

PUBLIC COMMENTS: SAP 4.6

Reviewer Name	Affiliation	Chpt	Pg	Ln	Comment	Authors' Response to Comment
William L. Fang and Eric Holdsworth	EEI	1	1	15	EEI observes that this chapter and the other chapters of the draft, except Chapter 5, fail to include a “Table of Contents”. We believe the draft would be enhanced by the addition of such a contents table in the Introduction.	We agree. Each chapter will include a table of contents.
J. Alan Roberson	AWWA	1	4	NA	<i>(This comment is duplicated for Chapter 4)</i> Drinking water utilities would benefit from more quantitative climate projections at smaller (more local) scales The Report points out that it does not make quantitative projections of specific impacts for specific locations, rather it points to vulnerabilities, and where possible the direction and magnitude of potential changes. This is important in providing a broad view of potential climate impacts. However, the scale of this type of information can make it difficult to utilize for planning agencies, including water utilities. As a next step, more quantitative analyses should be done on smaller, regional scales. If possible, watersheds should be looked at individually and methods for improving climate projections on smaller scales should be conducted. The Report acknowledges this idea in Chapter 4 (p. 25), where the suggestions regarding future research needs are made. The first point (lines 22-23), suggests increasing the number of case studies that will examine the effects of global climate change on human settlements in a variety of locations across the country. The Report also points out previous research that examined climate impacts on certain large U.S. cities (i.e. Chapter 4, p. 8, Table 1). In the context of drinking water utilities, the Awwa Research Foundation (AwwaRF) has conducted research with the National Center for Atmospheric Research (NCAR), including AwwaRF project 3132 entitled “Incorporating Climate Change Information in Water Utility Planning: A Collaborative, Decision-Analytic Approach” (ongoing), where a case study approach has been adopted. Nevertheless, more case studies should be conducted, especially in places that are more vulnerable to climate change, which as the Report points out, are also mainly areas that will experience population growth. The AwwaRF/NCAR collaboration also addresses the second point (p. 25, lines 25-26), which is to develop better	<p>This comment is incorporated in the Chapter 5 in recommended research and data gaps. We agree that methods for improving climate pojections on smaller scales are important to pursue.</p> <p>We agree that more case studies should be conducted in places that are more vulnerable to climate change.</p> <p>Language suggested here will be included in the new chapter 5 on research recommendations.</p>

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					<p>projections at the scale of U.S. metropolitan areas or smaller. In the AwwaRF/NCAR project, multi-model Bayesian methods (e.g. Tebaldi et al., 2005) are utilized to create climate projections, and then a nearest neighbor downscaling tool (e.g. Yates et al., 2003) is used. These sophisticated statistical tools could benefit from further research and testing. The Report also acknowledges that changes in climate extremes are very often of more concern than changes in climate averages (Chapter 4, p. 14). Thus, extreme value statistics and their applications (e.g. Gilleland and Katz, 2006) should continue to be developed for use in climate change projections.</p>	
William L. Fang and Eric Holdsworth	EEI	1	4	8 to 13	<p>These lines 3-13 note that climate models are projecting “warming in the intermountain West” affecting the sources of water flows for lower elevation rivers and that “[t]hese changes are affecting rapidly-developing cities in the West and exacerbating water allocation controversies”. We think that these comments about the impact of “warming” need to recognize that water capacity and availability, with or without warming, is also exacerbated by the increasing development of not only cities, but also other “settlements” of the West, and that development is, at least, a significant contributing factor to reduced water sources and supply in this region, even without drought. Climate change may be another contributing factor to, for example, water issues arising under western water allocation law.</p>	<p>We agree. The text will be revised to note that development in the West is a significant contributing factor to reduced water sources and supply in the region, even without drought.</p>
William L. Fang and Eric Holdsworth	EEI	1	5	3 to 17	<p>Section 1.2 of the Introduction (pages 4-5) purports to summarize “observed changes in the global climate”, as reported by “Alley, R. et al.”, from the Summary for Policymakers (SPM) by Working Group I to the 4th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). The bulleted selection of “general findings” are all in quotation marks, which suggests that the material therein is quoted exactly and accurately.. However, a comparison of those “findings” with the actual Working Group I’s SPM indicates that some of the bulleted findings are not quoted accurately and some appear to not include relevant and important words, phases, and sentences. We believe it important that if the selected findings are to be included in the draft as quoted “findings of the Fourth Assessment,” they should be accurately quoted and fully reflect the SPM. Thus, we recommend the following changes</p>	<p>We agree and we have incorporated the suggested edits to the text.</p>

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					<p>or corrections:</p> <p>Bullet finding No. 2, p.5, lines 6-7, after the “years” insert “(1995-2006)” and before the period at the end of the finding, insert “(since 1850)”. (see SPM, WGI, p.5)</p> <p>Bullet finding No. 3, p.5, line 8, should be revised to read as follows: “Urban heat island effects are real but local, and have a negligible influence (less than 0.006°C pre decade over land and zero over the oceans) on these values.” (see SPM, WGI, p. 5)</p> <p>Bullet finding No. 4, p.5, lines 9-10, should be revised to read as follows: “Observations since 1961 show that the average temperature of the global ocean has been absorbing more than 80% of the heat added to the climate system. Such warming causes sea water to expand, contributing to sea level rise.” (see SPM, WGI, p.7)</p> <p>Bullet finding No. 7, p.5, lines 14-15, should be revised to read as follows: “Widespread changes in extreme temperatures have been observed over the last 50 years. Cold days, cold nights, and frost have become less frequent, while hot days, hot nights, and heat waves have become more frequent. “(see Table SPM-2).” (see SPM, WGI, p. 8)</p> <p>Bullet finding No. 8, lines 16-17, should be revised to read as follows: “There is observational evidence for an increase of intense tropical cyclone activity in the North Atlantic since about 1970, correlated with increases of tropical sea surface temperatures. * * * Multi-decadal variability and the quality of the tropical cyclone records prior to routine satellite observations in about 1970 complicate the detection of long-term trends in tropical cyclone activity. There is no clear trend in the annual numbers of tropical cyclones.” (see SPM, WGI, p.8)</p> <p>In light of the title to this section of the Introduction (i.e., “1.2 Climate Variability and Change in the United States: Context for an Assessment of Impacts on Human Systems”), we question the listing of the above bulleted findings as “context” for Chapters 2-5 of the draft because all relate to global climate change, not to climate change just “in the United States”. (emphasis added)</p>	
J. Alan Roberson	AWWA	1	6	Figure 1	Figure 1 shows observed trends in annual average temperature and precipitation, both showing increases. The Report might benefit from some discussion of factors that contribute to the	We agree. We are incorporating discussion of factors that contribute to natural variability of climate variables.

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					natural variability of these climate variables, including large-scale atmospheric circulation patterns, such as the Southern Oscillation (i.e. El Nino, etc).	
William L. Fang and Eric Holdsworth	EEI	1	7	32	The attribution of climate change to increases in tropical storm and hurricane severity have not been demonstrated by any scientific study as pointed out properly on page 7 line 30. Page 7 line 32 should therefore be removed or if retained combined with a statement stating "despite increases in global temperature no definitive increases in tropical storm/hurricane intensity or frequency have been documented". For additional information, please see the World Meteorological Organization at: http://www.un.org/apps/news/story.asp?NewsID=20952&cr=weather&Cr1=	We disagree. We retain the language which is consistent with the science. See: references
William L. Fang and Eric Holdsworth	EEI	1	7	34 to 40	We note that under the title "Extremes", the draft states (p.7) that "[a]lthough no single extreme event can be directly attributed to climate change, many events typical of what is likely" (meaning, we assume, "66% probability", according to Table 1 of the draft, p. 14) "we can expect in the future (Alley et al., 2007) have occurred in recent decades. These include the very warm summers and prolonged heat waves of 1988, 1995, 1998, 1999 and 2006 . . .". The draft adds that "[t]hese heat waves", but apparently not the "very warm summers", "affected air quality and led to significant increases in heat-related morbidity and mortality, particularly in urban areas . . .". (emphasis added) The draft's "Glossary" (p. 6 of Appendix 1) distinguishes between the terms "extreme weather event" and "extreme climate event" and defines both. However, we note the absence of a reference to, or definition of, the term "extreme event". We, however, question the appropriateness of the term, which obviously cannot be classified as either an "extreme" weather or climate event. Moreover, the glossary for the IPCC's 4th Assessment WGI SPM, in defining the term "[e]xtreme weather event," states that "[s]ingle extreme events" cannot be simply and directly be attributed to anthropogenic climate change, as there is always a finite chance the event in question might have occurred naturally." That SPM Glossary adds "[W]hen a pattern of extreme weather persists for some time, such as a season, it may be classed as an extreme climate event, especially if it yields an average or total that is itself extreme (e.g., drought or heavy	Point well made and well taken. Glossary terms added for extreme weather event and extreme climate event.

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					rainfall over a season).” (emphasis added) In short, we question the use of the term “extreme event” in this context, particularly in reference to “warm summers” and in the light of the SPM explanations. We suggest that these lines should either be revised, consistent with the SPM and the draft’s glossary, or deleted entirely.	
William L. Fang and Eric Holdsworth	EEI	1	8	8 to 9	The World Meteorological Organization article cited above contradicts the statement found on page 8, line 8-9. Additionally a formal NOAA study (spring of 2007) that focused on hurricane intensity in a warmed world found hurricane frequency and intensity would actually be mitigated (for more details, see: http://www.noaa.gov/stories2007/s2840.htm). These findings contradict lines 8 and 9, and for completeness should be included in this document here. Alternatively, lines 8-9 and similar lines throughout the document should be removed.	No change made.
William L. Fang and Eric Holdsworth	EEI	1	8	8 to 9	A World Meteorological Organization article – http://www.un.org/apps/news/story.asp?NewsID=20952&cr=weather&Cr1= – contradicts the statement found on page 8, line 8-9. Additionally a formal NOAA study (spring of 2007) that focused on hurricane intensity in a warmed world found hurricane frequency and intensity would actually be mitigated (for more details, see: http://www.noaa.gov/stories2007/s2840.htm). These findings contradict lines 8 and 9, and for completeness should be included in this document here. Alternatively, lines 8-9 and similar lines throughout the document should be removed. [Note: this comment is a clarification of a comment on the same section of the report submitted as part of separate 31-page EEI comments, the difference being the addition of the WMO article link.]	No change made. Neither of these citations are in the peer-reviewed literature.
William L. Fang and Eric Holdsworth	EEI	2	4 to 5	Page 4 Line 27 to Page 5 Line 4	This paragraph states that “[h]igher temperatures are expected to raise sea level by expanding ocean water, melting glaciers and causing ice sheets in Greenland and the Antarctic to melt.” (emphasis added) We are concerned with the use of the words “are expected” in the paragraph, particularly in light of section 1.4 of the draft regarding uncertainty, likelihood, and confidence. Webster’s New World College Dictionary, 4th Ed., 2005 defines that the word “expect” as meaning “(1) to look for as likely to occur	Change made where needed. NOTE: the Chapter 2 portion of the original draft document is being deleted in part and transferred in part to Chapter 1. These concerns are addressed in that process.

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					<p>or appear”. It explains that “expect implies a considerable degree of confidence that a particular event will happen” (p. 500). However, the word “expect” is not part of the “Likelihood Terminology”, Table 1 on p. 14 of the draft’s Introduction. The word “expect” should not be a substitute for the use of such terminology, assuming such use is warranted.</p> <p>More importantly, the Summary for Policymakers (SPM) by Working Group I of the 4th Assessment Report of the Intergovernmental Report on Climate Change (IPCC) states (p. 14):</p> <p>Models used to date do not include uncertainties in climate-carbon cycle feedback nor do they include the full effects of changes in ice sheet flow, because a basis in published literature is lacking. The projections include a contribution due to increased ice flow from Greenland and Antarctica at the rates observed for 1993-2003, but these flow rates could increase or decrease in the future. (emphasis added)</p> <p>Also, the November 24, 2006 edition of SCIENCE contains an article by Amy Cazenave, Observatorre Midi Pyrennes (Toulouse, France), who notes (p. 1250) that while global sea level has risen since the 19th century, it remains unclear whether the recent rate increase reflects an acceleration in sea level rise, or a natural fluctuation on a decadal scale.” She points out that recent studies of Greenland and Antarctic ice sheets showing accelerated ice mass loss since 2002 show results that are “highly scattered”.</p> <p>Also, EEI is greatly concerned about the lack of emphasis in the introduction on “adaptation” by both the public and private sectors. In recent responses to questions on climate change issues by the House Committee on Energy and Commerce, EEI stressed the legislative importance of adaptation with mitigation efforts. Thus, we are concerned about the sentence that begins on p. 4, line 34 and ends on p. 5, line 2 that states that some adaptation efforts “(such as replenishing beaches and constructing seawalls)”to combat sea level rise could have other adverse effects. We note that for most, if not all, of the statements or contentions of this draft chapter 2 there is no source reference in support of such a statement. Indeed, this and other statements in the overall chapter give the impression of fact and certainty. Yet there is nothing in the chapter that gives support in the literature or</p>	

