Executive Summary

White Paper on Climate Change Impacts on Small and Rural Public Water Systems[1]

Prepared for:

John Regnier
National Rural Water Association (NRWA)
2915 South 13th Street
Duncan, OK 73533

Prepared by:

Frederick W. Pontius, Ph.D.
Pontius Water Consultants, Inc.
6657 W. Ottawa Ave, D-5
Lakewood, CO 80228
303-986-9923
303-716-7310 fax
fredp@pontiuswater.com

June 22, 2010

---

[1] This executive summary and white paper includes a brief review of the science on which climate change/global warming predictions are based, delineating major disputes in these predictions. It is not intended to resolve these disputes, but rather to explain the overall state of the science. The reader is encouraged to obtain copies of and review the Intergovernmental Panel on Climate Change (IPCC) documents and references cited throughout this summary and white paper and offer thoughtful comments for improvement of the white paper to the author at fredp@pontiuswater.com .

I. Introduction

Assessing the impacts of climate change on pubic water systems, and in particular small and rural systems, is a serious undertaking because human lives are at stake. Very large amounts of public monies will be required to mitigate or adapt to the potential impacts being predicted or attributed to "global warming" as a result of atmospheric carbon dioxide (CO_2) and other green house gases (GHGs).

Legislation, regulation, and water utility decisions to mitigate and/or adapt to "global warming" based on incomplete, incorrect, or spurious information may have disastrous consequences because of competing risks. If the phenomenon being labeled "climate change" is primarily driven by natural variations in weather patterns over time and space, then money spent to control GHGs will have little or no benefit.

Virtually every aspect of water system operation could be affected by global warming, climate change, and by any legislation eventually enacted to address GHGs. This includes not only water resources planning, but water system administration, design, operations, water distribution, utility vehicles, and customer service.

This white paper presents a critical evaluation of the possible impacts on small and rural water systems and management/operational techniques or actions that may be indicated as a result of these potential impacts. This evaluation addresses:

- A brief review of the science on which climate change/global warming predictions are based, clearly delineating major disputes in these predictions.
- A review of significant legislative/regulatory initiatives underway or contemplated in this area.
- Identification of specific impacts of a regulatory, operational or other nature that may affect small water systems and suggested approaches to deal with these impacts.

II. Definition of "Climate Change"

The U.S. Environmental Protection Agency (USEPA) defines "climate change as any significant changes in measures of climate (such as temperature, precipitation, or wind) lasting for an extended period (decades or longer)" (USEPA 2010). Such a definition is scientifically ambiguous. There is no agreed-upon uniform scientific criteria that can be applied to define exactly when a permanent change in the climate state has occurred or is occurring. "Climate change"[2] is defined as statistical changes in "measures of climate," which may or may not represent changes in the climate state.[3] Hence, the definition assumes any "change in a measure" is caused by a fundamental change in climate.

In reality, climate and weather are always changing.[4] To determine if "climate change" is occurring, changes in indicators of weather are measured locally at different points on the globe over long periods of time, and analyzed statistically. The measures used and the number of years that constitute an extended period (decades or longer) are arbitrarily defined. Changes in measures of weather (local) become changes in measures of climate (global) as data from many weather stations, extended over a long time (decades or longer) and space (globally), are analyzed using statistical methods and computer models. However, the actual measured data may be interpreted in alternative ways. Meteorologists have long recognized this and, knowing

---

[2] Climate change may result from natural factors, such as changes in the sun's intensity or slow changes in the Earth's orbit around the sun; natural processes within the climate system (e.g. changes in ocean circulation); human activities that change the atmosphere's composition (e.g. through burning fossil fuels) and the land surface (e.g. deforestation, reforestation, urbanization, desertification, etc.).

[3] Climate is usually defined as the "average weather." More precisely, climate is the statistical description in terms of the mean and variability of relevant measures over a period of time ranging from months to thousands of years. The classical period is 3 decades, as defined by the World Meteorological Organization (WMO). These measures are most often surface variables such as temperature, precipitation, and wind. Climate in a broad sense is the state, including a statistical description, of the climate system.

[4] It has been argued that climate is what you expect (e.g. cold winters) and "weather" is what you get (e.g. a blizzard). This distinction is artificial. Climate and climate change are statistical probabilities; Weather is a physical reality. At the local water utility level, climate change is abstract statistical theory; weather is experienced. In reality, "average weather" rarely exists, at least not for very long.

the very complicated nature of weather and climate science, and the difficulties faced in predicting the weather in general, many meteorologists have rejected the idea that computer models can accurately predict future global climate changes. Sophisticated application of statistical methods and impressive models (e.g., models used by the IPCC) to analyze global climate change does not necessarily make the results and output from those models and analyses true.

