Climate Ready Water Utilities Working Group

Annotated Bibliography

Thursday, May 6, 2010

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Overview

The following draft annotated bibliography is meant to inform the Climate Ready Water Utility (CRWU) Working Group as established by the, National Drinking Water Advisory Council per the *Federal Register* notice published on July 8, 2009. This document identifies a full range of information relevant to the CRWU Working Group's charge and is organized into the four following topic areas: 1) Climate Change Impacts to the Water Sector; 2) Adaptation & Mitigation Strategies; 3) Planning, Modeling, and Training Tools; and 4) Example Incentive & Voluntary Programs. In the many instances where a document was found to be applicable to more than one category, it was placed in the category that seemed most appropriate.

******Note**: Note: References marked with an "asterisk" identify documents which provide an overview of the key areas of consideration identified within the CRWU Working Group's Charge.*

Water Sector - Climate Change Impacts

Backlund, Peter; et al., 2008: The Effects of Climate Change on Agriculture, Land Resources, Water Resources, and Biodiversity in the United States. Synthesis and Assessment Product 4.3., U.S. Environmental Protection Agency, Climate Change Science Program, Washington, DC, USA. 240 pp.
<http://www.usda.gov/oce/global_change/files/CCSPFinalReport.pdf>

This report provides an assessment of the effects of climate change on U.S. agriculture, land resources, water resources, and biodiversity. It discusses the nation's ability to identify, observe, and monitor the stresses that influence agriculture, land resources, and water resources and evaluates the relative importance of these stresses and how they are likely to change in the future.

Bates, B.C., et al., 2008: Climate Change and Water. Technical Paper of the Intergovernmental Panel on Climate Change, IPCC Secretariat, Geneva, 210 pp.
<http://www.ipcc.ch/pdf/technical-papers/climate-change-water-en.pdf>

This report summarizes how climate change impacts freshwater. The report concludes that there is abundant evidence that freshwater resources are vulnerable and have the potential to be strongly impacted by climate change, with wide-ranging consequences for human societies and ecosystems. Sea level rise is dealt with only insofar as it can lead to impacts on freshwater in coastal areas and beyond.

Bader, D. C.; et al., 2008: Climate Models: An Assessment of Strengths and Limitations. Synthesis and Assessment Product (SAP) 3.1 by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research, Washington, DC, USA. 135 pp. <http://www.climatescience.gov/Library/sap/sap3-1/final-report/default.htm>

This report describes complex mathematical models used to simulate the Earth's climate on some of the most powerful supercomputers, and assesses their ability to reproduce observed climate features, and their sensitivity to changes in conditions such as atmospheric concentrations of carbon dioxide.

Climate Change Science Program (U.S.) and National Science and Technology Council (U.S.). Subcommittee on Global Change Research. Revised Research Plan for the U.S. Climate Change Science Program: A Report / by the Climate Change Science Program and the Subcommittee on Global Change Research, U.S. Climate Change Science Program, Washington, D.C.: 2003.
<http://www.climatescience.gov/Library/stratplan2008/CCSP-RRP-FINAL.pdf>

This Revised Research Plan is an update to the 2003 Strategic Plan of the US Climate Change Science Program (CCSP). Using the program's five strategic goals as an organizing framework, the Revised Research Plan provides a goal-by-goal overview of emerging research questions and themes, key research topics, and illustrative research plans for the years 2008 to 2010.

* Cromwell, J.E., et al., 2007: Implications of Climate Change for Urban Water Utilities. Association of Metropolitan Water Agencies, Washington, D.C., 18pp.
<http://www.amwa.net/galleries/climate-change/AMWA_Climate_Change_Paper_12.13.07.pdf>

This report examines the potential impacts of climate change on the hydrologic cycle, water availability and demand, water pollution, and extreme weather events. Impacts of climate change on water suppliers are discussed separately in this paper and further distinguished between direct impacts, indirect impacts, and compound impacts.

Frederick, Kenneth D. et al, 1999: Water and Global Climate Change: Potential Impacts on U.S. Water Resources. Pew Center on Global Climate Change: Arlington, VA. 55pp.
<http://www.pewclimate.org/global-warming-in-depth/all_reports/water_and_climate_change>

This report identifies climate change impacts to the quantity and quality of the water supply. Relevant chapters include: IV. Implications of Climate Change for Managed Water-Resource Systems; and VIII. Adapting to Changing Supply and Demand Conditions.

Gamble, J.L., et al., 2008: Analyses and Effects of Global Change on Human Health and Welfare and Human Systems. Synthesis and Assessment Product (SAP) 4.6 by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research, Washington, D.C.. 218 pp.

<http://downloads.climatescience.gov/sap/sap4-6/sap4-6-final-report-all.pdf>

This report details how climate change, interacting with changes in land use and demographics, will affect water availability, extreme precipitation, and the spread of waterborne illness in the United States.

Gleick, P.H., et al., 2001: Emerging Threats to the World's Freshwater Resources. A Report of the Pacific Institute for Studies in Development, Environment, and Security, Oakland, California. 64pp.
<http://www.pacinst.org/reports/freshwater_threats/threats_to_the_worlds_freshwater.pdf
>

This report focuses on four upcoming challenges and threats: water and human health; the destruction of freshwater ecosystems; freshwater quality concerns; and long-term global climatic change and its impact on water resources. Section 5 of this report addresses the future risks of climate change for water resources and complex developed water systems. Additionally, this section provides a summary of coping and adaptation methods that may assist water managers to reduce the risks of climatic variability and change for water resources.