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					elsewhere for this or other such broad statements. Moreover, in section 4.3 of the draft, p. 18, line 26 on “Potentials for Adaptation to Climate Change in Human Settlements” reference is made to anticipatory actions “to avoid damages and costs, such as ‘hardening’ of coastal structures to sea-level rise”.	
William L. Fang and Eric Holdsworth	EEI	2	2	29 to 30, 33 to 34	<p>The sentence beginning on line 29, states that “[p]rojected climate change is expected to exert significant effects on individuals and communities across” the U.S. There is no source or basis provided for such a projection. Moreover, the word “expect” is defined in Webster’s New World College Dictionary, 4th Ed., 2005 as meaning “(1) to look for as likely to occur or appear”. It explains that the word “expect” “implies a considerable degree of confidence that a particular event will happen” (p. 500). (emphasis added) If the authors believe such a “likelihood” exists, they should provide the estimate of probability in accordance with Table 1 of Chapter 1 of the draft (p. 14) and not use words such as “expected” as a substitute, assuming such use is warranted.</p> <p>The word “climate” appears twice on line 34 in reference to the “worsening ambient air pollution” and the “indirect effects” of climate on “disease”. We question the use, in both cases, of the term “climate” in light of the definition of the term in the draft’s Glossary, Appendix 1, p.2, which speaks of “average weather” in the “narrow sense” or “more vigorously as the statistical description in terms of mean and variability of relevant quantities over a period of time”, which ranges from “months” to many “years”.</p> <p>In regards to the reference to “ambient air pollution”, we think that the more appropriate reference is to “ambient air quality” because we believe it is the air quality that is potentially affected by climate change and the term “air pollution” is primarily a legislative term defined in various statutes, such as the Clean Air Act. We also do not understand the use hereof the word “large”. We therefore recommend that the sentence beginning on line 33, p. 2, consistent with our comments, be revised to read as follows: “Climate change is also realized in indirect effects, such as on the worsening of ambient air quality and on disease transmission dynamics”.</p>	<p>Change made to exchange “expected” to “may exert”.</p> <p>We are following the recommendation that the sentence beginning on line 33, p. 2, consistent with our comments, be revised to read as follows: “Climate change is also realized in indirect effects, such as on the worsening of ambient air quality and on disease transmission dynamics”.</p>
J. Alan Roberson	AWWA	2	3	3	The Report states “Coping with the consequences of decreased precipitation...” The term “decreased precipitation” may be misleading, since changes in	We agree. The passage will be edited to say “changes in precipitation patterns”

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					precipitation direction depend on location and precipitation events are increasing in intensity. This could be edited to say: "shifts in precipitation patterns".	
J. Alan Roberson	AWWA	2	4	NA	Sea level rise may affect the quality of water for drinking water utilities. The Report explains that "sea level rise increases salinity in bays and estuaries". This could be a problem for drinking water utilities on the coasts. An example location that might be impacted is the Sacramento-San Joaquin Delta and the San Francisco Bay, which form a large estuary in California. If the salt-line were to move up the estuary, it could cause problems with bromide and salinity for drinking water treatment plants. Bromide can cause a problem for plants that use ozone as a disinfectant, as ozone and bromide react to form bromate, which is a disinfection-by-product that is regulated. Sea level rise also has the potential to make ground waters more vulnerable to saltwater intrusion.	We agree. We will include a more detailed discussion of bromide and salinity for drinking water treatment plants.
J. Alan Roberson	AWWA	2	4	NA	<i>(This comment is duplicated for Chapter 4)</i> Changes in snow characteristics will affect drinking water utilities It has been shown that since the middle of the 20th century, the volume of snow pack in most locations in the western United States has been shown to decrease (e.g. Mote et al., 2005) and an earlier onset of spring snowmelt has been observed (e.g. Stewart et al., 2005). Changes in snow pack and in runoff timing events have profound implications for water managers. By diminishing the natural storage and by receiving flows before peak demand, areas that do not have adequate reservoir capacity risk losing freshwater supplies to the ocean. In addition, earlier snowmelt coupled with a warmer and drier summer season increases the risks of water shortages, droughts, and wildfires. Changes in in-stream flows will affect source water quality. Reduced summer stream flows are mentioned in the Report. Reduced summer stream flows will impact drinking water utilities, especially since summer is when demand is highest. In many places, in-stream flows will become dominated with wastewater effluent for much of the year. This raises issues of human health, especially regarding personal care products and endocrine disrupters that are commonly found in these wastewater streams. Preliminary research is only beginning to unveil the possible health effects of these compounds in	We agree. We are including some of the language in these three paragraphs to expand on impacts for drinking water utilities.

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					<p>drinking water.</p> <p>Reservoir management will be impacted by climate change. As the hydrologic cycle changes, reservoir management will be impacted. Reservoirs are often managed for multiple functions, including drinking water storage, navigation, hydropower, and in-stream flow releases. Changing trends in snow characteristics, such as reduced snow pack and earlier runoff, as well as shorter and more intense rainfall can cause problems for reservoir management. This can create difficulties for water utilities, as they compete with other demands on over-allocated water resources.</p>	
William L. Fang and Eric Holdsworth	EEI	2	5	6 to 15	<p>This paragraph begins in the first sentence by reference to “observational” evidence of increases in precipitation in the past and “widespread increases in the frequency of heavy precipitation events across the United States are projected for the future”. However, as in other paragraphs of the chapter, there are no sources or references for these “observations” and projections. Nevertheless, in the second sentence of the paragraph, the observations of the first sentence are referred to as “findings”, saying they “are consistent with observed and projected warming”. We point out that Webster’s New World College Dictionary, 4th Ed., 2005, defines the word “observation” as meaning “. . . (2a) the act, practice, or power of noticing . . . (3) the fact of being seen or noticed . . . (4a) the act or practice of noting and recoding facts or events, as for some scientific study . . .” (p. 996). It also defines the word “finding” as meaning “. . . (4) [often pl.] the conclusion reached after an examination or consideration of facts or data by a judge, coroner, scholar, etc.” (p. 531). We think the use of the word “findings” in reference to mere observations is inappropriate, particularly in regards to future projections.</p>	<p>We agree and are revising this passage to clarify the use of the word “findings”.</p>
John Kinsman	EEI	2	5	17 to 24	<p>Regarding Urban Heat, it is not clear why urban heat island effect would be more pronounced in the future than it is now.</p>	<p>It is generally agreed that warming temperatures in densely populated areas is expected to contribute to the urban heat island effect.</p>
William L. Fang and Eric Holdsworth	EEI	2	6	9 to 10	<p>We question the reference to “declining costs of airline travel” as having contributed to making “previously remote locations” in the U.S. “more accessible for work, recreation, or retirement.” We believe the growing availability of transportation facilities and infrastructure can be claimed as a significant factor in combination with others in opening such areas, but doubt the impact of such “costs” of air travel as</p>	<p>We agree. We will use a reference to such facilities and infrastructure in lieu of “declining costs” of air travel.</p>

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					being a significant factor. We suggest therefore a reference to such facilities and infrastructure in lieu of “declining costs” of air travel.	
John Kinsman	EEI	2	7	Table 1	Under Row “Temperature”, one of the future effects is stated to be “worsening of air quality”. This should be changed to “increases in ozone concentrations” to avoid the perception that other aspects of air quality would be degraded.	We agree. This edit has been made.
John Kinsman	EEI	2	11	Box 3	Text in this box, titled “Wildfire and the degradation of air quality,” that is not related to wildfire – e.g., the statistic related to mortality and health care costs related to ozone and particulate matter – should be removed. If the title is changed and the current write-up retained, then NOAA should consider the fact that these statements from a 2003 report by the California Climate Change Center are inconsistent with and more extreme than those throughout the rest of this CCSP report.	This paragraph stands. It fairly represents the citation included.
Kim Knowlton and Gina Solomon	NRDC	2	12	19 to 29	<i>(This comment is duplicated for App I)</i> Climate disruptions on a global scale are already causing millions of people to relocate into new areas, and there should be more discussion of the potential effects of these “environmental refugees” on US civil society. UN University (UNU) predicts that “by 2010 the world will need to cope with as many as 50 million people escaping the effects of creeping environmental deterioration,” noting that sea level rise, increasing desertification and catastrophic weather-induced flooding have already contributed to large permanent migrations. Although mentioned here in Chapter 2, if the United States becomes a refuge in the future for those people forced to leave their former homes after climate change-related disasters, there could be tremendous impacts on the economic and public health infrastructure in the US. Most such displaced people today migrate within their own country, as evidenced by post-hurricane relocations in 2005, but many others cross national borders. The term “environmental refugee” needs further clarification to address the compound environmental, economic and political motives behind migration, yet it should become part of the domestic US lexicon. Plans for how US civil society could adapt and provide the necessary services for periodic sudden influxes of “environmental refugees” is among the challenging topics that should be discussed in more detail in Chapter 5 on Human Welfare, and added to the Glossary of key terms in Appendix I.	We agree. Point well taken and language will be incorporated to expand on this issue in both Chapter 2 and the Glossary.

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Kim Knowlton and Gina Solomon	NRDC	2	13	28 to 29	The human health benefit conferred by air conditioning has only been documented for central air conditioning systems, to which many US residents do not have access. In many US cities, older housing stock and apartment complexes lack central air conditioning systems, and landlord-provided window air conditioning units may also be absent. US studies have found that while central air conditioning can mitigate the adverse effects of heat stress, room units provide no statistically significant benefit compared to no air conditioning. , Economically disadvantaged households are often unable to afford to purchase, operate, or repair air conditioning units. A recent study in four large US cities showed the prevalence of central air conditioning among African-American households was less than half that among white households, and deaths were more strongly associated with heat. Summer heat waves in 2006 in New York City and the state of California showed that, among those who died from the heat were individuals who owned a working air conditioner at the time of death but chose not to use it, perhaps for economic reasons or with the expectation that overnight outdoor temperatures would afford some cooling relief, which they did not. The Draft SAP 4.6 alludes to some of the environmental justice issues inherent in differential exposures to extreme heat, but we suggest not furthering the impression that there has been nor will there continue to be a “nearly universal spread of air conditioning” in the US.	We appreciate this more finely tuned discussion of the impacts of air conditioning on vulnerability to heat.
William L. Fang and Eric Holdsworth	EEI	2	17	27	<i>(This comment is duplicated for Chapter 4 and Chapter 5)</i> In Chapter 4 (Page 2 Line 10-11), the reference is to “human settlements”, which is defined in the Glossary as “[a] place or area occupied by settlers”. (see App. 1, p. 7) However, it is also apparently intended to include “U.S. cities and smaller settlements”. However, in Chapter 2 the reference is to “American communities” (e.g., Chapter 2, p. 17, line 27). Similarly, Chapter 5 uses the term “communities” [e.g. Page 1 Line 19]. While it appears that these two terms (i.e., settlements and communities) are used interchangeably in the draft, we are not sure why both are selected. Having two such terms in the draft suggests that the authors intend some different meaning. We think a clarification is needed.	There is no difference intended in the use of communities and the use of settlements. We will review the relative utility of each and then search and replace as necessary.
J. Alan Roberson	AWWA	2	NA	NA	Droughts, wildfires, and extreme precipitation events may all work together to affect water quality for drinking water utilities.	We agree. We have edited sections to reflect the importance of “piggy-back” effects.