Climate Change Science

The current state of climate science must be understood in light of the history of the United Nations (U.N.) Intergovernmental Panel on Climate Change (IPCC). From its beginning, the IPCC has functioned as an activist enterprise with an agenda to justify control of the emission of GHGs, and in particular CO_2. As a result, its reports have focused on evidence that supports the thesis of human-induced climate change, while ignoring contrary evidence (Sheth 2010). As a result, each IPCC report issued has generally been marred by controversy. Subsequent research frequently contradicts IPCC report statements. The IPCC organization as a government entity is subject to political influence. It's activities have focused on finding evidence of a human role in climate change. Large professional and financial rewards have gone to scientists and government employees who interpret scientific facts to further the IPCC and government agendas.

When published, many governments and policymakers adopted the 2007 IPCC reports as the benchmark standard on climate change science. Many U.S. government agencies and like-minded organizations simply assumed the IPCC 2007 report was sound and reliable, and proceeded to advocate its findings and conduct additional studies to assess climate change impacts and implement regulatory policies based on the work and models used by the IPCC.

Throughout the development of the first three IPCC reports, voices of educated and well-qualified scientists raised questions regarding the IPCC process and the quality and scientific basis its findings and conclusions (Lott 2008). However, supporters of the IPCC findings, self-assured of their own beliefs about global warming and climate change, began to characterize scientists who disagreed with the IPCC report narrative as "skeptics" and "deniers." These terms are pejorative, and have been used by the press, government agencies, politicians, and IPCC supporters to put those who question the IPCC report on the defensive and to suppress dissent (Max and Ritter 2009). Any scientist who question the IPCC analysis on any level (e.g., scientific, statistical, etc.) are vehemently rebuffed (Enserink 2010) and, in some cases, have had their scientific papers blocked for publication by journal editors (Clarke 2010) and/or biased "peer" reviews (Douglass and Christy 2009, Frank 2010), had funding cuts (Associated Press 2009, Cotter 2010), physical threats (Nelson 2010), and/or forced resignations (Solomon 2010).

Scientists supporting the IPCC have attempted to marginalize others who may disagree with the IPCC analyses and findings, and have relied on name calling (e.g., "skeptic" or "denier"), rather than responding to science-based alternative hypotheses presented by other scientists. The IPCC has not considered available evidence against a human contribution to observed warming, nor has it considered substantial research of the past few years.

For many scientists, the IPCC process and its most recent 2007 reports are unreliable, if not completely erroneous. A variety of errors and problems with the IPCC 2007 report have been reported, as well as problems and limitations of General Circulation Models (GCM) in general. Reasons given for the IPCC's unreliability include the withholding of data from external review, rejecting reviewer comments without a response (Gray 2007), low standards for accepting "peer-reviewed" literature as necessarily authoritative (Idso and Singer 2009), and its reliance upon

unpublished research, news articles, and environmental advocacy group reports (Gray and Lefort 2010, Gunter 2010). Leaked emails and documents from the Climatic Research Unit (CRU) of the University of East Anglia in the United Kingdom, known as “ClimateGate,” show systematic suppression and discrediting of climate skeptics' views, and discarding of temperature data.

The IPCC places too much confidence in the ability of general circulation models (GCMs) to simulate future climate and attribute observed climate change to anthropogenic emissions of greenhouse gases. Global and regional climate models are not able to predict regional and local climate change and variability (Pielke Sr. 2008). Climate models cannot be tested by comparing models with other models. Attribution cannot be based on the ability or lack thereof of faulty models to simulate a small portion of the climate record (Lindzen 2010). Models simply do not portray well the underlying basic physics.

Alternative explanations that fit observable data have been put forth to explain the general warming that has been observed over the prior 100 years that do not involve a significant role of CO_2. Such evidence for alternative explanations of climate change has been ignored by the IPCC. For political expediency the IPCC has narrowly focused all of its energy and resources on advocating one possible hypothesis (CO_2 and GHGs) for explaining observed warming trends (and predicting future climate change) while ignoring or attempting to discredit alternative hypotheses and those scientists who raise them. U.S. government agencies have followed suit, and largely dictate the focus of scientific activity for or against a particular hypothesis. As a result, many professional societies, research centers, universities, and nonprofit organizations, focus their efforts primarily on lobbying government agencies to gain special advantage and funding, often with little regard for the quality or basis of the study being funded (Carlin 2010).