Gleick, P., et al., 2009: The World's Water 2008-2009: The Biennial Report On Freshwater Resources. Pacific Institute for Studies in Development, Environment, and Security, Washington, D.C.. 402pp.
<http://books.google.com/books?id=_wd-s1FB7VEC&pg=PT19&lpg=PT19&dq=Chapter+Three,+The+world%27s+water+2008-2009+:+the+biennial+report+on+freshwater+resources&source=bl&ots=Ex2BiRNn-S&sig=VvhnWuBLVvx-Abq5wqONLakAd3s&hl=en&ei=-fG8SrXPMYKuswPGsMTcBQ&sa=X&oi=book_result&ct=result&resnum=3#v=onepage&q=&f=false>

This report contains a comprehensive and up-to-date source of information and analysis on freshwater resources and the political, economic, scientific, and technological issues associated with them. Specifically, this report examines the key issues surrounding the use of freshwater resources in addition to identifying and explaining the most significant trends worldwide, and offers the best data available on a variety of topics related to water.

Global Climate Change Impacts in the United States, Thomas R. Karl, Jerry M. Melillo, and Thomas C. Peterson, (eds.). Cambridge University Press, 2009.
<http://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf>

This report summarizes the science of climate change and the impacts of climate change on the United States, now and in the future. It is largely based on results of the U.S. Global Change Research Program (USGCRP), and integrates those results with related

research from around the world. This report discusses climate-related impacts for various societal and environmental sectors and regions across the nation.

Hanemann, M., et al., 2006: The Economic Cost of Climate Change Impact on California Water: A Scenario Analysis. California Energy Commission, Public Interest Energy Research (PIER) Program, Energy-Related Environmental Research, California. 29pp. <http://www.energy.ca.gov/2006publications/CEC-500-2006-003/CEC-500-2006-003.PDF>

This report focuses on the impacts on water supply in California as a result of climate change and provides a rough estimate of the economic consequences of several of these impacts. It provides a partial analysis of the economic costs caused by the reduction in surface water supply in California due to the GFDLA2 scenario to agricultural water users in the Central Valley and urban users in the South Coast.

Hanemann, M., et al., 2005: Economic Impacts of Climate Change on Urban Water Use in California. California Energy Commission, PIER Energy-Related Environmental Research, California. 34pp. <http://www.energy.ca.gov/pier/project_reports/CEC-500-2005-124.html>

This report describes the California Climate Change Center's initial efforts to estimate both urban water demand and the short-term and long-term consumer surplus losses for urban water agencies in California. This report presents the results of the estimations for Los Angeles and the descriptive results for the City of Santa Rosa.

IPCC, 2007: Summary for Policymakers. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. < http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-spm.pdf>

This report describes progress in understanding of the human and natural drivers of climate change, observed climate change, climate processes and attribution, and estimates of projected future climate change. It builds upon past IPCC assessments and incorporates new findings from the past six years of research. Scientific progress since the Third Assessment Report (TAR) is based upon large amounts of new and more comprehensive data, more sophisticated analyses of data, improvements in understanding of processes and their simulation in models and more extensive exploration of uncertainty ranges.

IPCC, 2007: Summary for Policymakers. In: Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the

Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 7-22. <http://www.ipcc.ch/ipccreports/ar4-wg2.htm>

This report assesses the scientific, technical, environmental, economic and social aspects of the vulnerability (sensitivity and adaptability) to climate change of, and the negative and positive consequences for, ecological systems, socio-economic sectors and human health, with an emphasis on regional sectoral and cross-sectoral issues.

Loáiciga, H.A. 2003: Climate Change and Ground Water. Annals of the Association of American Geographers, Vol. 93, No. 1, March, pp. 30-41.
<http://www3.interscience.wiley.com/journal/118827923/abstract>

This article focuses on regional aquifer systems and currently available methods used to link large-scale climate-change processes to ground-water recharge. In addition, it outlines the development of a methodology to quantify the effects of climate change and of changes in ground-water use by population growth on hydrologic response.

Morrison, J.; et al., 2009: Water Scarcity & Climate Change: Growing Risks for Businesses & Investors. A report by Ceres and the Pacific Institute. 60pp.
< http://www.pacinst.org/reports/business_water_climate/full_report.pdf>

This Ceres/Pacific Institute report outlines the wide-ranging risks investors and companies face from water scarcity and how global climate change will heighten those risks in many parts of the world. This report identifies water-related risks specific to eight water-intensive industry sectors. The report also identifies water-related risks for electric power/energy, apparel, biotechnology/pharmaceutical, forest products and metals/mining firms.

* National Association of Clean Water Agencies (NACWA), 2007: Climate Change: Emerging Issues for Clean Water Agencies, Washington D.C.. 14 pp.
<http://www.nacwa.org/images/stories/public/2007-11ccwp.pdf>

This report provides background information on the potential impacts of climate change on planning and operations for wastewater treatment facilities. In addition, this paper examines recent actions regarding climate change in the legislative, regulatory, and legal forums, and their possible effects on the clean water community.

National Association of Clean Water Agencies (NACWA), 2009: Confronting Climate Change: An Early Analysis of Water and Wastewater Adaptation Costs. 104 pp.
< http://www.amwa.net/galleries/climate-change/ConfrontingClimateChangeOct09.pdf>

This report is an early cost assessment of adaptations to address some of the likely impacts of climate change on our nation's drinking water and wastewater utilities through

2050. The report estimates adaptation costs for these facilities to be between $448 billion and $944 billion over this period of time.

Parry, M. et al., 2009: Assessing the Costs of Adaptation to Climate Change: A Review of the UNFCCC and other recent estimates, London: International Institute for Environment and Development (IIED) and Grantham Institute for Climate Change (Imperial College, London). <http://www.iied.org/pubs/pdfs/11501IIED.pdf>

This report reviews the costs of adapting to climate change. The estimates for 2030 used by the UN Framework Convention on Climate Change are likely to be substantial under-estimates and this report aims to demonstrate the need for the further and transparent refinement of cost estimates for responding to climate change.