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					The Report discusses multiple changes in extreme climate conditions and their impacts. At different points, it discusses independently how there will be increased instances of droughts, wildfires, and extreme rainfall events. However, these events can “piggy-back” each other, which can create problems for water utilities. In general, droughts cause increased vulnerability to wildfires. If a wildfire occurs in a watershed, then any extreme precipitation event that follows (until the area is re-vegetated) can cause large sediment loads in the precipitation runoff that can be difficult for utilities to treat.	
J. Alan Roberson	AWWA	2	NA	NA	Extreme precipitation events will cause greater sediment mobilization in watersheds. Another water quality issue that is related to climate change, but is not explicitly stated in the Report, is of greater sediment mobilization due to more intense rainfall events. Intense storms could cause much wider variations in turbidity, which is a major challenge to drinking water treatment plants, especially in light of more stringent turbidity regulations. In addition, organic carbon could be mobilized in the same regard, which is a precursor for disinfection-by-products (DBPs), which are regulated carcinogens.	We agree and are using some of this language to expand on these issues.
J. Alan Roberson	AWWA	2	NA	NA	Drinking water utilities should develop contingency plans for extreme climate conditions. The Report discusses changes in extreme conditions, including more intense storms, heavy precipitation events, and prolonged drought. Extreme climate events, such as hurricanes and floods, can onset quickly and do considerable damage to infrastructure. Drinking water utilities in vulnerable areas should develop contingency plans for these types of situations. In addition, utilities in vulnerable areas would also benefit from drought contingency plans. Even though droughts occur more slowly, it is very important for utilities to have an efficient and effective response, such as a well thought out water conservation plan.	We agree. But the report is not making any effort at prescribing policy.
William L. Fang and Eric Holdsworth	EEI	3	1	11 to 13	We note that chapter 5 has a Table of Contents, but none is provided for chapter 3. We think it is needed.	The chapters will be made consistent in style and format.
J. Alan Roberson	AWWA	3	2	NA	More extreme precipitation events will increase pathogen loadings in source waters The Report states that while regulations at the federal and	This statement is from the summary of the 2000 National Assessment, not new text for this SAP

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					<p>state level aim to protect the public from waterborne diseases, increases in climate variability will probably increase the risk of contamination events. Of note is in Section 3.2's subsection "Waterborne and Foodborne Disease" (p. 11, lines 17-29, and p. 12 lines 5-13), where the association of drinking water outbreaks and extreme precipitation and/or flooding is pointed out. It has been shown that extreme precipitation events have increased over time and are likely to keep increasing (p. 16, lines 10-19). In addition, the population is shifting towards an older demographic, who will be more susceptible to health effects of climate change, including waterborne diseases. However, it has been shown that many of these outbreak data are from before modern regulations were put into place (Pickel and Johnson, 2000), thus this vulnerability has mainly been removed. Nevertheless, these points are relevant to water utilities and associated agencies that are responsible for providing safe drinking water. For example, pathogens such as Cryptosporidium, whose loadings are likely to increase with more extreme precipitation (Chapter 3, p. 20, Table 2), are resistant to conventional water treatment techniques. Alternative water treatment options that are more effective at inactivating Cryptosporidium, such as ultra-violet (UV) disinfection, should be further studied. In addition, analyses on more recent data (since the modern regulations) should be conducted to determine if there are emerging trends or implications in the prevalence of outbreaks. Governing agencies can use this information when reviewing drinking water regulatory standards, such as the Long-Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR).</p>	<p>I have not been able to access this citation (which appears to be a response to Rose et al. 2000). Nevertheless, the studies cited in this section are looking at trends irrespective of water source and as such include small systems and untreated well water that would not fall under regulations.</p> <p>I agree with these statements but they do not fit well within the context of this section; these are adaptation measures</p> <p>Long times series are generally required to provide enough quality for these kinds of studies and therefore there is a tradeoff in looking at short time scales (post-implementation of new regs) where little data may be available. But, in general, updated assessments will be important.</p>
William L. Fang and Eric Holdsworth	EEI	3	6	1 to 23	<p>The issues described in this paragraph, although accurate (preparation and warning in high risk regions), are independent of climate change since they are significant in a any kind of climate regime (warming, cooling, or steady state scenario). And since no relationship between observed warming and hurricane intensity or frequency has been documented by the World Meteorological Organization (see http://www.un.org/apps/news/story.asp?NewsID=20952&cr=weather&Cr1=), implications of these issues being a function of climate change (warming) should not be included in this document. Therefore lines 1-23 should be omitted from the document.</p>	<p>Disagree. Note the research that draws conflicting results are referenced, and conclusions are consistent with the recent IPCC reports. Text will not be removed.</p>

Reviewer Name	Affiliation	Chpt	Pg	Ln	Comment	Authors' Response to Comment
Kim Knowlton and Gina Solomon	NRDC	3	7	21 to 22	<p>The authors state here that "...diseases such as typhus, malaria, yellow fever and dengue fever have largely disappeared..." Yet we know that the dengue vector is at least present in a band of southern US states (see map below), and since dengue infections could present appreciable health risks in future, more discussion should be included.</p> <p>2005 Distribution of dengue, Western Hemisphere (see included Figure in 'PUBLIC COMMENTS COLLATED SAP 4_6 Final.doc, page 10).</p> <p>Dengue fever and the more severe dengue hemorrhagic fever (DHF) are among the viral infectious diseases transmitted by mosquitoes whose range and incidence will be changed by global warming. The symptoms of dengue range from a flu-like fever, severe headache and rash to the more severe and life-threatening DHF which occurs in around 1% of infections. Dengue is common in most tropical and subtropical areas of the world, and more than 2.5 billion people live in areas where the disease can be acquired from local mosquitoes. With international travel increasingly common, cases of dengue are confirmed every year in the US, imported by travelers returning from dengue-endemic areas. Dengue fever is transmitted by the <i>Aedes aegypti</i> mosquito vector, which is adapted to living near areas of human habitation. The disease itself affects hundreds of millions of people worldwide every year. The <i>A. aegypti</i> mosquito vector is found across a swath of states in the southern US (see map below). Each year, there are sporadic cases of the disease in this country in travelers returning from dengue-endemic areas. The combined presence of the vector and sporadic cases of the disease creates conditions that could be conducive to an outbreak... Surveillance for cases of dengue infection is widely under-funded, and there are concerns that dengue infections are already under-reported. No effective vaccine or drug treatment for dengue fever is yet available. Because climate changes projected for the US could expand the range of vector-hospitable breeding areas, dengue is among the infectious vector-borne diseases that should be discussed more thoroughly in SAP 4.6. In particular, a discussion of adaptive mechanisms including improvements in the dengue surveillance and treatment system would be valuable.</p>	<p>A sentence added, noting that the vector may expand its range, but many additional cases of dengue are unlikely due to characteristics of the vector.</p> <p>Disease surveillance is discussed in the adaptation section.</p>

Reviewer Name	Affiliation	Chpt	Pg	Ln	Comment	Authors' Response to Comment
John Kinsman	EEI	3	13	24 to 25	The discussion on factors affecting ozone only mentions sunlight and temperatures. Increases in mixing heights due to higher temperatures will have the opposite effect. Some models predict increases in cloudiness that would again have the opposite effect.	Added sentence to address.
William L. Fang and Eric Holdsworth	EEI	3	15	27	The NOAA 2007 study referenced above (see http://www.noaaneews.noaa.gov/stories2007/s2840.htm) contradicts the statement on line 27 regarding hurricanes and should be included here for completeness.	Agree this result should be recognized. Text was revised and the appropriate citation made. The research itself notes the uncertainty in predicting future incidence and intensity of these events. Specifically, in discussing the results, the authors note “This doesn’t settle the issue. It’s one piece of the puzzle that will contribute to what is an incredibly active field of research.”
Katherine Farrell	AACDH	3	18	Table 2	The comment on vibrio species in this table refers to ambient temperature increases leading to growth in "post harvest shellfish species". While vibrio are indeed exquisitely sensitive to temperature, the concern is for the temperature in the harvest water, not post-harvest where cooling can easily be ensured. This needs recognition since vibrio can survive and remain a threat to the immune compromised even when properly handled post-harvest. Since oysters in particular may be consumed without further cooking, the consumer ingests the entire animal including the gut and its contents. Unlike most other foodborne pathogens, vibrio can cause illness without multiplying post-harvest. Restrictions on harvest seasons or increased public education may be necessary to protect public health if vibrio species increase their range. Similarly recreational and occupational water exposures may result in more percutaneous infections with vibrio species.	This is a good point and the table has been amended.
John Kinsman	EEI	3	21	13 to 39	EPA recently presented interim results from their STAR grant program on this issue, which found that a) projected emissions reductions will have a much greater effect than the so-called "climate penalty," and b) inter annual weather variability has a larger effect than the projected climate change effect.	The new paragraph on p.23 addresses the precursor emissions issue.
William L. Fang and Eric Holdsworth	EEI	3	21	26 to 39	Citing “EPRI, 2005”, lines 26-27 state that the “influence of meteorology on air quality is substantial and well-established”. The draft then draws from that statement that there is therefore a suggestion that “changes in climate could alter patterns of air pollution concentrations” with no reference to any source for this suggestion. (emphasis added) No source is cited for this suggestion. Also, the paragraph later admits that “most studies” have, in fact, been “limited”	Paragraph edited to tighten text in a way consistent with this comment.

Reviewer Name	Affiliation	Chpt	Pg	Ln	Comment	Authors' Response to Comment
					to “climate effects on ozone concentrations” only (which is discussed in some detail on page 21, line 40, through page 24, line 14), with “little research” of “climate impacts on anthropogenic particular matter concentrations”, even though “of great concern from a human health perspective”. The word “could” is highly speculative and uncertain. We therefore believe that the sentence beginning on line 26 should end with a period after “(EPRI, 2005)”. We note also the sentence on p. 21, lines 32-33 that “Climate Change will alter the temporal and spatial distribution of meteorological factors, which could influence air quality”. (emphasis added) Again, there is no reference source for the first part of the sentence or indication of “likelihood” or “confidence” about the assertion or the impact of such alteration on human health. Again the word “could” leaves the impression of uncertainty and does not indicate whether such “influence” would be positive or negative.	
John Kinsman	EEI	3	21	26 to 39	Regarding the influence of meteorology on air quality, increases in mixing heights due to higher temperatures will have the opposite effect as higher temperatures. Some models predict increases in cloudiness that would again have the opposite effect. There is also the issue of scale - many of the analyses can't reasonably get to the spatial scales of importance. Because local effects (including meteorological changes) of climate change are so uncertain, one cannot make an assertion with 90% certainty that climate change will increase ozone concentrations. The statement from Chapter: 5, Page: 11, Bullet 3 – “Consequently, overall effects of climate change on respiratory health are variable and, therefore, difficult to predict.” – should be heeded here.	Edit added
John Kinsman	EEI	3	22	18 to 19	This finding is directly contradicted by work for EPA by a team led by Harvard’s Daniel Jacob – see http://es.epa.gov/ncer/science/globalclimate/02_22_07_event.html – in which the researchers project that ozone precursors in 2050 increase on global scale (+71% anthropogenic NOx, +150% anthropogenic NMVOCs, +25% CO), while U.S. emissions decline 39, 52 and 47%, respectively. Further, the current wording does not explain what background or what urban issue is being addressed – e.g., ozone?	Simply describing the results of a study; section clarified.
Katherine Farrell	AACDH	3	24	25	In commenting on the fact "in a warmer climate more people would stay indoors with air conditioners on in summer" thus mitigating their personal ozone exposure, it should be also	Edit added

Reviewer Name	Affiliation	Chpt	Pg	Ln	Comment	Authors' Response to Comment
					noted that increasing days of air conditioner use would increase energy demand from fossil fuels and thus precursors for ozone. The overall effect is thus unpredictable. Additionally, staying indoors is only a temporary adaptation and is not desirable since it increases risk of chronic illness related to sedentary lifestyle. As climate changes, so would the number of days of enforced inactivity. As noted elsewhere in the report, those with chronic illnesses are at most risk from climate related illness and death.	
Katherine Farrell	AACDH	3	25	68	The discussion of outdoor air pollution is very thorough, an excellent summation of the large body of research on this subject, but indoor air pollution with mold as a consequence of floods may also be worth mentioning. In this county respiratory illness was reported as a problem during cleanup after tropical storm Isabel in 2003 and has also been prominent in the Katrina cleanup. Recent news reports have also mentioned exposure to formaldehyde in trailers used as temporary housing following floods. These indoor pollution problems have been regarded as temporary issues and they are hard to quantify, but flooded homes are difficult to rid of mold and Katrina victims are still in trailers. Reference: Commitment to a Healthier Future. Report Card of Community Health Indicators, May 2004, Anne Arundel County Department of Health www.aahealth.org	There is limited literature to assess in this area; most publications are from Europe. The few studies published have been from two research groups. This is an area where additional research is needed.
John Kinsman	EEI	3	25	21 to 23	The statement seems too strong based on the current evidence. For today's air quality management, we should worry more about weather than climate change 50 years from now, especially given that major advances in technology are going to substantially alter the "solution" to the "penalty."	Acknowledged, but we stand by statements made
William L. Fang and Eric Holdsworth	EEI	3	25	27 to 30	These lines define the terms "Vulnerability" and "Sensitivity". However, the definitions here differ from the definitions provided in the draft's Glossary (see pages 16 and 12, respectively). As far as we can tell, there is nothing in the section titled "Vulnerable Subpopulations" to explain why there is a difference in the definitions. We point out that the Glossary provides a "Source" for its definitions, namely the "Intergovernmental Panel on Climate Change Third Assessment Report, Working Group II." There is no source cited for the definitions of these terms in Chapter 3. We believe that the authors must apply the Glossary definitions and comply with them or if they want to abandon them, they should explain why.	The definitions used are more consistent with the IPCC's second assessment report and are more appropriate, at least for consideration of health impacts. The glossary definitions were changed to be more consistent with these definitions.