Under pressure from the criticisms of the IPCC 2007 report and ClimateGate, some activists and scientists are on the defensive and are speaking out. Activist scientists and politicians have initiated OpEd articles (Emanuel 2010), letters to the editor (Gleick et al. 2010), and more drastic actions to fight back by taking an aggressive approach to gut the credibility of those who disagree with them (Dinan 2010, Broder 2010). Such actions include hearings before the House Select Committee on Energy Independence and Global Warming to address the claims of "deniers," and publication of a blacklist of researchers in the *Proceedings of the National Academy of Sciences*.

Legislative Initiatives

In 2009, advocates in U.S. Congress introduced legislation to address global warming, climate change, as well as energy development. Hearings were held in the House of Representatives, resulting in the passage of H.R. 2454, the American Clean Energy and Security Act of 2009 (also known as the Waxman-Markey bill, Cap-and-Trade bill, or Cap-and-Tax bill). The bill is intended to create clean energy jobs, achieve energy independence, reduce global warming pollution, and transition to a clean energy economy. The 1,427-page bill would restrict greenhouse gas emissions from industry, and mainly carbon dioxide from the combustion of coal, oil, and natural gas. The bill is projected to have a very high household cost (Beach et al. 2009), while not significantly lowering global temperatures (Knappenberger 2009). The bill is awaiting action in the Senate.

The House cap-and-trade bill (H.R. 2454) does not have support in the Senate, and therefore a new Senate bill is in the works. Senators John Kerry (D-Mass.) and Joe Lieberman (I-Conn.) have been conducting climate bill negotiations across the Senate, and have released a draft of their climate bill, known as Kerry-Lieberman Climate Bill. The bill has not been

formally introduced and its provisions are still being negotiated. It is expected to be taken up in the Senate in June 2010.

Regulatory Initiatives

Climate change-related regulatory activities are underway by USEPA. Many of these activities will directly and indirectly affect small water systems. The more significant regulatory actions include USEPA's USEPA's Endangerment Finding Declared That CO_2 and Five Other Greenhouses Gases Are Pollutants; USEPA Final Standard to Limit Greenhouse Gas Emissions From Vehicles; USEPA Rule on Economy-Wide Greenhouse Gas Emissions Reporting; USEPA Seeks To Require Emissions Reporting For Three Additional Facilities; EPA Seeks To Require Emissions Reporting For Four Additional Facilities; and USEPA Greenhouse Gas Tailoring Rule.

USEPA has established a Climate Ready Water Utilities (CRWU) Work Group of the National Drinking Water Advisory Council (NDWAC) to evaluate the concept of "Climate Ready Water Utilities" and provide recommendations on the development of an effective program for drinking water and wastewater utilities. As with other government agencies, the activities of USEPA and the CRWU assume the results of the IPCC 2007 report are credible. No allowance is made for new science or alternative, but equally credible, views of climate change other than the IPCC narrative. The CRWU's primary mission is to advise USEPA on how to develop and increase their regulatory programs. The CRWU is considering the experiences of Australia, where increased government control is being used to force water system consolidation and force implementation of other measures to address climate change.

Impacts and Adaptation

Several governmental agencies and non-governmental organizations have conducted studies, developed web sites, and held workshops to assess the impact of climate change on water systems. The information and recommendations presented in existing web sites and documents focus on a national perspective. The practical needs of small and rural water systems are not generally addressed.

Practically, planning for climate change is no different than typical vulnerability assessment, and water resources and emergency planning. At a local level, identify reasonable future scenarios of expected climate change, and systematically consider the potential effects on resources, treatment, operation, distribution, management, customer service, and regulatory compliance.

Recommendations for Small Systems

1. **Small water systems should assess their infrastructure and strategically plan to provide potable to their customers under reasonably expected long-term weather changes and extremes. In most respects, planning for climate change is no different than conventional water resources and emergency planning.** Climate and climate change are a statistical probabilities; Weather is a physical reality. At the local water utility level, climate change is abstract statistical theory; we experience weather and weather changes, we do not experience statistics nor statistical changes. Weather changes form and magnitude day-to-day, month-to-month, season-to-season, over both space and time.

2. **Small water systems must consider that because of natural variability, the weather experienced in a particular area (especially rural areas) may or may not follow general global, country-wide, or regional trends.** Therefore, small water systems should be prepared to adapt to extended periods of both warming and cooling. For example, catastrophic flooding (e.g., occurred in Nashville) may occur anytime as a result of natural weather variability without regard to warming or cooling or atmospheric CO_2.