Poff, LeRoyf N., et al., 2002: Aquatic Ecosystems and Global Climate Change: Potential Impacts on Inland Freshwater and Coastal Wetland Ecosystems in the United States. Pew Center on Global Climate Change: Arlington, VA. 56pp.
<http://www.pewclimate.org/docUploads/aquatic.pdf>

This report examines the potential impacts of climate change on the U.S. environment. It details the likely impacts of climate change over the next century on U.S. aquatic ecosystems.

Rose, Joan B., et al., 2000: Climate and Waterborne Disease Outbreaks. Journal AWWA, Vol. 92, Issue 9, September 2000, Page Range 77-87. 11pp.
<http://apps.awwa.org/waterlibrary/search.aspx>

This article offers recommendations for improving the assessment of changes in water quality and the effect that climate variability and environmental factors have on waterborne disease risk.

Sykes, Richard G., 2009: "How Should Water Utilities Prepare for Climate Change?", OPF, Vol. 35 Issue 1, January 2009, Page Range 12-17. 6pp.
<http://aquadoc.typepad.com/files/opf0109.pdf>

This article presents new developments by East Bay Municipal Utility District (EBMUD) in Oakland, California, in using current climate change research for water resource and operational planning. Specifically, this article focuses on reducing greenhouse gases, the effect of climate change on supply sources, and rising sea levels in relation to effects on utilities.

U.S. EPA, 2006: A Screening Assessment of the Potential Impacts of Climate Change on Combined Sewer Overflow (CSO) Mitigation in the Great Lakes and New England

Regions (External Review Draft). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-07/033A.
<http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=166365>

This report describes the potential scope and magnitude of climate change impacts on combined sewer overflow (CSOs) mitigation efforts in the Great Lakes Region and New England Region. The report describes the extent to which CSO long-term control plans may be under-designed if planners assume that past precipitation conditions are representative of future conditions.

U.S. EPA, 2006: A Screening Assessment of the Potential Impacts of Climate Change on the Costs of Implementing Water Quality-Based Effluent Limits at Publicly-Owned Treatment Works (POTWS) in the Great Lakes Region (External Review Draft). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-07/034A.
<http://oaspub.epa.gov/eims/eimscomm.getfile?p_download_id=461098>

This report describes the potential scope and magnitude of climate change impacts on the cost of meeting water quality based effluent limits at publicly owned treatment works (POTWs) discharging to rivers and streams in the Great Lakes Region (GLR).

Adaptation & Mitigation Strategies

Allen Consulting Group, 2005: Climate Change Risk and Vulnerability: Promoting an Efficient Adaptation Response in Australia. Department of the Environment and Heritage Australian Greenhouse Office, Canberra, Australia. 159pp.
<http://www.climatechange.gov.au/impacts/publications/pubs/risk-vulnerability.pdf>

This report explores the risks to Australia from the impacts of climate change over the next 30 to 50 years. The report takes a risk management approach identifies the sectors and regions that might have the highest priority for adaptation planning.

Anderson, M., 2009: The State of Climate Change Science for Water Resources Operations, Planning, and Management. Public Review Draft. California Department of Water Resources, California. 41pp.
<http://www.waterplan.water.ca.gov/docs/climate_change/CCScience_DWROperations.pdf>

This article assess the state of climate change science available for California water resources operations, planning, and management at the time of the second Climate Action Team (CAT) assessment and Water Plan Update 2009. The document examines observations, paleoclimate, future projections, and planning and assessment tools that are used to inform climate change mitigation and adaptation efforts.

Barsugli, J. and Anderson, C.; 2009: Options for Improving Climate Modeling to Assist Water Utility Planning for Climate Change, prepared for the Water Utilities Climate Alliance.149 pp. <http://www.wucaonline.org/assets/pdf/actions_whitepaper_120909.pdf>

This report concerns how investments in the science of climate change, and in particular climate modeling, can best be directed to help improve the quality of science so that it may be more useful to water utilities and other possible users in adapting to climate change. The main focus of this report is the identification of investments in the science of climate change that, in the opinion of the authors, can best improve the science to support adaptation.

Bolger, R., D. Monsma, R. Nelson, 2009: Sustainable Water Systems: Step One - Redefining the Nation's Infrastructure Challenge. A report of the Aspen Institute's Dialogue on Sustainable Water Infrastructure. 42 pp.
<http://www.aspeninstitute.org/sites/default/files/content/docs/pubs/water_infra_final.pdf>

This study examines the challenges that America's drinking water and wastewater systems are now facing in maintaining and replacing their pipes, treatment plants, and other critical infrastructure. The report offers 10 policy recommendations, three key principles of sustainable water infrastructure, and 20 guiding elements of water management. It attempts to create a "sustainable path forward for the nation," according to its authors.

Brekke, L.D., et al., 2009: Climate Change and Water Resources Management – A Federal Perspective. U.S. Geological Survey Circular 1331, Reston, Virginia. 65 pp.
<http://pubs.usgs.gov/circ/1331/Circ1331.pdf>

This interagency report explores strategies to improve water management by tracking, anticipating, and responding to climate change. This report describes the existing and still needed underpinning science crucial to addressing the many impacts of climate change on water resources management.

California Resources Agency, 2009: California Water Plan Update 2009. Department of Water Resources, Sacramento, CA. <http://www.waterplan.water.ca.gov/cwpu2009/index.cfm>

The Water Plan is a strategic document that describes the role of State government and California's regions in managing the state's water resources. The plan provides a Framework for Action which identifies a number of support activities, including those for adapting to global climate change.