Reviewer Name	Affiliation	Chpt	Pg	Ln	Comment	Authors' Response to Comment
Katherine Farrell	AACDH	3	26	11, Table 3	<p>1. The presumed increased vulnerability to Lyme Disease among outdoor occupational groups is intuitive but not borne out by the numbers reported by CDC which show peaks among children and elderly, neither of whom are likely to have occupational exposures. While being outdoors provides opportunity for tick bites, the failure to check for and remove ticks may be more common among non-occupational groups who have infrequent and uncontrolled exposures to ticks. Non-occupational groups may use less repellents or have lower awareness of preventive strategies.</p> <p>2. A special vulnerability from floods exists for those dependent on individual private wells which can be contaminated by flood waters. In this county following a storm surge in September 2003 resulting from Tropical storm Isabel, 1,154 wells were submerged and contaminated. It took months and a major public health effort to restore them to potability. While water-borne disease is mentioned in the document, this aspect of water sanitation following floods is not mentioned.</p> <p>Reference: Commitment to a Healthier Future. Report Card of Community Health Indicators, May 2004, Anne Arundel County Department of Health www.aahealth.org</p> <p>3. It seems obvious but is not mentioned that those living in low lying areas have more vulnerability from floods. This may have important planning implications for infrastructure.</p>	<p>1. Noted the lack of increased risk of clinical disease in workers (though studies indicate increased risk of exposure to lyme-carrying ticks) and added children as susceptible group.</p> <p>2. This is a good point. However, we could not find any studies on this topic, and so included a mention of dependence on private wells for drinking water, but could not reference any scientific studies to expand on this point.</p> <p>3. Elevation is mentioned as an element of geographic vulnerability, as is susceptibility to flooding.</p>
John Kinsman	EEI	3	32	15 to 16	For today's air quality management, we should worry more about weather than climate change 50 years from now, especially given that major advances in technology are going to substantially alter the "solution" to the "penalty."	Acknowledged, but we stand by statements made
John Kinsman	EEI	3	35	11 to 13	For today's air quality management, we should worry more about weather than climate change 50 years from now, especially given that major advances in technology are going to substantially alter the "solution" to the "penalty."	Acknowledged, but we stand by statements made
Katherine Farrell	AACDH	3	39	13	The statement is made that "vaccine is available for Lyme Disease". The human vaccine was withdrawn from the market by the manufacturer in 2002 due to safety concerns. There is no currently marketed human Lyme Disease vaccine. Vaccines as a future solution to vector borne illness may not live up to expectations. Delivery of vaccines to those most at risk would pose a formidable public health challenge especially since many people spending time outdoors are basically healthy and do not access health care. Many people	Reference to Lyme disease deleted. Concur with statements about limitations of vaccines.

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					not considered high risk, nevertheless get exposed as a result of occasional leisure time activities like gardening, camping or hunting. When Lyme Disease vaccine was available it primarily reached those with good insurance, high educational attainment and high anxiety levels. Populations like the homeless, unskilled laborers, ethnic minorities or even vacationers to endemic areas had very low vaccine penetration.	
William L. Fang and Eric Holdsworth	EEI	3	44	Table 6	We think there is considerable overlap and duplication between this table and Table 5 on page 40 of this chapter. We believe both should be consolidated into one table. In regards to Table 6, we think that the words “Legislative Policies” should be changed to just “Policies”, as some policies at various levels of government can probably be established administratively. Also, we believe that the words “Air Pollution” in the last column should be changed to “Air Quality”, consistent with the heading at page 21, line 12 of Chapter 3 and the chapter’s contention that climate change, as that term is defined in the draft’s Glossary, could affect or influence air quality. In that column, we note in regards to “Technology Development”, there is a blank. We believe that it should call for research on technology to reduce greenhouse gas emissions, including capture and sequestration technology. Also, in the last column, we believe the words “[d]evelop and enforce regulations to reduce emissions of air pollutants from traffic, industry, and other sources” and “[i]ncentive programs to increase energy efficiency” should be changed to “develop policies and programs to limit and reduce greenhouse gas emissions from all economic sectors and sources and improve climate change impacted air quality through efficiency and use of diverse energy sources.”	There is overlap between the two tables, but as each approaches the issues from a different perspective, each has value for public health professionals. Legislative deleted. This table focuses on adaptation and does not include mitigation actions. Sentences edited
John Kinsman	EEI	3	13 to 14	Page 13 Line 15 to Page 14 Line 21	On page 13, lines 23-24, this list of VOC sources is very much truncated, ignoring for example solvents/chemicals. On line 28, there is a reference to “burning of the cells lining the lungs”. I searched the thousands of pages of the February 2006 final EPA criteria document for the ozone standard and did not find one use of this terminology, which I suspect is a gross oversimplification and should be stricken. On page 14, lines 17-21, the variation with education status of statistical relationships between mortality and particulate matter exposure has not been explained; thus, the attempt here to explain variation as being due to differing exposure to ozone	Edits on VOCs added. Burning changed to inflammation and citation added. Deleted speculation regarding Pope study.

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					is highly speculative. Further, the terminology “higher concentration/response function” does not explain the fact that those with the higher education did not exhibit adverse health outcomes.	
William L. Fang and Eric Holdsworth	EEI	3	29 to 31	Page 29 Line 7 to 31 Line 26	<p>Section 3.4 is titled “Priority Research Needs and Data Gaps” that includes a list of research “needs”. Some relate to adaptation. It states (p. 29) that “[f]ew research needs and data gaps have been filled since” the U.S. Global Change Research Program’s “First National Assessment” issued pursuant to the Global Change Research Act of 1990. Further, the conclusion portion of section 3.4, states that the “conclusions” from “this assessment are consistent with those” of such first assessment, and that the “strength and consistency of projections for climate changes for some exposures to human health suggest that adaptation actions are needed now.” It then adds that “the nature of the risks posed by climate change” (and outlined in great detail in prior sections of Chapter 3) “mean that all adverse health outcomes will not be avoided”. (emphasis added) It also includes a Table 6 of “Key Adaptations”. However, section 3.4 and the prior sections of chapter 3 do not address adaptation. Indeed, for Chapter 3, adaptation is not covered until the following section 3.5. We therefore question this sequence.</p> <p>In our view, the section on adaptation should precede the section on research needs with its “conclusions”, because the adaptation discussion is relevant to the development of “research needs” for adaptation. Further, we think such “needs” should all be focused on what is needed, not only for adaptation, but for all “needs”, in the near-and mid-term and, most importantly, for the long-term.</p> <p>As to the above, rather negative conclusion that for the U.S. the “nature” of the climate change “risks” are so great that “all adverse health outcomes will not be avoided”, we believe it is highly dependent on whether “all” the extensive risks listed earlier in the chapter are “likely” to be significant in the U.S. or, for that matter, in other highly developed countries with their available resources. We question whether many are “likely” for the U.S. over the long-term given the capabilities of the U.S.</p>	<p>Sections reorganized.</p> <p>The published evidence does not support the suggestion that the US will not experience health impacts from climate change.</p>
William L. Fang and Eric	EEI	3	34, 35	Page 34 Lines	On page 34, lines 4-6, the draft states that “[r]esponsibility for the prevention of climate-sensitive health risks rests”, among others, with “national agencies” and their “roles and	<p>Reference to drinking water eliminated</p> <p>Support for the last statement is found in the section assessing</p>

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Holdsworth				4 to 6, Page 35 Box 2	responsibilities” vary by “health outcomes”, citing, as an example, Box 2, which is titled “Ensuring Safe Air and Drinking Water”. However, other than pointing out that the “U.S. EPA is tasked” with regulating “drinking water”, the Box makes no further reference to safe drinking water in regards to climate change. Its sole focus is on air quality in general and the Clean Air Act’s ozone standard in particular. Indeed, the only reference to climate change therein is in the last sentence. It first states that such change “may increase ozone concentrations in some” unidentified “regions”, presumably in the U.S., and then concludes that “more aggressive emissions controls may be needed to reduce ozone concentrations”, while noting that the ozone standard “is currently under review”. (emphasis added) There is, however, nothing in the Box or the preceding paragraphs to support such a conclusionary result. We think the Box needs further elaboration regarding climate change and drinking water, assuming there is a basis for it, and that the last sentence of the Box should be deleted in light of the word “may” therein and the obvious uncertainty that it suggests.	the possible impact of climate change on air quality
William L. Fang and Eric Holdsworth	EEI	3	40 to 42	Table 5	Table 5 appears overly simplistic and not very informative or helpful. For example, in the last column the “responsibilities or roles” for “Individual” actions is to “[s]eek treatment when needed”, whether it involves some disease or a weather event. We would think that, particularly in the case of weather or temperature events or wildfires, individuals would be urged to, for example, seek air conditioning or warm clothing or to escape to safe areas at the direction of firefighters or other individuals. In short, not every event will result in a contracting disease. Some of this is covered in the third column, but that column is headed “Prevent Disease Onset”, which suggests that the Table is primarily disease-oriented. Again, we do not think disease will always be the result of some climate-change related event, particularly those that are weather-related or wildfire related. In regards to the “Community, State, and National Agencies”, no mention is made of their providing research on near-, mid-, and long-term adaptation measures and programs that not only reduce morbidity and mortality, but also prevent such results.	<p>Because impacts, and the adaptations to address them, are site specific and path dependent, any table of this nature will have to simplify the possible responses. We appreciate the concern for specificity, but that will have to wait for detailed statewide or regional assessments.</p> <p>The chapter has tried to make clear that not all climate change-related health impacts will result in disease. The framework for this table is the three pillars of public health prevention. Heading change to Prevent Onset of Adverse Health Outcomes.</p> <p>To keep the table from being too repetitive, the need for research is mentioned in the text.</p> <p>Change made</p>

Reviewer Name	Affiliation	Chpt	Pg	Ln	Comment	Authors' Response to Comment
					We also believe that the words “to Climate Change Risks” should be added after the word “Adaptation” in the title to Table 5 and the last item in the table “Diseases Related to Air Pollution” should be changed to “Diseases Related to Air Quality”.	
William L. Fang and Eric Holdsworth	EEl	3	47 to 48	Page 47 to 48 Line 11 to 48 Line 5	<p>Overall we do not think this section provides much in the way of conclusions drawn from the prior nearly 50 pages of discussion, other than a rather vague suggestion that “[p]ublic health adaptation will be facilitated by identifying and supporting a lead agency” and that a “central agency” for local and state government to “call” for answers to “questions about adaptation would be extremely beneficial and efficient”. It cites two examples as possible models. Neither seem too relevant. Indeed, it states that one model has “limited focus on public health”.</p> <p>We question the use of the terms “lead agency” and “central agency” in this context. Possibly, the draft has reference to a central clearinghouse or similar function, assuming there is enough valuable information, data, and experience available to make such an entity worthwhile as an answering entity. In our view, this section should focus more on what are the needs in the U.S. for achieving an effective and meaningful program of adaptation for the United States.</p>	Section reorganized, references to lead agency deleted
Kim Knowlton and Gina Solomon	NRDC	3	NA	NA	<p>The dengue vector is present across of southern US states and since dengue infections could present appreciable health risks in future, more discussion should be included.</p> <p>Dengue fever and the more severe dengue hemorrhagic fever (DHF) are among the viral infectious diseases transmitted by mosquitoes whose range and incidence will be changed by global warming. The symptoms of dengue range from a flu-like fever, severe headache and rash to the more severe and life-threatening DHF which occurs in around 1% of infections. Dengue is common in most tropical and subtropical areas of the world, and more than 2.5 billion people live in areas where the disease can be acquired from local mosquitoes. With international travel increasingly common, cases of dengue are confirmed every year in the US, imported by travelers returning from dengue-endemic areas (USCDC 2007). Dengue fever is transmitted by the Aedes aegypti mosquito vector, which is adapted to living near areas of human habitation (Hales et al. 2002). The disease itself</p>	<p>A sentence added, noting that the vector may expand its range, but many additional cases of dengue are unlikely due to characteristics of the vector.</p> <p>Disease surveillance is discussed in the adaptation section.</p>

Reviewer Name	Affiliation	Chpt	Pg	Ln	Comment	Authors' Response to Comment
					<p>affects hundreds of millions of people worldwide every year. The <i>A. aegypti</i> mosquito vector is found across a swath of states in the southern US (see map -- Figure in 'PUBLIC COMMENTS COLLATED SAP 4_6 Final.doc, page 10; from USCDC 2007). Each year, there are sporadic cases of the disease in this country in travelers returning from dengue-endemic areas. The combined presence of the vector and sporadic cases of the disease creates conditions that could be conducive to an outbreak... Surveillance for cases of dengue infection is widely under-funded, and there are concerns that dengue infections are already under-reported. No effective vaccine or drug treatment for dengue fever is yet available. Because climate changes projected for the US could expand the range of vector-hospitable breeding areas, dengue is among the infectious vector-borne diseases that should be discussed more thoroughly in SAP 4.6. In particular, a discussion of adaptive mechanisms including improvements in the dengue surveillance and treatment system would be valuable.</p>	
Kim Knowlton and Gina Solomon	NRDC	3	NA	NA	<p>2005 Distribution of dengue, Western Hemisphere (see included Figure in 'PUBLIC COMMENTS COLLATED SAP 4_6 Final.doc, page 10; from USCDC 2007).</p> <p>Global warming has already had effects on the timing and range of a number of pollen-bearing and other invasive plants species, and further discussion of their potential impacts on human health is warranted.</p> <p>Although earlier pollen production in urban areas is mentioned as being associated with urban heat island warming, there is no reference to the growing body of literature which documents a wide range of health-relevant impacts of global warming on pollen-bearing plants. In a growing number of laboratory and field tests, it has been shown that when there is more CO₂ in the environment, ragweed produces significantly more pollen (Wayne et al. 2002). In one study, ragweed plants exposed to current CO₂ conditions (370 ppm) and those possible by the mid- to late 21st century (600 ppm) increased their pollen production by 131% and 320% respectively, compared to ragweed plants grown at pre-industrial levels (280 ppm) (Ziska and Caulfield</p>	<p>See earlier response re dengue.</p> <p>A paragraph was added noting there is evidence that climate change is affecting the phenology of some spring-flowering plants. There is limited research linking these changes to health impacts, with most of it conducted in laboratory settings.</p>