3. **Existing IPCC computer models are limited and do not produce sufficiently reliable results to be used for strategic planning or assessing climate change impacts at any geographical scale (e.g., local utility, regional, national, global).** Indeed, the results of such models to predict future temperatures, rainfall, or other measures of weather may have no relationship whatsoever to the weather actually experienced by a small and rural

water system over space (geographical location) and time (daily, weekly, monthly, yearly). Small and rural water systems should develop reasonable local planning scenarios based on their own historical experiences, with assistance from trustworthy experts to develop future scenarios. Future scenarios should consider reasonable changes in temperature (warming/cooling); changes in precipitation (flooding/drought); changes in prevailing winds; changes in vegetation (less/more); changes in sea, lake, or reservoir levels (rising/falling); changes in intensity (stronger/weaker); changing ground water tables (lowering/increasing) and others.

4. **Temperature changes are greater in urban areas due to the Urban Heat Island Effect (UHIE). The UHIE does not appear to effect atmospheric temperatures in rural areas.** Therefore, Earth-based weather station measurements in urban areas are not applicable to rural areas. Small and rural water systems should identify the closest National Weather Service monitoring station to their location. If that weather station does not adequately represent the area where the small system is located, then the small system (or group of systems in a local area) should consider establishing their own weather station, giving careful consideration to the weather parameters measured and the station location so as not to bias the measurements. Such data may not be useful for several decades, but is necessary if forecasting models (once improved) are to be useful in the future.

5. **A general global cooling trend has been observed since 1998, and is projected by some solar scientists to extend for the next several decades.** Since the affects of global cooling have a greater public health impact than warming, small water systems should pay particular attention to and plan for the affects of extended colder weather periods.

6. **Climate change science is by no means settled, including the role of CO_2. Indeed, carbon footprints will likely have no relevance to future weather variability experienced by small and rural water systems.** Given the conflicts of interest and political nature of the IPCC, the NRC, the NAS, the USEPA, and the CRWU work group, these and other agencies will likely continue to assume the IPCC narrative to be true, and resist fair consideration of alternative hypotheses and contrary data. However, as has been demonstrated time and again over many centuries, the best science will in the end ultimately emerge and prevail. Regardless of the position of the IPCC, NRC, USEPA, CRWU work group and other organizations, small and rural water systems must keep abreast of the latest developments in the underlying climate change science, and make decisions based on the best available science, eliminating information that is propaganda in nature. Recommendations for assessing climate science are presented below.

7. **Small and rural water system organizations (NRWA) should consider developing a web site focused on digesting the technical information available on climate change into an unbiased form that is useful to small and rural water systems.** Practical scientific and technical information on climate change useful to small and rural water systems is very limited at this time. Most web sites are focused on national policy, promoting IPCC-style modeling, promoting control of carbon footprints, promoting the biases and agenda of the particular government or non-government agency, disseminating

information with a particular point of view, or attempting to seek favor or funding from government agencies.

8. **Any federal legislation and/or regulations to control GHG emissions using a cap-and-trade system, carbon tax, or other means that raise the cost of energy will adversely affect small and rural water systems by forcing increases in water rates with little or no measurable benefit.** Assessments of legislation pending and being considered in Congress indicate that little benefit will be achieved if implemented, but individual households and small and rural water systems will face real cost increases.

Recommendations for Assessing Climate Science

The following recommendations to small and rural water systems are made regarding assessing climate science for strategic planning and adaptation:

1. ***Find Trustworthy Experts.***

2. ***Take into account direct and indirect conflicts of interest, including those of government agencies, government funded research centers, scientific academies, and professional organizations.***

3. ***When the term "climate change" or "global warming" is used in a report, in a regulation, or in testimony, insist on clear definitions. Give careful attention to fairly evaluating scientific methods and findings.***

4. ***Allow room for "new" scientific findings, even if contrary to prior "facts," especially when computer models are involved. Modify hypotheses and models based on new studies, properly peer-reviewed.***

5. ***Avoid drawing conclusions based on extending science beyond what is known or can be reliably tested.***

Decision makers are often in the position of having to act in the face of incomplete information. In the case of climate change and presumed long-term global warming, the consequences of a poor decision now will be high (either in terms of unnecessarily high costs, or avoidable loss of life and property, or both). Clearly, a better understanding of climate science is needed to ensure that laws and regulations enacted to mitigate and/or adapt to climate change impacts do not proceed down a path resulting in more harm than good. At present, at a national level, the best strategy would be to do nothing until a better understanding of climate science is

achieved. However, small and rural water systems should proceed now at the local level with appropriate vulnerability assessments, strategic, and emergency planning based on reasonable climate change scenarios.