California Resources Agency, 2006: Progress of Incorporating Climate Change into Management of California's Water Resources, Technical Memorandum Report. State of California, Department of Water Resources, Sacramento California, July 2006. 339pp. <http://www.water.ca.gov/climatechange/docs/DWRClimateChangeJuly06.pdf#pagemode=bookmarks&page=1>

This report presents progress and future directions on incorporating climate change science into management of California's water resources. It focuses on assessment methodologies and preliminary study results.

California Resources Agency, 2008: Managing an Uncertain Future: Climate Change Adaptation Strategies for California's Water. California Department of Water Resources, Sacramento, California. 34pp.
<http://www.water.ca.gov/climatechange/docs/ClimateChangeWhitePaper.pdf>

This report focuses discussion on the need for California's water managers to adapt to impacts of climate change and proposes 10 adaptation strategies in four categories.

California Resources Agency, 2009: California Climate Adaptation Strategy Discussion Draft. Public Review Draft. California Department of Water Resources, Sacramento, California. 161pp.
<http://www.energy.ca.gov/2009publications/CNRA-1000-2009-027/CNRA-1000-2009-027-D.PDF>

This draft report summarizes the best known science on climate change impacts in seven specific sectors, including the Water Management sector, and provides recommendations on how to manage against those threats.

California Resources Agency, 2005: California Water Plan Update 2005. Department of Water Resources, Sacramento, California, December 2005.
<http://www.waterplan.water.ca.gov/previous/cwpu2005/index.cfm>

The Water Plan is a strategic document that describes the role of State government and California's regions in managing the state's water resources. The plan provides a Framework for Action which identifies a number of support activities, including those for adapting to global climate change.

City of New York, 2009: The New York City Department of Environmental Protection Climate Change Program, Assessment and Action Plan. 102 pp.
<http://www.nyc.gov/html/dep/pdf/climate/climate_complete.pdf>

This report presents the initial steps that the New York City Department of Environmental Protection (DEP) has taken over the past four years to address climate change. The report includes the findings and recommendations to date of DEP's Climate Change Program and Task Force and the immediate actions that DEP is committed to undertaking to further address this critical issue.

Climate Impacts Group, 2009: The Washington Climate Change Impacts Assessment. Center for Science in the Earth System, Joint Institute for the Study of the Atmosphere and Oceans, University of Washington, Seattle, Washington. 414pp. <http://www.cses.washington.edu/db/pdf/wacciareport681.pdf>

The Assessment addresses the impacts of global climate change over the next 50 years or more on eight sectors: Hydrology and Water Resources, Energy, Agriculture, Salmon, Forests, Coasts, Urban Stormwater Infrastructure, and Human Health. In addition, this Assessment addresses the need for adaptive planning and adaptation options within each sector.

Cromwell, JE, et al., 2007: No Doubt About Climate Change and Its Implications for Water Suppliers. Journal AWWA, Vol. 99, Issue 9, September 2007, Page Range 112-117. 6pp. <http://apps.awwa.org/WaterLibrary/showabstract.aspx?an=JAW_0065067>

This article reviews adaptable measures that water suppliers can incorporate into their ongoing planning efforts to address potential impacts cause by Climate Change.

Easterling, William E. III; et al., 2004: Coping with Global Climate Change: The Role of Adaptation in the United States. Pew Center on Global Climate Change, Arlington, VA. 52pp. <http://www.pewclimate.org/global-warming-in-depth/all_reports/adaptation>

This report discusses the importance of adapting to climate change, the options available for adaptation, and the challenges of implementing them in the United States. The report highlights the importance of anticipating the impacts of climate change and making climate-conscious decisions while designing and investing in long-lived infrastructures, such as water management, transportation and health care systems.

Fleming, Paul, 2009: Presentation: Water and Climate: Observations from Seattle, Water and Climate Change Workshop, Amsterdam, Netherlands. 39 pp. <http://www.agci.org/dB/PPTs/09S1_JKersnar_0922.pdf>

This presentation provides the following: 1) background on Seattle Washington's regional water system; 2) examination of what constitutes climate vulnerability; highlights projected impacts of Climate Change on the water supply in the Seattle area; and describes approaches to enhance adaptation and coping capacities.

Franco, G., 2005: Climate Change Impacts and Adaptation in California. California Energy Commission, Sacramento, California, USA. 41pp. <http://www.energy.ca.gov/2005publications/CEC-500-2005-103/CEC-500-2005-103.PDF>

This paper presents a short review of the existing literature on climate change impacts and adaptation options for California. Specifically, the paper summarizes potential

impacts to key sectors such as the Water sector and identifies adaptation and mitigation options.

Henderson, J.; et al., 2009: Climate Change and Water: International Perspectives on Mitigation and Adaptation. Published By American Water Works Association and International Water Association. 309pp. <http://apps.awwa.org/EbusMain/Default.aspx?TabId=55&ProductID=6683>

This book provides a collection of international scientific papers which address the effects of climate change on urban water and wastewater utilities. Additionally, this book offers scientific findings (as of 2009) on climate change and its increasingly important impacts on fresh water resources and water quality. Case studies within this book provide actual examples of how climate change and global warming are beginning to impact water resources and water utilities.

Hewes, W. and Pitts, K., 2009: Natural Security: How Sustainable Water Strategies Prepare Communities for a Changing Climate. American Rivers. 112pp. <http://www.americanrivers.org/assets/pdfs/reports-and-publications/natural-security-report.pdf>

This report provides eight case studies of communities that have embraced green infrastructure as a means to become more resilient to the impacts of climate change. Each community has taken steps to prepare themselves in four areas: public health, extreme weather, water supply, and quality of life. Each case study demonstrates how water management strategies build resilience to the projected impacts of climate change in that area and how the communities that have adopted them will continue to thrive in an uncertain future.