Reviewer Name	Affiliation	Chpt	Pg	Ln	Comment	Authors' Response to Comment
					<p>2000). Along with ragweed, many other pollen-producing plants including trees like birch, oak and pine tend to produce pollen earlier, for a longer time, and in greater total amounts under higher CO₂ and temperature conditions – the kinds of conditions associated with global warming (Rogers 1998). Weeds like ragweed, dandelion and poison ivy are expected to proliferate as carbon dioxide levels continue to rise in the atmosphere (McPeck and Wang 2007). For example, not only does poison ivy grow faster and stronger as carbon dioxide increases, but the irritant urushiol that it produces becomes more toxic to human skin, “potentially affecting global forest dynamics and human health.” (Mohan 2006) Ragweed thrives in urban and suburban environments where disturbed soils are common and where vehicle and industrial emissions from fossil fuel combustion create “CO₂ domes” over cities (Ziska et al. 2003). Furthermore, temperatures tend to be higher in urbanized areas because building and pavement materials capture and re-radiate heat more slowly than natural vegetated areas, creating an “urban heat island” effect that could contribute to higher pollen and ozone production, especially in a warming world (Lo and Quattrochi 2003). We urge that the CCSP Synthesis contain a fuller discussion of the important health issues related to pollen and allergy in a changing climate.</p>	
Kim Knowlton and Gina Solomon	NRDC	3	NA	NA	<p>Plans for how US civil society could adapt and provide the necessary services for periodic sudden influxes of “environmental refugees” is among the challenging topics that should be discussed in more detail in Chapter 5 on Human Welfare, and added to the Glossary of key terms in Appendix I.</p> <p>There needs to be additional discussion of the significant undesirable feedbacks between the increased use of air conditioning, a likely first compensatory response to climate change, and further increases in greenhouse gas emissions that further exacerbate warming.</p> <p>While central air conditioning has value in offering short-term relief for summer heat (O'Neill 2003), a number of recent studies point out that it is not a sustainable long-term adaptive technology because air conditioners require large amounts of electricity. Electricity generation causes 40% of carbon</p>	<p>There is no page number suggesting where this text should be added, so a paragraph was added under the Impoverished populations section:</p> <p>“Air conditioning is an important short-term method for protecting health, but is not a sustainable long-term adaptive technology because the electricity use is associated with greenhouse gas emissions and during heatwaves can overload the grid and contribute to outages (O’Neill, 2003c). Furthermore, the elderly with limited budgets and racial minorities are less likely to have access to air conditioning or to use it during hot weather (O’Neill <i>et al.</i> 2005b, Sheridan, 2006). Incentives for and availability of high-efficiency, low energy-demand residential cooling systems, especially among disadvantaged populations, can advance health equity and minimize some of the negative aspects of air conditioning.”</p>

Reviewer Name	Affiliation	Chpt	Pg	Ln	Comment	Authors' Response to Comment
					<p>dioxide emissions in the US and thus severely aggravates global warming (USEIA 2006 p. xii). Air conditioners are currently the single biggest user of electricity in American homes (16% of residential electricity consumption) (USEIA 2007). Increasing the usage of air conditioning would increase electrical demand and exacerbate global warming trends by increasing greenhouse gas emissions from power plants. Residential electricity consumption already accounts for over 14% of US carbon dioxide emissions (USEIA 2006 p. xiii). Furthermore, use of air conditioning during heat waves drastically increases peak demand in cities, which can lead to power outages that remove the ability to deliver air conditioning as well as other forms of refrigeration, health-adaptive technologies, and protective responses to heat. While mentioned in passing in Chapter 5 (USCCSP 2007, Ch. 5, App. I, p. 38 of 63, Lines 1-2), there is a need for more discussion of the pressing need for widely available, high-efficiency, low energy-demand residential cooling systems.</p>	
<p>Kim Knowlton and Gina Solomon</p>	<p>NRDC</p>	<p>3</p>	<p>NA</p>	<p>NA</p>	<p>The human health benefit conferred by air conditioning has only been documented for central air conditioning systems, to which many US residents do not have access.</p> <p>In many US cities, older housing stock and apartment complexes lack central air conditioning systems, and landlord-provided window air conditioning units may also be absent. US studies have found that while central air conditioning can mitigate the adverse effects of heat stress, room units provide no statistically significant benefit compared to no air conditioning (Rogot et al. 1992; O'Neill et al. 2005). , Economically disadvantaged households are often unable to afford to purchase, operate, or repair air conditioning units. A recent study in four large US cities showed the prevalence of central air conditioning among African-American households was less than half that among white households, and deaths were more strongly associated with heat (O'Neill et al. 2005). Summer heat waves in 2006 in New York City and the state of California showed that, among those who died from the heat were individuals who owned a working air conditioner at the time of death but chose not to use it (NYCDHMH 2006), perhaps for economic reasons or with the expectation that overnight outdoor temperatures would afford some cooling relief, which they</p>	<p>We have addressed this comment in the paragraph cited above.</p>

Reviewer Name	Affiliation	Chpt	Pg	Ln	Comment	Authors' Response to Comment
					did not. The Draft SAP 4.6 alludes to some of the environmental justice issues inherent in differential exposures to extreme heat, but we suggest not furthering the impression that there has been nor will there continue to be a “nearly universal spread of air conditioning” (USCCSP 2007, Ch. 2, p. 13 of 21, Lines 28-29) in the US.	
Kim Knowlton and Gina Solomon	NRDC	3	NA	NA	<p><i>(This comment is duplicated for Chapter 4)</i> Regulations that limit where and with what materials residences can be built in areas at-risk from wildfires, hurricane, storm surge and storm events are not discussed in the draft report as adaptive mechanisms that may limit human settlement and health damages.</p> <p>There is now strong evidence that wildfires, precipitation patterns, and snowmelt are being influenced by anthropogenic climate change (IPCC 2007 pp. 7-22). A combination of climate-related changes in forest pests, diseases and fire are projected to have “increasing impacts on forests, with an extended period of high fire risk and large increases in area burned.” (IPCC 2007 pp. 14 and 18) Two primary ways that global warming can increase the threat of fire are by increasing oscillations between periods of increased precipitation and periods of drought (as projected in some climate scenarios) which could increase fuel loads and create extreme fire conditions; and by warmer temperatures with consequent lower moisture content in soils. Increased fuel could thus create increased fire risk, which would be further exacerbated by high winds and heat waves (Nelson et al. 2007). While it remains controversial, this would be an appropriate context in which to discuss appropriate ways to limit further expansion of residential building into at-risk locations, or to regulate the types of materials used in such locations. For example, the density and flammability of buildings at the wildland-urban interface could be taken into account and regulated to help mitigate forest fire risks (Spyratos et al. 2007).</p>	Additional information added in the risks of and responses to extreme events. Table 5 already included reference to building materials.
Kim Knowlton and Gina Solomon	NRDC	3	NA	NA	The US CCSP has grappled with an enormous variety of human health and societal impacts for the United States across a wide variety of affected sectors. We commend the authors for synthesizing elements from many of the various human dimensions of global warming impacts, and have suggested areas in which more attention could be paid to some salient areas for further discussion. While the United	<p>Thank you. No response necessary.</p> <p>Section on vulnerable populations discusses various groups at higher risk. The need to improve public health infrastructure is discussed in the section on adaptation.</p>

Reviewer Name	Affiliation	Chpt	Pg	Ln	Comment	Authors' Response to Comment
					<p>States is indeed fortunate to have relatively high adaptive capacity as a developed nation, the recent experiences of Hurricanes Katrina and Rita has shown us how vulnerable our emergency preparedness and healthcare systems are, and the extent to which some communities suffer from a lack of coping capacity (USCCSP 2007, Ch. 2, p. 8 of 21, Lines 22-30). The authors refer to the environmental justice issues that climate change will pose when they state,</p> <p>“...Climate change is very likely to accentuate the disparities already evident in the American health care system. Many of the expected health effects are likely to fall disproportionately on the poor, the elderly, the disabled, and the uninsured. The most important adaptation to ameliorate health effects from climate change is to support and maintain the United States’ public health infrastructure. (USCCSP 2007, ES, p. 6 of 10, Lines 21-25)”</p> <p>The relevant research and current thinking on these topics should be brought to bear as American society considers how we will improve the public health infrastructure to help our communities cope with the burden of climate change impacts. Thank you for consideration of these comments.</p>	
William L. Fang and Eric Holdsworth	EEI	4	1	13	We believe that the chapter needs a Table of Contents, as is provided in Chapter 5.	Response will be determined by the SAP 4.6 leadership so that all chapters are consistent in this regard.
William L. Fang and Eric Holdsworth	EEI	4	2	10 to 11	<i>(This comment is duplicated for Chapter 2 and Chapter 5)</i> In Chapter 4 (Page 2 Line 10-11), the reference is to “human settlements”, which is defined in the Glossary as “[a] place or area occupied by settlers”. (see App. 1, p. 7) However, it is also apparently intended to include “U.S. cities and smaller settlements”. However, in Chapter 2 the reference is to “American communities” (e.g., Chapter 2, p. 17, line 27). Similarly, Chapter 5 uses the term “communities” [e.g. Page 1 Line 19]. While it appears that these two terms (i.e., settlements and communities) are used interchangeably in the draft, we are not sure why both are selected. Having two such terms in the draft suggests that the authors intend some different meaning. We think a clarification is needed.	Will clarify as appropriate, including possible modifications of glossary definitions. But “human settlements,” which are places, are different from “communities,” which are social units.
J. Alan Roberson	AWWA	4	3	6-8	Water managers should consider the impacts of climate change as they plan for the future. As indicated in the Intergovernmental Panel on Climate	Addressed in section 4.2.

Reviewer Name	Affiliation	Chpt	Pg	Ln	Comment	Authors' Response to Comment
					<p>Change (IPCC)'s Fourth Assessment Report, the warming of the climate system is unequivocal. As such, drinking water utilities and their associated agencies need to understand its implications and uncertainties. For example, consider a location whose climate is expected to become warmer and drier and is expected to increase in population. This location may be better off in developing water re-use facilities than in building a new dam.</p>	
J. Alan Roberson	AWWA	4	9	Table 2	<p><i>(This comment is duplicated for Chapter 4)</i> Changes in snow characteristics will affect drinking water utilities. It has been shown that since the middle of the 20th century, the volume of snow pack in most locations in the western United States has been shown to decrease (e.g. Mote et al., 2005) and an earlier onset of spring snowmelt has been observed (e.g. Stewart et al., 2005). Changes in snow pack and in runoff timing events have profound implications for water managers. By diminishing the natural storage and by receiving flows before peak demand, areas that do not have adequate reservoir capacity risk losing freshwater supplies to the ocean. In addition, earlier snowmelt coupled with a warmer and drier summer season increases the risks of water shortages, droughts, and wildfires.</p> <p>Changes in in-stream flows will affect source water quality. Reduced summer stream flows are mentioned in the Report. Reduced summer stream flows will impact drinking water utilities, especially since summer is when demand is highest. In many places, in-stream flows will become dominated with wastewater effluent for much of the year. This raises issues of human health, especially regarding personal care products and endocrine disrupters that are commonly found in these wastewater streams. Preliminary research is only beginning to unveil the possible health effects of these compounds in drinking water.</p> <p>Reservoir management will be impacted by climate change. As the hydrologic cycle changes, reservoir management will be impacted. Reservoirs are often managed for multiple functions, including drinking water storage, navigation, hydropower, and in-stream flow releases. Changing trends in snow characteristics, such as reduced snow pack and earlier runoff, as well as shorter and more intense rainfall can cause</p>	Water impacts are noted in the table and in the text; health implications are covered in greater detail in the health chapter.

Reviewer Name	Affiliation	Chpt	Pg	Ln	Comment	Authors' Response to Comment
					<p>problems for reservoir management. This can create difficulties for water utilities, as they compete with other demands on over-allocated water resources.</p>	
J. Alan Roberson	AWWA	4	9	Table 2	<p>Increases in water temperatures will affect source water quality The regional vulnerabilities of settlements to impacts of climate change are listed. For many of the regions, water supply issues are highlighted. Nevertheless, there are a few water quality issues that are not explicitly pointed out that warrant discussion. For “Upper Midwest”, lake and river levels are listed as vulnerabilities, but it is also important to note that the water quality of lakes in this region is vulnerable. For example, water temperatures in Lake Erie are increasing, causing increased algal blooms and anoxic “dead zones”. These eutrophic conditions can cause degraded water quality that is challenging for utilities to treat. This is particularly compelling given the fact that what happens in the Great Lakes system usually happens in Lake Erie first. In addition, the Great Lakes provide water for 30 million people who live in the watershed of a basin that holds 98 percent of America’s fresh water supply.</p> <p>Another associated point is that higher water temperatures increase process reaction rates, including of the formation of disinfection-by-products (DBPs), which are regulated under the Safe Drinking Water Act (SDWA).</p>	Such water effects are addressed in other SAP reports.
J. Alan Roberson	AWWA	4	14	NA	<p>More extreme precipitation events will cause increases in combined sewer overflows (CSOs). Combined sewer systems can still be found in many older cities and towns in the U.S. As precipitation events become more intense, including those due to urban-induced rainfall production, there is an increased likelihood of combined sewer overflows (CSOs). CSOs can contribute to water pollution, and is therefore of concern to drinking water utilities. As mentioned in the Report (Chapter 2, p. 18, point 3), sewer systems can be updated to reduce this risk. This is particularly important in places where CSOs could affect drinking water supplies.</p> <p>More extreme precipitation events will make watershed</p>	We agree with these comments, but this box reports results from UHI analyses that do not address these issues.

