

**Request for Assessment of Climate Change Scenarios and Analysis Procedures by
Climate Change Technical Advisory Group (CCTAG)
March 30, 2012**

The California Department of Water Resources (DWR)—Climate Change Framework Workgroup (Workgroup) has been tasked with developing a guidance document and tools to assist DWR project managers with meeting the need for including climate change analysis in their planning activities and guiding their decision making process in selecting analytical tools, assumptions about future conditions, and analysis procedures.

Based on analysis of past projects, the Workgroup has determined that it is desirable for DWR to have a recommended set of future climate scenarios and associated hydrologic impact analyses to be used for analysis of future conditions for most planning purposes. The Workgroup requests that the Climate Change Technical Advisory Group provide review, guidance, and recommendations on the selection of future climate scenarios and the use of those scenarios for DWR planning purposes.

The anticipated major outcomes from this task:

1. Detailed recommendations on a suite of climate scenarios appropriate for DWR's planning activities.
2. Detailed recommendations on whether climate model outputs should be adjusted with historical data for DWR's planning activities and the most appropriate methodology for doing so.
3. Detailed recommendations on whether hydrology model projections should be adjusted with historical data and the most appropriate methodology for doing so.

Additional potential outcomes:

1. Extreme climate change scenarios (prolonged drought or wet periods) that represent very challenging scenarios of potential climate changes, potentially informed by paleo-climate records.
2. Interim guidance on projecting and modeling extreme weather events that cause flooding.

Background

DWR recently completed a study of climate change characterization and analysis approaches used by DWR and its partners (Khan and Schwarz, 2010). The Study found that a range of approaches had been used and that DWR lacked consistency in both characterization of future climate conditions (how hot will it get, how will precipitation change) and in its analysis of how climate changes will impact hydrology (how will climate changes effect streamflow and State Water Project Operations). The study of past projects indicated that while there may be important reasons for using different approaches for different types of studies, more consistency is needed.

Analysis of past projects indicate that DWR's dominant use of climate change projections is for eliciting temperature, precipitation, and humidity data which were used to generate projections of future hydrology needed for the various types of planning studies. Past projects have used a variety of approaches but most projects have used the 12 climate scenarios identified by the Climate Action Team in 2009 (Cayan et al 2009). In 2010, as part of the Bay Delta Conservation Plan, a new set of climate scenarios was developed using an ensemble informed approach (CH2MHill 2009). Since the development of this ensemble approach, other programs within DWR have shown interest in using it.

Beyond the selection of climate change scenarios, DWR has used several different methods for using temperature, precipitation, and humidity data to generate hydrologic projections. The climate data are used to drive a hydrology model which generates streamflow projections. However, two different streamflow projection approaches have been used at DWR. One approach uses the model generated streamflows as is. The other approach was to use the model generated streamflows to develop perturbation factors which are then applied to the historical observed streamflow record (in order to skew the historical record up or down).

Scope

- A. The Workgroup would like assistance with development of a set of future climate scenarios and analysis procedures. The CCTAG will be asked to
 1. Review and become familiar with the approaches to characterizing and analyzing climate change that DWR has taken in previous reports and planning studies as detailed in Khan and Schwarz (2010). *Characterization and Analysis of Climate Change in California Water Resources Planning Studies*.
 2. Review various regionally downscaled climate scenarios or ensembles of regionally downscaled climate scenarios and provide detailed recommendations on a suite of climate scenarios appropriate for DWR's planning activities.
 3. Review various approaches for adjusting climate model outputs with historical data (e.g. quantile mapping) and provide detailed recommendations on whether climate model outputs should be adjusted with historical data for DWR's planning activities and the most appropriate methodology for doing so.
 4. Review of various approaches for adjusting hydrology model projections with historical data and provide detailed recommendations on whether hydrology model projections should be adjusted with historical data for DWR's planning activities and the most appropriate methodology for doing so.

As background for approaches and methods that DWR has used in the past, the Workgroup recommends that the CCTAG review the following documents:

1. Cayan et al. (2009). *Climate Change Scenarios and Sea Level Rise Estimates for California 2008 Climate Change Scenarios Assessment*

2. Draft Bay Delta Conservation Plan- Appendix E2: Physical Modeling Methods, Chapter 1: Climate and Sea Level Change Scenarios- Methods
3. National Research Council (2011). *A Review of the Use of Science and Adaptive Management in California's Draft Bay Delta Conservation Plan*

Based on the analysis of past and upcoming DWR projects, the Workgroup has identified several business uses of climate change analysis. The Workgroup asks that the CCTAG consider these uses when making recommendations so as to ensure that the recommendations are implementable for DWR:

- DWR engages in a number of general planning activities which project general conditions or impacts at future time periods. These studies often look at future variables in addition to climate change (e.g., population and land use). In these studies DWR typically wishes to explore a range of potential futures conditions that are understood to exist in the available projections of future climate change.
 - DWR also engages in climate change analysis pursuant to evaluations of specific projects proposed for implementation. These analyses are typically conducted for California Environmental Quality Act (CEQA) or federal feasibility studies. For these types of studies the analysis is very detailed often involving multiple linked models and analysis of multiple resource areas. For such analyses it is often necessary to establish “future conditions with and without the project”. Time and resource constraints on these projects often make analysis of multiple potential futures infeasible. And several past projects have elected to define a single scenario as indicative of the potential impacts of climate change and have relied on a single scenario of climate change to analyze impacts on all resource areas. For these types of analysis, a sensitivity analysis, is often, but not always, done.
- B. The Workgroup would also like assistance from the CCTAG to include the following additional aspects into a set of future climate scenarios:
1. An extreme climate change scenario or scenarios (i.e. extended drought or extremely wet periods) that represent very challenging scenarios of potential climate changes. Such scenarios would be used to “stress test” critical facilities.
 2. Evaluate extreme climate states (prolonged drought or wet periods) that have occurred in the past as represented by paleo-climate records.
- C. Finally, review of past studies indicates that DWR has not developed analytical procedures for evaluating the impact of climate change on flooding, though significant work has been done in this area, for example, threshold analysis for flood management being developed for use in the Central Valley Flood Protection Plan (DWR, 2010). If time permits, the Workgroup would also like assistance from the CCTAG to review work done by for the Central Valley Flood Protection Plan and to provide interim guidance on projecting and modeling extreme weather events that cause flooding¹.

¹ The 2012 CVFPP is not likely to include a complete climate change analysis; the 2017 CVFPP is expected to include a complete climate change analysis using the Threshold Approach.

References

Cayan, D.; Tyree, M.; Dettinger, M.; Hidalgo, H.; Das, T.; Maurer, E.; Bromirski, P.; Graham, N.; Flick, R. 2009. *Climate Change Scenarios and Sea Level Rise Estimates for California - 2008 Climate Change Scenarios Assessment - Final Report*. Report number CEC-500-2009-014-F.

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CH2MHill. 2010 (unpublished). Draft Bay-Delta Conservation Plan—Methodology for Incorporating Climate Change. Technical memorandum.

Department of Water Resources. 2011. *Draft Technical Memorandum: Climate Change Threshold Analysis Work Plan*. <http://www.water.ca.gov/cvfm/docs/ThresholdAnalysisWorkPlan-DRAFT-20100930.pdf>

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http://www.water.ca.gov/climatechange/docs/DWR_CCCStudy_FinalReport_Dec23.pdf

National Research Council. 2011. *A Review of the Use of Science and Adaptive Management in California's Draft Bay Delta Conservation Plan*.

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