IPCC, 2007: Summary for Policymakers. In: Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. < http://www.ipcc.ch/ipccreports/ar4-wg3.htm>

This report discusses adaptation, mitigation, the risk associated with rapid and/or abrupt changes in climate, trends in irrigation, as well as the greenhouse gas emissions of wastewater. Relevant chapters include: Chapter 8: Agriculture; Chapter 10: Waste management; Chapter 11: Mitigation from a cross-sectoral perspective; and Chapter 12: Sustainable Development and mitigation.

IPCC, 2007: Climate Change 2007 Synthesis Report Summary for Policymakers. Intergovernmental Panel on Climate Change, Geneva, Switzerland. pp. 52. <http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf>

This report is based on the assessment carried out by the three working groups of the IPCC, and provides an integrated view of climate change as the final part of the IPCC's Fourth Assessment Report. The report addresses six topics: observed changes in climate and their effects on natural and human systems; causes of the observed changes; projections of future climate change and related impacts under different scenarios; adaptation and mitigation options over the next few decades and their interactions with sustainable development; the relationship between adaptation and mitigation on a more conceptual basis and over the long-term; and the major robust findings and remaining key uncertainties in the assessment.

Jeffcoat, Stuart; et al., 2009: Total Water Management Strategies for Utility Master Planning. Journal AWWA, Vol. 101 Issue 2, February 2009, Page Range 56-64. 9pp. http://apps.awwa.org/WaterLibrary/showabstract.aspx?an=JAW_0069595

This article highlights the increasing demands on water resources and the associated stresses of continued population growth, land-use changes, and climate uncertainty and the need for water managers to use more innovative approaches to long-term water management planning. The author discusses the total water management (TWM) approach, which integrates management of the watershed, water supply sources, land-use practices, and related resources to provide sustainable supplies while considering equitable economic and social considerations and promoting a healthy ecosystem.

Kabat P., et al. (Editors), 2002: Coping with Impacts of Climate Variability and Climate Change in Water Management: A Scoping Paper. DWC-Report no. DWCSSO-01(2002), International Secretariat of the Dialogue on Water and Climate, Wageningen, Netherlands. 114pp.
<http://www.cru.uea.ac.uk/~timm/papers/dwc.pdf>

This report offers an overview of outcomes and coping recommendations from the workshop of the International Dialogue on Water and Climate held in Delft in the Netherlands in November 2001.

Lowe, Ashley; et al., 2009: Ask the Climate Question: Adapting to Climate Change Impacts in Urban Regions. Center for Clean Air Policy, New York, N.Y. 44pp.
<http://www.amwa.net/galleries/climate-change/CCAP_Urban_Climate_Adaptation.pdf>

This report highlights the innovative measures local governments are beginning to implement to adapt to the impacts of climate change. The report offers best practices for how cities and counties throughout the country should be thinking about the actions and strategies that can reduce their communities' vulnerability to the dangers of a changing climate.

Matthews, John; et al., 2009: Eco Logic...From the Nature Conservancy -- Managing Water in a Shifting Climate. Journal AWWA, Vol. 101 Issue 8, August 2009, Page Range 28-29, 99. 3pp. <http://apps.awwa.org/WaterLibrary/showabstract.aspx?an=JAW_0070530>

This article discusses the challenges of managing water resources in the context of climate change and outlines five elements that should be considered when adapting water management programs to climate change.

Mathews, K., 2008: Adaptations to Climate Change - The Victoria We Imagine In 50 Years Time. Australian Government National Water Commission, Canberra, Australia. 6pp. <http://www.nwc.gov.au/resources/documents/Adaptations-Climate-Change-PRES-080508.pdf>

This paper outlines 70 snapshots of where Australia might be in 50 years covering the topics of: 1) Urban water security; 2) Urban water use; 3) Water metering and charging; 4) Water ; 5) Charging and pricing; 6) Environmental water management; 7) Irrigation water; 8) Management; 9) Changes to cropping; and 10) Changes to distribution.

Miles, Janet; et al., 2001: Planning for the Effects of Climate Change. Journal AWWA, Vol. 93 Issue 10, October 2001, Page Range 38-40. 3 pp. <http://apps.awwa.org/WaterLibrary/showabstract.aspx?an=JAW_0054850>

This article is part of a continuing series that draws on the findings from the recently completed AWWA Research Foundation (AWWARF) project, "A Strategic Assessment of the Future of Water Utilities". This study examines and provides examples of how climate change could affect a water utility's strategic planning over the next 20 to 25 years.

Miller, Kathleen; et. Al., 2006: Climate Change and Water Resources: A Primer for Municipal Water Providers. AWWA Research Foundation, Denver, CO, USA. 83 pp. <http://books.google.com/books?id=BhhFyiLSEuMC&lpg=PP1&dq=%22Climate%20Change%20and%20Water%20Resources%3A%20A%20Primer%20for%20Municipal%20Water%20Providers%22&pg=PP7#v=onepage&q=&f=false>

This study summarizes the best available scientific evidence on climate change. The goals of this primer are to: 1) Introduce water quality managers to the science of climate change; 2) Suggest the types of impacts it can have on water resources; and 3) Provide guidance on planning and adaptation strategies.

Retamal, M.L.; et al., 2009: The Water-Energy-Climate Nexus - Systems Thinking and Virtuous Circles In Climate Change and Water: International Perspectives On Mitigation and Adaptation. Institute for Sustainable Futures University of Technology, Sydney, Australia. 11pp. <http://www.isf.uts.edu.au/publications/retamal2009climatechange.pdf>

This paper discusses water-energy-climate change issues and the potential consequences and impacts if this fragmented approach continues. It further identifies how systems thinking and applied systems thinking frameworks, such as integrated resource planning, can be used to develop a new range of potential solutions.