Reviewer Name	Affiliation	Chpt	Pg	Ln	Comment	Authors' Response to Comment
					<p>protection more important. As the likelihood of more intense precipitation events increases, so does the potential for higher sediment loads in drinking water sources. This information could help to motivate drinking water utilities to develop and enforce watershed protection. This could include being more conscience of land-use changes occurring in a watershed and/or in assessing and reducing the vulnerability of the watershed to wildfires.</p>	
<p>Kim Knowlton and Gina Solomon</p>	<p>NRDC</p>	<p>4</p>	<p>14</p>	<p>14 to 16</p>	<p>Global warming has already had effects on the timing and range of a number of pollen-bearing and other invasive plants species. Although earlier pollen production in urban areas is mentioned as being associated with urban heat island warming, there is no reference to the growing body of literature which documents a wide range of health-relevant impacts of global warming on pollen-bearing plants. In a growing number of laboratory and field tests, it has been shown that when there is more CO2 in the environment, ragweed produces significantly more pollen. In one study, ragweed plants exposed to current CO2 conditions (370 ppm) and those possible by the mid- to late 21st century (600 ppm) increased their pollen production by 131% and 320% respectively, compared to ragweed plants grown at pre-industrial levels (280 ppm). Along with ragweed, many other pollen-producing plants including trees like birch, oak and pine tend to produce pollen earlier, for a longer time, and in greater total amounts under higher CO2 and temperature conditions – the kinds of conditions associated with global warming. Weeds like ragweed, dandelion and poison ivy are expected to proliferate as carbon dioxide levels continue to rise in the atmosphere. For example, not only does poison ivy grow faster and stronger as carbon dioxide increases, but the irritant urushiol that it produces becomes more toxic to human skin, “potentially affecting global forest dynamics and human health.” Ragweed thrives in urban and suburban environments where disturbed soils are common and where vehicle and industrial emissions from fossil fuel combustion create “CO2 domes” over cities. Furthermore, temperatures tend to be higher in urbanized areas because building and pavement materials capture and re-radiate heat more slowly than natural vegetated areas, creating an “urban heat island” effect that could contribute to higher pollen and ozone</p>	<p>Noted briefly in section 4.2, vulnerability #1; but these issues are addressed in greater detail in the health chapter of SAP 4.6.</p>

Reviewer Name	Affiliation	Chpt	Pg	Ln	Comment	Authors' Response to Comment
					production, especially in a warming world. We urge that the CCSP Synthesis contain a fuller discussion of the important health issues related to pollen and allergy in a changing climate.	
William L. Fang and Eric Holdsworth	EEI	4	18	33	Change the word “could” to “should”. We believe that adaptation not only “could” be “important to the well-being of U.S. settlements as climate change emerges” over the next century, but “should be important”.	Done. A helpful suggestion.
J. Alan Roberson	AWWA	4	25	22 to 23, 25 to 26	<i>(This comment is duplicated for Chapter 1)</i> Drinking water utilities would benefit from more quantitative climate projections at smaller (more local) scales The Report points out that it does not make quantitative projections of specific impacts for specific locations, rather it points to vulnerabilities, and where possible the direction and magnitude of potential changes. This is important in providing a broad view of potential climate impacts. However, the scale of this type of information can make it difficult to utilize for planning agencies, including water utilities. As a next step, more quantitative analyses should be done on smaller, regional scales. If possible, watersheds should be looked at individually and methods for improving climate projections on smaller scales should be conducted. The Report acknowledges this idea in Chapter 4 (p. 25), where the suggestions regarding future research needs are made. The first point (lines 22-23), suggests increasing the number of case studies that will examine the effects of global climate change on human settlements in a variety of locations across the country. The Report also points out previous research that examined climate impacts on certain large U.S. cities (i.e. Chapter 4, p. 8, Table 1). In the context of drinking water utilities, the Awwa Research Foundation (AwwaRF) has conducted research with the National Center for Atmospheric Research (NCAR), including AwwaRF project 3132 entitled “Incorporating Climate Change Information in Water Utility Planning: A Collaborative, Decision-Analytic Approach” (ongoing), where a case study approach has been adopted. Nevertheless, more case studies should be conducted, especially in places that are more vulnerable to climate change, which as the Report points out, are also mainly areas that will experience population growth. The AwwaRF/NCAR collaboration also addresses the second point (p. 25, lines 25-26), which is to develop better	The authors believe that research needs should be identified in this report at a more general level than is suggested here.

Reviewer Name	Affiliation	Chpt	Pg	Ln	Comment	Authors' Response to Comment
					<p>projections at the scale of U.S. metropolitan areas or smaller. In the AwwaRF/NCAR project, multi-model Bayesian methods (e.g. Tebaldi et al., 2005) are utilized to create climate projections, and then a nearest neighbor downscaling tool (e.g. Yates et al., 2003) is used. These sophisticated statistical tools could benefit from further research and testing. The Report also acknowledges that changes in climate extremes are very often of more concern than changes in climate averages (Chapter 4, p. 14). Thus, extreme value statistics and their applications (e.g. Gilleland and Katz, 2006) should continue to be developed for use in climate change projections.</p>	
John Kinsman	EEI	4	13 to 14	Page 13 to 14 Last Bullet to Page 14 Line 16	<p>The conclusion of this report in Chapter 3, page 25 – “To few data yet exist for PM to draw firm conclusions about the direction or magnitude of climate impacts.” – is directly refuted here with the statement, “Additionally, particulate matter (PM2.5) will potentially increase due to a number of human induced and natural factors (e.g., more energy production to support higher usage of air conditioning).” Even more important is the fact that the author obviously does not understand that the electricity production to power air conditioners comes from facilities regulated under three major EPA air regulatory programs that cap emissions of sulfur dioxide and nitrogen oxides at lower and lower levels going into the future, therefore not allowing emissions to grow even when demand for electricity increases. On page 14, lines 10-14 again refer with more certainty than justified to increases in particulate matter with urban heat islands (increased temperature).</p>	Language changed to reflect uncertainties.
William L. Fang and Eric Holdsworth	EEI	4	21 to 26	Page 21 to 26 Line 38 to 26 Line 22	<p>The conclusions with their parenthetical statements of “likelihood” lack a reference back to the relevant sections of the chapter as a basis for the conclusions and the statements of likelihood. For example, the last clause of conclusion (4) regarding “initiatives” being “shown at the local level across the U.S.” seems over-stated, as the chapter does not appear to elaborate on such “initiatives”, except two “assessments” of “possible” climate change impacts in New York and Boston. Further, there is no conclusion on some positive effects of climate change. Yet the chapter discusses them. Conclusion (7) is about promoting “climate change mitigation and adaptation discussions” at the “urban/settlement scale” and states that it will benefit from involvement of</p>	<p>See pp. 20-21</p> <p>We mention these possibilities, but we did not find sufficient research literature to justify a conclusion.</p> <p>Deleted; we agree.</p>

Reviewer Name	Affiliation	Chpt	Pg	Ln	Comment	Authors' Response to Comment
					<p>stakeholders.” (emphasis added) Yet it is unclear where in the chapter such a promotion has a basis. More importantly, while we generally encourage involvement of “stakeholders” in issues of mitigation and adaptation, we think the reference to “discussions” without some indication about who the other parties thereto would be and about the nature of them is vague and open-ended. What is intended by “discussions”? In short, the conclusion is too general and does not appear to deserve the likelihood parenthetical assigned to this conclusion.</p> <p>In regards to the recommendations, we view them as weak and too vague. Most importantly, none address adaptation.</p>	<p>Recommendation regarding adaptation added. Given the limits of the available research base, it is difficult to get very specific.</p>
<p>Kim Knowlton and Gina Solomon</p>	<p>NRDC</p>	<p>4</p>	<p>NA</p>	<p>NA</p>	<p>Climate disruptions on a global scale are already causing millions of people to relocate into new areas, and there should be more discussion of the potential effects of these “environmental refugees” on US civil society.</p> <p>UN University (UNU) predicts that “by 2010 the world will need to cope with as many as 50 million people escaping the effects of creeping environmental deterioration,” noting that sea level rise, increasing desertification and catastrophic weather-induced flooding have already contributed to large permanent migrations (Space Daily 2005). Although mentioned in Chapter 2, if the United States becomes a refuge in the future for those people forced to leave their former homes after climate change-related disasters, there could be tremendous impacts on the economic and public health infrastructure in the US. Most such displaced people today migrate within their own country, as evidenced by post-hurricane relocations in 2005, but many others cross national borders (Space Daily 2005). The term “environmental refugee” needs further clarification to address the compound environmental, economic and political motives behind migration, yet it should become part of the domestic US lexicon.</p>	<p>We agree in principle, but effects of such processes due to climate change are still speculative for US cities.</p>
<p>Kim Knowlton and Gina Solomon</p>	<p>NRDC</p>	<p>4</p>	<p>NA</p>	<p>NA</p>	<p><i>(This comment is duplicated for Chapter 3)</i> Regulations that limit where and with what materials residences can be built in areas at-risk from wildfires, hurricane, storm surge and storm events are not discussed in the draft report as adaptive mechanisms that may limit human settlement and health damages.</p> <p>There is now strong evidence that wildfires, precipitation</p>	<p>This appears to suggest a research need rather than a research finding. Will discuss with the SAP 4.6 leadership and author team.</p>

Reviewer Name	Affiliation	Chpt	Pg	Ln	Comment	Authors' Response to Comment
					<p>patterns, and snowmelt are being influenced by anthropogenic climate change (IPCC 2007 pp. 7-22). A combination of climate-related changes in forest pests, diseases and fire are projected to have “increasing impacts on forests, with an extended period of high fire risk and large increases in area burned.” (IPCC 2007 pp. 14 and 18) Two primary ways that global warming can increase the threat of fire are by increasing oscillations between periods of increased precipitation and periods of drought (as projected in some climate scenarios) which could increase fuel loads and create extreme fire conditions; and by warmer temperatures with consequent lower moisture content in soils. Increased fuel could thus create increased fire risk, which would be further exacerbated by high winds and heat waves (Nelson et al. 2007). While it remains controversial, this would be an appropriate context in which to discuss appropriate ways to limit further expansion of residential building into at-risk locations, or to regulate the types of materials used in such locations. For example, the density and flammability of buildings at the wildland-urban interface could be taken into account and regulated to help mitigate forest fire risks (Spyratos et al. 2007).</p>	
<p>William L. Fang and Eric Holdsworth</p>	<p>EEI</p>	<p>5</p>	<p>1</p>	<p>1 to 2, Table 1</p>	<p>[Note: the pages in this chapter appear to be miss-numbered. There are several page “1’s”.] Table 1 is titled “Categorization of Welfare and Quality of Life”, presumably in the U.S., although not so stated. The first column is headed “Category of Welfare” and it is followed by four columns. The fourth is headed “Examples of Climate Linkage, which, according to p. 5, lines 36-37, are “some examples of climate impacts that may be linked to that category.” It probably should be headed “Negative Examples of Climate Leakages”, because all of the listed so-called links are negative and none have any timeframe. For example, in the case of “Economic Conditions”, the fourth column’s “Climate Leakages” are two with the second being: “Higher electricity prices resulting from increased demand for air conditioning as average temperatures and frequency of heat use.” For the “Government and public safety”, the “Climate Linkage” is: “Dislocations and pressures created by climate change stressors can place significant new burdens on police, fire and emergency services.”</p>	<p>This page numbering problem has been corrected. The word negative has been added to the table, and clarifying material added to the text. The table is intended to be illustrative and not to represent recommendations or a definitive list of climate impacts. The authors believe that it serves that purpose and are leaving it in the document.</p>

