, state, and regional initiatives are also important tools in the face of federal inaction.

- **Take action at the district level.** Water agencies should develop programs to reduce their energy consumption and greenhouse gas emissions. A thorough understanding of the energy implications of water management decisions can lead to a range of options for achieving this goal. (NRDC's 2004 report *Energy Down the Drain* explores this relationship in detail.)

Action 4: Increase Awareness of Global Warming and Water Impacts

- **Educate customers and decision makers.** Global warming is not just an environmental concern—it affects the future of all Western communities, particularly through water-related issues. Addressing the impacts of climate change on water management will require increased awareness and involvement by water district customers and decision makers, including elected officials.

- **Raise public awareness.** Given the global nature of climate change and the need for far-reaching actions to address its causes, raising public awareness is essential to encouraging effective action. Water managers can play an important role in increasing awareness of global warming and the need to take action. Outreach can take the form of advertisements, media outreach, discussions with business groups, conferences, community forums, and more.

Total Surface and Groundwater Withdrawals by U.S. County



The Western United States withdraws more water than any other region in the nation. The changes to hydrology and water supply that are likely to be caused by global warming threaten to have serious implications for western water management.

Source: USGS 2004

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Western communities look to water managers for leadership on water issues. With global warming changing the way we think about water in the American West and around the globe, water managers and other decision makers must lead the way in ensuring

that our drinking water supply is safe, that our communities are protected from floods, and that our aquatic ecosystems support healthy fish and wildlife populations. The time to prepare is now.

Highlights of Efforts to Incorporate Climate Change into Water Management

Across the West, water agencies and other water managers have begun taking action to address the challenges presented by climate change. Here are a few highlights of those efforts.

Evaluating the Vulnerability of Water Systems to Global Warming Impacts

- Many Western communities, including Seattle, Portland, Denver, the San Francisco Bay Area, and water districts in the Sierra Nevada foothills have undertaken analyses of potential impacts to their existing water systems.
- New Mexico and California have released statewide vulnerability analyses.
- In 2005, the American Water Works Association Research Foundation released *Climate Change and Water Resources: A Primer for Municipal Water Providers*.

Implementing Response Strategies to Reduce Future Impacts

- Denver Water has decided to dramatically accelerate its long-range water conservation program, partially in response to potential impacts from global warming.
- California's Department of Water Resources has issued multiple reports regarding climate impacts, including *Progress on Incorporating Climate Change into Management of California's Water Resources*.
- Southern California's Santa Ana Watershed Project Authority has created a national model for integrated regional water management, producing far-reaching water supply, water quality, energy, and climate benefits.

Preventing Future Impacts by Reducing Greenhouse Gas Emissions

- In California, three water agencies—the Santa Clara Valley Water District, the East Bay Municipal Utility District, and the Marin Municipal Water District—supported AB 32, which Governor Schwarzenegger signed into law in September 2006, creating the nation's first state-level mandatory cap on greenhouse gas emissions.
- The Santa Clara County Water District has helped to create a public/private partnership called Sustainable Silicon Valley, which is working to reduce the emission of global warming gases and other pollutants.
- The Bay Area's East Bay Municipal Utility District has joined the California Climate Action Registry to report its greenhouse gas emissions, earning the district a "Green Power Leadership" award from the Environmental Protection Agency.
- The Marin Municipal Water District has joined the Cities for Climate Protection campaign, uniting with dozens of other Western cities that run municipal water utilities to create a strategic agenda to reduce global warming.

Increasing Public and Decision Maker Awareness

- The Santa Clara Valley Water District has added a discussion of global warming to its website, stating that "The reality of global warming and climate change is the most significant long-term threat to water resources management in Silicon Valley."