Pacific Institute; et al., 2009: Sustaining California Agriculture in an Uncertain Future. A report by the Pacific Institute. 81 pp.<http://www.pacinst.org/reports/california_agriculture/final.pdf>

This report makes the case that California agriculture can flourish despite diminishing water supply and future uncertainty from climate change and advocates for making great strides in increasing the water efficiency of the agricultural sector.

Rosenberg, E.A., et al., 2009: Precipitation Extremes and the Impacts of Climate Change on Stormwater Infrastructure in Washington State. Chapter 9 in the Washington Climate Change Impacts Assessment: Evaluating Washington's Future in a Changing Climate, Climate Impacts Group. University of Washington, Seattle, Washington. <http://cses.washington.edu/db/pdf/wacciach9storminfra652.pdf>

This paper focuses on potential climate change impacts to stormwater management facilities in urban areas. The paper discusses the consequences of inadequate stormwater facilities and available adaptation strategies.

SMEC Australia, 2007: Climate Change Adaptation Actions for Local Government. Department of the Environment and Heritage Australian Greenhouse Office, Canberra, Australia. 71pp. <http://www.climatechange.gov.au/impacts/publications/pubs/local-government.pdf>

This report identifies climate change adaptation actions that are applicable to Australia's climatic conditions and climate impact risks as currently predicted (using CSIRO 2001 scenarios) and that can be implemented by Australian local governments.

Smith, J.B., 2008: Climate Change is Real: How Can Utilities Cope with Potential Risks? OPF, Vol. 34 Iss. 2, February 2008, Page Range 12-17, 6pp. <http://apps.awwa.org/WaterLibrary/showabstract.aspx?an=OPF_0066009>

This article discusses the acceleration of climate change and how it will affect water resources and water utilities, and offers strategies for preparing for future change.

Smith, J.B., et al., 2006: Climate change and its implications for the Rocky Mountain region. Journal of AWWA, Vol. 98, Issue 6, June 2006, pg. 80-92. 13pp. <http://apps.awwa.org/WaterLibrary/showabstract.aspx?an=JAW_0063306>

The analysis within this article is intended to assist water managers in their long-term planning efforts and help ensure that those efforts consider not only population and economic factors but also the implications of climate change.

Thom, Bruce, et al., 2009: National Climate Change Adaptation Research Plan: Settlements and Infrastructure. Public Review Draft. National Climate Change Adaptation Facility, QLD, Australia. 54pp.
<http://www.nccarf.edu.au/userfiles/Settlements%20NARP_consultation_draft_FINAL_23-9-09%281%29.pdf>

This research plan identifies critical gaps in the information needed to address the full range of issues arising from potential impacts of climate change on settlements and infrastructure. Additionally, this research plan will set the priority research agenda for the next 5-7 years to inform a better understanding of climate change risks and impacts on the built environment and how these risks can be managed and impacts reduced through planned adaptation interventions.

U.S. EPA, 2008: Implementing the National Water Program Strategy: Response to Climate Change Progress Report for 2008. Environmental Protection Agency, Office of Water, Washington, D.C..
<http://www.epa.gov/water/climatechange/docs/2008_Implementation_Progress_Report.pdf>

This report provides an update on the implementation of the National Water Program Strategy. It includes: 1) a description of activities by National Program Offices to implement the 44 key actions in the Strategy, 2) a review of implementation of water related climate change activities in EPA Regions, 3) a summary of EPA climate and water related activities not specifically addressed in the Strategy.

U.S. EPA; 2008: National Water Program Strategy: Response to Climate Change. U.S. Environmental Protection Agency, Washington, DC, EPA 800-R-08-001. 114pp.
<http://www.epa.gov/water/climatechange/docs/TO5_DRAFT_CCR_Revised_10-16.pdf>

This report provides an overview of the major impacts of a changing climate on water resources and water programs in the US, describes overall goals for the water program response to climate change, and identifies 44 specific actions for EPA to take to accomplish these goals during 2008 and 2009.

U.S. EPA, 2009: Synthesis of Adaptation Options for Coastal Areas. Environmental Protection Agency, Climate Ready Estuaries Program. EPA 430-F-08-024, Washington, D.C..
<http://www.epa.gov/cre/downloads/CRE_Synthesis_1.09.pdf>

This guide provides a brief introduction to key physical impacts of climate change on estuaries and a review of on-the-ground adaptation options available to coastal managers to reduce their systems' vulnerability to climate change impacts. Key areas of focus include maintaining water quality and availability.

U.S. EPA, 2007: Water Sector Collaboration on Effective Utility Management Fact Sheet. 4pp

Identifies ten attributes of effective utilities and keys to management success in combating problems facing utilities nationwide.
<http://www.peercenter.net/ewebeditpro/items/O73F12973.pdf>

Vicuna, S., et al., 2007: The Sensitivity of California Water Resources to Climate Change Scenarios. Journal of the American Water Resources Association (AWRA). Vol. 43, No. 2. pp. 482-498.
<http://www3.interscience.wiley.com/journal/118544643/abstract>

Using the latest available General Circulation Model (GCM) results, this article presents an assessment of climate change impacts on California hydrology and water resources. The results show that impacts, which translate into smaller stream flows, lower reservoir storage and decreased water supply deliveries and reliability, will be especially pronounced later in the 21st Century and south of the San Francisco bay Delta.

* Wallis, Michael J. et al., 2008: Climate Change: Charting a Water Course in an Uncertain Future. Journal AWWA, Vol. 100 Issue 6, June 2008, Page Range 70-79. 10pp. < http://www.ebmud.com/water_&_environment/environmental_protection/climate_change/awwa_article/Journal-06-08.pdf>

This article presents the findings of a comprehensive case study, conducted by the East Bay Municipal Utility District in California on strategies to mitigate and adapt to climate changes. The information presented in this article is applicable to long-term water supply planning and can assist with decision-making.