Reviewer Name	Affiliation	Chpt	Pg	Ln	Comment	Authors' Response to Comment
					We view these examples of “Climate Linkage” as far too general and negative and clearly not related to any timeframe. We urge reconsideration of the Table.	
	EEI	5	1	19	<i>(This comment is duplicated for Chapter 2 and Chapter 4)</i> In Chapter 4 (Page 2 Line 10-11), the reference is to “human settlements”, which is defined in the Glossary as “[a] place or area occupied by settlers”. (see App. 1, p. 7) However, it is also apparently intended to include “U.S. cities and smaller settlements”. However, in Chapter 2 the reference is to “American communities” (e.g., Chapter 2, p. 17, line 27). Similarly, Chapter 5 uses the term “communities” [e.g. Page 1 Line 19]. While it appears that these two terms (i.e., settlements and communities) are used interchangeably in the draft, we are not sure why both are selected. Having two such terms in the draft suggests that the authors intend some different meaning. We think a clarification is needed.	Welfare chapter does not use the term Settlements.
William L. Fang and Eric Holdsworth	EEI	5	7	33 to 34	Section 5.3, titled “An Economic Approach to Human Welfare” states on lines 33-34 that such an approach “is not appropriate in all circumstances, and is often viewed as controversial in the context of climate change”. However, as far as we can tell, the chapter does not identify the “circumstances” when it “is not appropriate”, nor does it elaborate about the nature and extent of the controversy “in the context of climate change”. We think in both cases explanations are needed.	The text has been edited slightly, and explanations of both points have been added, including references to the recent IPCC Synthesis Report.
William L. Fang and Eric Holdsworth	EEI	5	11	1 to 45	This page begins by stating that the “U.S. is a developed country with a temperate climate” and because of its “well-developed health infrastructure” and “greater involvement” of government and NGOs, “the health effects from climate change are expected to be less significant than in the developing world”. Nevertheless, the “U.S. will face difficult challenges”. It then goes on to list some of those challenges and their impacts with the use of the rather positive word “will” quite frequently (e.g., lines 7, 8, 9, 10) rather than referencing, as appropriate, the “Likelihood” estimates of probabilities in Table 1 of the draft’s Introduction. The page also provides examples in bullet format of some “[s]pecific effects on health”. In the first bullet, the words “most likely” are used, which are not a probability “likelihood” term listed in Table 1 of the Introduction. The second bullet states that climate change is “predicted” to alter the “frequency, timing”, etc., of “extreme weather events”,	Comparison with the developing world has been deleted. Use of the term “most likely” has been discontinued. The word prediction has been replaced with projected throughout the draft. Discussion of health effects in this chapter has been edited to conform with the Health chapter.

Reviewer Name	Affiliation	Chpt	Pg	Ln	Comment	Authors' Response to Comment
					which is defined in the draft's Glossary. We question the use of the word "predicted" as opposed to "projection", in light of the 4th Assessment Report's Working Group I conclusions, which are cast as projections.	
John Kinsman	EEI	5	11	27 to 32	Due to a possible glitch in page numbering, note that this comment refers to the text in the section entitled, "Overview of Health Effects of Climate Change." – The uncertainties listed in bullet 3 are valid and should inform the rest of the report. Most notable is the statement, "Consequently, overall effects of climate change on respiratory health are variable and, therefore, difficult to predict."	Page numbering glitch has been fixed in this draft.
William L. Fang and Eric Holdsworth	EEI	5	25	26 to 36	In both lines, the word "predicted" is used and the "EPA" is cited as a 1995 source. No timeframe is provided for when these predictions will, in fact, materialize. We question whether these are EPA predictions or merely possible projections. If there are predictions, we wonder what the basis is for them.	Changed word to projected here an in other cases.
William L. Fang and Eric Holdsworth	EEI	5	26	11	The sentence beginning on line 11 refers to a source as finding that "most National Park resources will be adversely affected by climate change". (emphasis added) We note that the words "National Park" are capitalized. We question, however, whether this reference is just to "National Parks" in the U.S. or does it include other areas of the National Park System, such as recreation areas and seashores. Further, the word "most" seems very comprehensive, given the number of National Parks within the U.S. National Park system.	We have revised this sentence in two ways. First the report we cite focuses just on western units of the National Park System. But the commentors are correct, that the analysis covers more than just National Parks, and includes National Recreation Areas and National Monuments. Both these points are clarified in the revision. Second, "most" is changed to "many" to be more consistent with the fact there are literally hundreds of individual units of the National Park System, and the authors primarily focused on major units.
Kim Knowlton and Gina Solomon	NRDC	5	38	1 to 2	There needs to be additional discussion of the significant undesirable feedbacks between the increased use of air conditioning, a likely first compensatory response to climate change, and further increases in greenhouse gas emissions that further exacerbate warming. While central air conditioning has value in offering short-term relief for summer heat, a number of recent studies point out that it is not a sustainable long-term adaptive technology because air conditioners require large amounts of electricity. Electricity generation causes 40% of carbon dioxide emissions in the US and thus severely aggravates global warming. Air conditioners are currently the single biggest user of electricity in American homes (16% of residential electricity consumption). Increasing the usage of air conditioning would increase electrical demand and exacerbate global warming trends by increasing greenhouse gas emissions from power plants.	The focus of this chapter is on a few discrete aspects of economic welfare, and on what the literature states about impacts in those areas (health, ecosystems, etc.). While we recognize that there are co-benefits and dis-benefits associated with adaptation, they are outside the scope of this chapter. This issue is, we believe, discussed in the health chapter.

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					Residential electricity consumption already accounts for over 14% of US carbon dioxide emissions. Furthermore, use of air conditioning during heat waves drastically increases peak demand in cities, which can lead to power outages that remove the ability to deliver air conditioning as well as other forms of refrigeration, health-adaptive technologies, and protective responses to heat. While mentioned in passing in Chapter 5, there is a need for more discussion of the pressing need for widely available, high-efficiency, low energy-demand residential cooling systems.	
J. Alan Roberson	AWWA	5	3 to 6	NA	Drinking water utilities may be affected by how the value of water changes with global climate change. An economic approach to the effects of global climate change on human welfare was examined, including climate amenities. While it is not mentioned in the Report, and may fall slightly outside of the scope, it is interesting to think of this idea from the side of drinking water utilities. As more people move to the arid Southwest, what value will they attach to reliable and clean drinking water supplies? With increased water shortages, will people be willing to give up having a green lawn in the desert? If water quality in a community deteriorates, will they be willing to pay to improve their drinking water treatment? The value of water is discussed by Raucher (2005), and further consideration of this idea might be warranted in light of the impacts of climate change.	This is an interesting idea, but we did not find literature on this welfare effect and so did not report it.
John Kinsman	EEI	App 1	5	NA	The definition of “External cost” provides an inappropriate example that should be modified. There is no justification to defining external cost with a single example of emissions of particulate matter for a power station. Virtually any release of any substance from any source could be used as an example. If such an example must be retained, change the wording to something like “Emissions of an air pollutant from an industrial source....”	We agree. This edit was incorporated.
Kim Knowlton and Gina Solomon	NRDC	App 1	5	NA	<i>(This comment is duplicated in Chapter 2)</i> Climate disruptions on a global scale are already causing millions of people to relocate into new areas, and there should be more discussion of the potential effects of these “environmental refugees” on US civil society. UN University (UNU) predicts that “by 2010 the world will need to cope with as many as 50 million people escaping the effects of creeping environmental deterioration,” noting that sea level rise, increasing desertification and catastrophic weather-induced flooding	We agree.

Reviewer Name	Affiliation	Chpt	Pg	Ln	Comment	Authors' Response to Comment
					have already contributed to large permanent migrations. Although mentioned here in Chapter 2, if the United States becomes a refuge in the future for those people forced to leave their former homes after climate change-related disasters, there could be tremendous impacts on the economic and public health infrastructure in the US. Most such displaced people today migrate within their own country, as evidenced by post-hurricane relocations in 2005, but many others cross national borders. The term “environmental refugee” needs further clarification to address the compound environmental, economic and political motives behind migration, yet it should become part of the domestic US lexicon. Plans for how US civil society could adapt and provide the necessary services for periodic sudden influxes of “environmental refugees” is among the challenging topics that should be discussed in more detail in Chapter 5 on Human Welfare, and added to the Glossary of key terms in Appendix I.	
William L. Fang and Eric Holdsworth	EEI	App 1	NA	NA	This Appendix states that the draft Glossary is “[d]erived from Intergovernmental Panel on Climate Change Third Assessment Report, Working Group II. The statement appears somewhat unclear because a comparison of the draft Glossary to be above-referenced 2001 Working Group II indicates that a number of words in that Glossary “Annex B: Glossary of Terms” are not included in the draft and some words, such as “Atmosphere”, and “co-benefits” and “cost-effective”, are not in the Group’s Glossary. We think a better explanation or clarification is needed. Also, we wonder why the draft does not adopt definitions from the 4th Assessment.	The source material for the Glossary has been more clearly labeled as to origin.
Kim Knowlton and Gina Solomon	NRDC	ES	2	3 to 5	The authors do a commendable job in describing how “the challenges presented by population growth, an aging population, migration patterns, and urban and coastal development are likely to be compounded by changes in temperature, precipitation, and extreme climate-related events.” The report is a highly readable document that attempts to synthesize current knowledge about interacting natural and human societal systems and draw a comprehensive picture of how global warming will affect the US. Undoubtedly it will be accessible to and read by a wide public and policymaking audience.	Thank you.
John Kinsman	EEI	ES	3	Table 1	In the last two items of the Table under the column titled “Climate Factor”, the reference to the words “Air Pollution” should be changed to “Air Quality” consistent with the last	We agree.

Reviewer Name	Affiliation	Chpt	Pg	Ln	Comment	Authors' Response to Comment
					<p>column titled “Adaptation Strategies”, which references “air quality” action and advisories. The term “air pollution” is a term used and defined in law, such as the Clean Air Act and in State statutes. It is not a “climate” (as that term is defined in the draft Glossary) factor. Further, regarding the first “Air Pollution” entry, the Adaptation Strategy should be revised to state “Public health air quality advisories and government air quality “action” day activities related to fuels, transportation, and energy usage.” The current reference to HVAC as an action day choice seems very narrow and is unclearly worded. Further, the first “Air Pollution” entry refers to “aeroallergens”, which is unclear and certainly not an air “pollution” issue; changing the wording to “air quality” will alleviate this problem.</p>	
John Kinsman	EEI	ES	3	Table 1	<p>The text defines as “very likely” (which means 90% probability, per Table 1, Page 14, Chapter 1) aggravated air pollution, defined as increased ozone caused by higher temperatures, in urban centers in the west, the southwest, the mid-Atlantic, and the northeast. There is substantial uncertainty in how different factors (temperature, increases in mixing heights, precipitation changes, wind speeds) may affect ozone and results from different modeling exercises can be quite different, so it is surprising that such a strong likelihood is assigned to this assessment. We believe a “likely” or 66% probability is more reasonable. The statement from Chapter: 5, Page: 11, Bullet 3 – “Consequently, overall effects of climate change on respiratory health are variable and, therefore, difficult to predict.” – should be heeded here.</p>	We agree.
Sabrina McCormick	MSU	ES	3	Table 1 'Human Health'	<p>Extreme temperature adaptation strategies box should include greening urban spaces and usage of reflective roofs. Hurricane storm surge adaptive strategy box should also include a measure that would be provided by social service or government agencies since many people many not have the capacity to just follow directions. For example, provide transportation away from surge site. Air pollution (temperature) adaptation strategy should be stronger since that is already happening in some countries. For example, charge motorists for driving in congested urban areas. Air pollution (wildfire) adaptation strategy should also include a preventative measure of some sort.</p>	Points well taken.

Reviewer Name	Affiliation	Chpt	Pg	Ln	Comment	Authors' Response to Comment
Sabrina McCormick	MSU	ES	4	Table 1 'Human Welfare'	<p>Extreme temperature adaptation strategies box should include greening urban spaces and usage of reflective roofs.</p> <p>Hurricane storm surge adaptive strategy box should also include a measure that would be provided by social service or government agencies since many people many not have the capacity to just follow directions. For example, provide transportation away from surge site.</p> <p>Air pollution (temperature) adaptation strategy should be stronger since that is already happening in some countries. For example, charge motorists for driving in congested urban areas.</p> <p>Air pollution (wildfire) adaptation strategy should also include a preventative measure of some sort.</p>	Additions made to text to reflect this point.
Kim Knowlton and Gina Solomon	NRDC	ES	4	Table 1	<p>Under “Human Settlements,” “Wildfires” could include reference to possible regulations that limit where and with what materials residences can be built in areas at-risk from wildfires, hurricane, storm surge and storm events. For example, the density and flammability of buildings at the wildland-urban interface could be taken into account and regulated to help mitigate forest fire risks. These are not discussed in the draft report as adaptive mechanisms that may limit human settlement and health damages. There is now strong evidence that wildfires, precipitation patterns, and snowmelt are being influenced by anthropogenic climate change. A combination of climate-related changes in forest pests, diseases and fire are projected to have “increasing impacts on forests, with an extended period of high fire risk and large increases in area burned.” Two primary ways that global warming can increase the threat of fire are by increasing oscillations between periods of increased precipitation and periods of drought (as projected in some climate scenarios) which could increase fuel loads and create extreme fire conditions; and by warmer temperatures with consequent lower moisture content in soils. Increased fuel could thus create increased fire risk, which would be further exacerbated by high winds and heat waves. While it remains controversial, this would be an appropriate context in which to discuss appropriate ways to limit further expansion of residential building into at-risk locations, or to regulate the types of materials used in such locations.</p>	Point well taken. But, the report is pointedly NOT policy proscriptive
William L. Fang and	EEl	ES	5	5, 6, 14	We question the statement in the sentence beginning on line 5 and ending on line 6 that highlights “declining costs of airline	We agree.