Waage, M., 2008: Presentation on Developing New Methods for Incorporating Climatic Uncertainties into Water Planning. Water Utility Climate Alliance. EPA Sustainable Water Infrastructure and Climate Change Workshop, Washington D.C.. 9pp.
<http://www.epa.gov/nrmrl/wswrd/wqm/wrap/pdf/workshop/P3_Waage.pdf>

Presentation highlights the need for new planning methods to address climatic uncertainty with regards to water utility operations. The presentation offers seven steps for adaptation, decision support committee, four planning methods, and outlines the Water Utility Climate Alliances decision support committee activities.

YANG, Y. J., 2009: First National Expert and Stakeholder Workshop on Water Infrastructure Sustainability and Adaptation to Climate Change. In Proceedings, First National Expert and Stakeholder Workshop on Water Infrastructure Sustainability and Adaptation to Climate Change, Washington, DC, January 06 - 09, 2009. U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-09/010. <http://www.epa.gov/nrmrl/wswrd/wqm/wrap/pdf/workshop/600r09010.pdf>

This document covers an EPA Workshop on water infrastructure sustainability and adaptation to climate change held on Jan. 6-7, 2009, in Arlington, VA. The workshop included several plenary sessions, as well as two concurrent tracks: Climate Change Impacts on Hydrology and Water Resource Management; and Adaptive Management and Engineering: Information and Tools. These proceedings include summaries of each of the presentations, as well as the discussion sessions. Where available, hyperlinks are provided to each of the presentations on the EPA Web site.

Planning, Modeling, and Training Tools

Döpp, Sonja, et al., 2009: Climate Change In the Netherlands: Challenges for a Safe and Attractive Urban Environment. Fifth Urban Research Symposium 2009, Marseille, France. 16pp. <http://www.urs2009.net/docs/papers/Dopp.pdf>

This paper discusses possible synergies with climate change mitigation in the Netherlands and summarizes possible urban adaptation measures and describes a systematic approach to their implementation. It concludes with elements for a research agenda.

* Freas, Kathy, et al., 2008: Incorporating Climate Change in Water Planning. Journal AWWA, Vol. 100 Issue 6, June 2008, Page Range 92-99. 8pp. <http://www.ch2m-idc.com/corporate/siww/assets/press/water/13_Total_Water_Management.pdf>

This article argues that two powerful tools, climate change risk assessment and total water management, can be used to determine the vulnerability of water management systems to climate change. This article provides tools, resources, examples, and new, holistic solutions that can be used to manage both the built and natural portions of the water cycle.

McKinsey, 2009: Shaping Climate-Resilient Development. A Framework for Decision-Making. Report of the Economics of Adaptation Working Group. 164pp. <http://www.mckinsey.com/App_Media/Images/Page_Images/Offices/SocialSector/PDF/ECA_Shaping_Climate%20Resilent_Development.pdf>

This report offers a comprehensive and replicable methodology to determine the risks that climate change imposes on economies. It provides a set of tools for decision makers

to adopt a tailored approach for estimating these costs based on local climate conditions, and for building more resilient economies.

* Nelson, B., et al., 2007: In Hot Water: Water Management Strategies to Weather the Effects of Global Warming. Natural Resources Defense Council, Washington D.C. University of California, Santa Barbara, Water Policy Program, Santa Barbara, California. 90pp. <http://www.nrdc.org/globalWarming/hotwater/hotwater.pdf>

This report summarizes the broad potential water management impacts of climate change, the many existing climate-related activities of water managers around the West, and a full range of recommendations for water managers and staff to consider as they incorporate global warming into the planning and management of their agencies.

Groves DG, Yates D,Tebaldi C., 2008: Developing and applying uncertain global climate change projections for regional water management planning. Water Resources Research. <http://www.agu.org/pubs/crossref/2008/2008WR006964.shtml>

This article presents a new method for incorporating information about potential climate change from global models into local- and regional-scale water management models and tools to support local planning. The method is demonstrated by evaluating the possible impact of climate change on the Inland Empire Utilities Agency service area in southern California.

Snover, A.K., et al., 2007: Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments. In association with and published by ICLEI – Local Governments for Sustainability, Oakland, CA. 186pp. < http://www.cses.washington.edu/db/pdf/snoveretalgb574.pdf>

This report is designed to help local, regional, and state governments prepare for climate change by recommending a detailed, easy-to-understand process for climate change preparedness based on familiar resources and tools.

Example Incentive & Voluntary Programs

Cashore, B., 2002: Legitimacy and the Privatization of Environmental Governance: How Non State Market-Driven (NSMD) Governance Systems Gain Rule Making Authority. Governance, Volume 15, Number 4, October 2002 , pp. 503-529(27). < http://www3.interscience.wiley.com/journal/118922237/abstract>

This article examines an analytical framework designed to understand better the emergence of Non State Market-Driven (NSMD) governance systems and the conditions under which they may gain authority to create policy. While the articles empirical focus is

on the case of sustainable forestry certification, it's considered an advanced case of NSMD governance globally.

Koehler, Dinah A., 2007: The Effectiveness of Voluntary Environmental Programs--A Policy at a Crossroads? Policy Studies Journal 35.4 (Nov 2007): 689(34). Expanded Academic ASAP. Gale. Seattle Public Library. 6 Oct. 2009 <http://find.galegroup.com.ezproxy.spl.org:2048/gtx/start.do?prodId=EAIM>

This article presents a summary of research to date that describes and evaluates Voluntary Environmental Programs (VEPs) in the United States. The article focuses on VEPs that target pollution abatement via changes in industrial production processes and not changes to product design, as in various eco-labeling schemes.