Reviewer Name	Affiliation	Chpt	Pg	Ln	Comment	Authors' Response to Comment
Eric Holdsworth					travel” as having contributed significantly to making “remote locations more accessible for work or retirement”. We think that the widespread availability of transportation facilities, including cars, planes, trains, etc., and transportation infrastructure may have made such a contribution, but not airline travel or assessed declining costs thereof alone. We therefore suggest changing the words “declining costs of air travel” to “the expansion and ready availability of transportation sources and infrastructure”. On page 5, line 14 insert “Change” after the word “Climate”. This is consistent with the headings on page 6, line 26 and page 8, line 22.	
John Kinsman	EEI	ES	6	9 to 11	These two sentences are somewhat misleading, as is the similar coverage of the issue of increased ozone due to warmer days throughout the document. The Clean Air Act requires through state plans reductions of emissions sufficient to meet the National Ambient Air Quality Standard (NAAQS) for ozone. Substantial progress has been achieved – e.g., see EPA’s ozone trends information at http://www.epa.gov/airtrends/ozone.html . Emissions of nitrogen oxides (NOx) from electric generators in the Eastern U.S. during the summer ozone season have declined 72% from 1990 to 2005 due to the 1990 Clean Air Act’s acid rain program combined with the 1998 NOx SIP Call – see http://www.epa.gov/airmarkets/progress/docs/2005-NBP-Compliance-Report.pdf . Further reductions will occur due to the Clean Air Interstate Rule and other EPA programs to control emissions of NOx and VOCs from other types of sources. EPA, the states and emission sources will continue to reduce emissions until standards are met. The success of this effort can be seen in the numerous recent EPA final rules redesignating counties as complying with the 1997 8-hour ozone standard. Further, EPA is almost certain to tighten the primary 8-hour ozone standard in 2008 and may establish a secondary standard. These would drive even greater emission control actions. The bottom line is that ozone levels are being reduced and will continue to decline, as mandated by the Clean Air Act, EPA and states through concrete emission controls programs, emission monitoring, operating permits, etc. This report needs to put in the proper future ozone levels. In other words, while it is likely that climate change could increase ozone levels, because ozone levels are	Edit made to address these concerns.

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Kim Knowlton and Gina Solomon	NRDC	ES	6	21 to 25	<p>declining due to air quality programs, future ozone levels most likely will still be lower than levels of today.</p> <p>The US CCSP has grappled with an enormous variety of human health and societal impacts for the United States across a wide variety of affected sectors. We commend the authors for synthesizing elements from many of the various human dimensions of global warming impacts, and have suggested areas in which more attention could be paid to some salient areas for further discussion. While the United States is indeed fortunate to have relatively high adaptive capacity as a developed nation, the recent experiences of Hurricanes Katrina and Rita has shown us how vulnerable our emergency preparedness and healthcare systems are, and the extent to which some communities suffer from a lack of coping capacity. The authors refer to the environmental justice issues that climate change will pose when they state, "...Climate change is very likely to accentuate the disparities already evident in the American health care system. Many of the expected health effects are likely to fall disproportionately on the poor, the elderly, the disabled, and the uninsured. The most important adaptation to ameliorate health effects from climate change is to support and maintain the United States' public health infrastructure."</p> <p>The relevant research and current thinking on these topics should be brought to bear as American society considers how we will improve the public health infrastructure to help our communities cope with the burden of climate change impacts.</p>	We agree.
Hans-Martin Fuessel	PICIR	ES	8	Figure 1	<p>I generally welcome inclusion of this figure, which shows differential vulnerability of human welfare across US counties. Given that a large variety of vulnerability and risk indices are in use, and that the term "vulnerability" itself is used in a variety of ways (see my paper in <i>Global Environmental Change</i> 17(2):155-167), however, detailed explanatory text is needed with this diagram, explaining the endpoints assessed, the methodology used, underlying assumptions (if any), etc. The only reference in the text is to a forthcoming paper, which is insufficient for the reader to appreciate the results presented in this diagram. Furthermore, given the many uncertainties about vulnerability factors and their interaction, stating vulnerability quantitatively with seven significant digits, but without specifying the metrics, gives a completely wrong impression on the level of</p>	We are undecided as to the determination of keeping or dropping this figure.

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John Kinsman	EEI	ES	10	Table 2	<p>understanding of vulnerability to climate change.</p> <p>In this table, currently New England does not warrant identification of Air Quality as being degraded in the summer, despite the page 3 reference to the Northeast and the page 6 reference to Northern latitudes as having potential concerns with degraded air quality with climate change.</p>	A correction has been made.
William L. Fang and Eric Holdsworth	EEI	ES	1 to 2	Title, Abstract	<p>The Edison Electric Institute (EEI) appreciates the opportunity to comment, pursuant to the July 20, 2007 Federal Register notice of the National Oceanic and Atmospheric Administration (NOAA), on the draft SAP 4.6 report of the U.S. Climate Change Science Program (CCSP), 72 Fed. Reg. 39798.. EEI welcomes the focus of the analysis provided by the draft of the effects of global climate change, “especially the effects of climate variability and change” (as those terms are defined in the draft’s Glossary) “on human health, human settlements and human welfare”. We note, however, that while the Executive Summary’s “Abstract”, its Table ES 1, and its Figure ES 1, and some other parts of such Summary indicate that the analyses is about such effects “in the United States”, no where in the above-referenced Federal Register notice, the CCSP letter of invitation for public comments, the Executive Summary, or the draft itself is there a clearly expressed statement that such analysis is solely about the potential effects of climate change on these “three broad dimensions of the human condition” in the “United States”. We think that, at a minimum, the draft title that appears on page 1, lines 3 and 4 of the Executive Summary should be revised to read as follows:</p> <p>“Analyses of the Effects of Global Change on Human Health and Welfare and Human Systems in the United States.”</p> <p>Similarly, we believe that the words “in the United States” should also be inserted in the second paragraph of the “Abstract”, on page 2, line 15 after the word “impacts”.</p> <p>Consistent with the last sentence of the second paragraph of the “Abstract”, we believe that the word “potential” should be inserted on page 2, line 6 before the word “impacts” and that the word “potential” on line 8 should be deleted. We believe that consistent with the draft, the “Abstract” needs to convey that not all climate change will adversely affect “individuals and communities” or settlements in the United States, nor will all such “impacts” always be attributed to “climate change”, but many will be attributed to “climate”, as that term is</p>	Yes and No.

Reviewer Name	Affiliation	Chpt	Pg	Ln	Comment	Authors' Response to Comment
					<p>defined in the draft’s Glossary or weather. Indeed, some such impacts, such as rainfall and tropical storms that occur in drought affected areas of the U.S., may likely be beneficial. Thus, adding the qualifying word “potential” where we urge in the paragraph is important and significant.</p> <p>Also, in the first paragraph of the “Abstract”, we think that the words “anticipated changes”, page 2, line 8, should be changed to “potential impacts” consistent with the preceding sentences of this paragraph.</p> <p>Lastly, in the first paragraph of the “Abstract”, we question the characterization of the United States as a “wealthy” society. It is unclear what message the authors used for such a statement. We note that Webster’s New World College Dictionary, 4th ed. defines the word “wealthy” as “(1) having wealth; rich; prosperous affluent (2) of, characterized by, or suggestive of wealth (3) rich or abundant (in something specific).” (p. 1620). We think such a characterization is inappropriate. Like many developed or industrialized countries, the United States is fortunate to have many natural and other resources. But that does not translate into the U.S. or any other developed country being a “wealthy society”. We think the words “wealthy societies” on page 2, lines 5-6, should be changed to either “developed country” or “industrialized societies”, either of which would distinguish the U.S. from developing countries and lesser developed country nations, as that term is used by the United Nations.</p>	
J. Alan Roberson	AWWA	General	NA	NA	<p>The American Water Works Association (AWWA) is an international, nonprofit, scientific and educational society dedicated to the improvement of drinking water quality and supply. Founded in 1881, the Association is the largest organization of water supply professionals in the world. Our 60,000 plus members represent the full spectrum of the drinking water community: treatment plant operators and managers, environmental advocates, engineers, scientists, academicians, and others who hold a genuine interest in water supply and public health. Our membership includes more than 4,700 utilities that supply roughly 80 percent of the nation's drinking water.</p> <p>AWWA appreciates the opportunity to comment on the above referenced document. The July 20th Federal Register notice on the availability of this document for public comment</p>	Thank you for the thoughtful discussion re: water quality impacts.

Reviewer Name	Affiliation	Chpt	Pg	Ln	Comment	Authors' Response to Comment
					<p>represents one of the initial opportunities for the water sector to provide its perspective on the potential impacts of climate change to water quantity and quality. AWWA recommends that climate change impacts on relationships between water quantity and water quality become a research priority for NOAA, the Environmental Protection Agency (EPA), the Centers for Disease Control and Prevention (CDC), and other federal agencies involved the water sector. More detailed comments on this specific Synthesis and Assessment Product 4.6 (SAP 4.6) follow the general comments in this letter.</p> <p>The potential for major impacts of climate change on water supply and wastewater utilities is becoming clearer all the time. It is increasingly evident that impacts could be on a large enough scale financially, and within a near enough timeframe, to elevate adaptation to a serious priority in today's planning for new water supplies and water and wastewater infrastructure that is designed to last for decades. While there are some obvious steps utilities can take now to anticipate potential impacts of climate change, more research is needed to improve our understanding of climate change processes and adaptation options.</p> <p>Climate change could have substantial impacts on water quality with important implications for capital and operating expenditures related to water treatment. In general, AWWA recommends that climate change impacts on relationships between water quantity and water quality become a research priority for Federal agencies. Many issues particularly relevant to drinking water treatment deserve specific research attention and increased research funding. For example, more intense storms could produce much wider variations in turbidity which is a major challenge to drinking water treatment plants. From a regulatory perspective under the Long-Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR), this could translate into a change in the treatment required ("the bin") if the average concentration of Cryptosporidium changes in the second round of required monitoring for Cryptosporidium starting in 2015. Similar changes could impact Total Organic Carbon (TOC) concentrations that are a significant factor in compliance with Disinfection By-Product (DBP) regulations. Increased</p>	

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					<p>sediment loads could challenge treatment plants in meeting the new, more stringent turbidity regulations. The impacts to reservoirs are unknown, and there is a general trend in reservoirs towards eutrophication, which can increase algal blooms that increase TOC concentrations and/or produce algal toxins. In general, decreased water quality due to higher runoff rates or other related factors could challenge water treatment plants in meeting the regulations.</p> <p>The research on the potential impacts to drinking water utilities has been started by EPA's Office of Research and Development (ORD) with some initial research conducted by Stratus Consulting and American Water Service Company. The Awwa Research Foundation (AwwaRF) has conducted the following research with the National Center of Atmospheric Research (NCAR):</p> <ul style="list-style-type: none"> • Climate Change and Water Resources: A Primer for Municipal Water Providers (completed in 2006); and • Incorporating Climate Change Information in Water Utility Planning: A Collaborative, Decision-Analytic Approach (ongoing). <p>AwwaRF is also participating in a climate change research needs workshop being sponsored by the United Kingdom Water Institute for Research (UKWIR) in late September.</p> <p>All of this initial research highlighted the need for an increased knowledge base in order to help water utilities plan the way forward. Again, more research is needed to better understand the potential impacts to water utilities.</p> <p>If you have any questions about these comments, please feel to call Alan Roberson or me in our Washington Office at 202-628-8303.</p>	
Kim Knowlton and Gina Solomon	NRDC	General	NA	NA	These comments are submitted by the Natural Resources Defense Council (NRDC), who on behalf of our 1.2 million members and online activists, uses law and science to protect the planet's wildlife and wild places and to ensure a safe and healthy environment for all living things.	Thank you.
Kim Knowlton and Gina	NRDC	General	NA	NA	NRDC appreciates the significant amount of time spent by the authors in the preparation of this report, which is one of 212 synthesis and assessment products being prepared by the US	Thanks for the positive comments.

Reviewer Name	Affiliation	Chpt	Pg	Ln	Comment	Authors' Response to Comment
Solomon					<p>CCSP. This compilation and critical review of evidence pertaining to national and regional effects of global change on human health and welfare makes an appreciable contribution in its wide purview of various climate-sensitive sectors. The authors do a commendable job of describing how “the challenges presented by population growth, an aging population, migration patterns, and urban and coastal development are likely to be compounded by changes in temperature, precipitation, and extreme climate-related events.” (USCCSP 2007, ES, p. 2 of 10, Lines 3-5.) The report is a highly readable document that attempts to synthesize current knowledge about interacting natural and human societal systems and draw a comprehensive picture of how global warming will affect the US. Undoubtedly it will be accessible to and read by a wide public and policymaking audience. However, there are some climate impacts issues for which more of the available health-relevant research could be included in this draft report. Brief descriptions of some major points in these areas follow.</p>	