Lyon, Thomas P., and John W. Maxwell, 2007: Environmental Public Voluntary Programs Reconsidered. Policy Studies Journal 35.4 (Nov 2007): 723(28). Expanded Academic ASAP. Gale. Seattle Public Library. 6 Oct. 2009 <http://find.galegroup.com.ezproxy.spl.org:2048/gtx/start.do?prodId=EAIM>.

This article discusses Environmental "public voluntary programs" (PVPs), which involve government offers of positive publicity and technical assistance to firms that reach certain environmental goals. The article focuses on the political-economic framework and overall design of PVPs and how they can potentially enhance the diffusion of cost-effective techniques for pollution abatement.

Meidinger, Errol E., 2003: Law Making by Global Civil Society: The Forest Certification Prototype. <http://ssrn.com/abstract=304924>

The purpose of this paper is to elucidate both forest certification and the concept of civil society by locating forest certification in the larger concept of civil society theory and practice. The paper concludes with a review of potential implications of forest certification for global governance.

Morgenstern RD, Shih JS, 2008: Evaluating Voluntary Climate Programs in the United States. RFF Discussion Paper 08-13. <http://www.rff.org/RFF/Documents/RFF-DP-08-13.pdf>

This paper provides an overview of program evaluations conducted to determine the environmental effectiveness of two voluntary climate change programs—the U.S. Environmental Protection Agency's Climate Wise program and the U.S. Department of Energy's Voluntary Reporting of Greenhouse Gases Program, or 1605(b). The paper focuses on the "participation decision" and how various assumptions affect estimates of program outcomes.

Morgenstern RD, Pizer WA, 2007: How Well Do Voluntary Environmental Programs Really Work? *Resources* 2007:23-26.
<http://www.rff.org/rff/News/Features/upload/26490_1.pdf>

This article addresses the effectiveness of voluntary environmental program. The author focuses on voluntary approaches vs. command-and-control regulation and whether voluntary programs are able to act as a substitute for mandatory requirements.

Nash, J, and Larson, T., 2007. Performance-Based Environmental Programs: Literature Review. Draft. October 2007. 47pp.

This document was prepared as part of collaborative project to study the results and outcomes of performance-based environmental programs (PBEPs). Furthermore, this document provides a review of literature related to voluntary programs of which PBEPs are based. The literature reviewed addresses these four major topics: 1) program taxonomies; 2) why firms join PBEPs; 3) Results of participation; and 4) approaches to measurement.

Paton, B., 2000: Voluntary Environmental Initiatives and Sustainable Industry, Business Strategy and the Environment, Vol. 9 No.5, pp.328-38.
< http://www.greeningofindustry.org/gin1999/Paton.pdf>

Considerable uncertainty exists concerning the effectiveness, economic efficiency, equity and transparency of voluntary programs relative to other policy instruments. This paper considers the potential role for voluntary initiatives in the transition toward more sustainable industrial systems, in light of these criteria.

Peacey, J., 2000: The Marine Stewardship Council Fisheries Certification Program: Progress and Challenges. Paper presented at the 2000 conference of the International Institute of Fisheries Economics and Trade, Oregon State University. 5pp.
<http://oregonstate.edu/dept/IIFET/2000/papers/peacey.pdf>

This paper reports on progress in the implementation of the Marine Stewardship Council Fisheries Certification Program—including experience from the certification of the first two fisheries. It also identifies issues facing the Marine Stewardship Council as the Certification Program develops.

U.S. EPA, 2006: Active and Effective Water Security Programs, A Summary Report of the National Drinking Water Advisory Council Recommendations on Water Security. United Stated Environmental Protection Agency, Washington D.C. Office of Water. EPA 817-K-06-001. 12pp.

<http://www.michigan.gov/documents/deq/deq-wb-wws-NDWAC-handbook050106_265803_7.pdf>

This document provides a summary of the water security recommendations of the National Drinking Water Advisory Council (NDWAC). The purpose of this summary is to raise awareness of active and effective security features, resources, incentives, and measures for drinking water and wastewater utilities nationwide. Relevant chapters include: Chapter III - Incentives For Utilities To Develop An Active And Effective Security Program; and Chapter IV - Measures To Assess Improvements In Security Programs.

U.S. EPA, 2007: Building a Powerful and Enduring Brand: The Past, Present, and Future of the ENERGY STAR Brand. Written and designed by Interbrand. 44pp. <http://www.energystar.gov/ia/partners/downloads/ENERGY_STARBndManf508.pdf>

This report provides background information on the art and science of branding, core principles of the ENERGY STAR brand, evolution of the ENERGY STAR brand, future opportunities and challenges, and ways to ensure future success.

Welch, Eric W. Masur A., and Bretschneider S., 2009: Voluntary Behavior by Electric Utilities: Levels of Adoption and Contribution of the Climate Challenge Program to the Reduction Of Carbon Dioxide. Journal of Policy Analysis and Management 19.3 (2000): 407. Discovery, ProQuest. Web. 6 Oct. 2009. <http://proquest.umi.com.ezproxy.spl.org:2048/pqdweb?index=16&sid=1&srchmode=3&vinst=PROD&fmt=3&startpage=-1&clientid=11206&vname=PQD&RQT=309&did=62646205&scaling=FULL&ts=1254862287&vtype=PQD&aid=1&rqt=309&TS=1254862514&clientId=11206&cc=1&TS=1254862514>

This paper analyzes the effect of participation in the Department of Energy's Climate Challenge Program on CO2 emission reduction activity of the largest 50 electric utilities east of the Rocky Mountains from 1995 to 1997. The paper further discusses the development and testing of a two stage model based on the regulatory influence theory. The first stage of the model predicts voluntarism and the second stage uses the predicted values to test how voluntarism contributes to pollution reduction.