American Water Resources Association
2009 SUMMER SPECIALTY CONFERENCE
Adaptive Management of Water Resources II
June 29 – July 1, 2009
Snowbird, UT

Tuesday, June 30
1:30 PM – 3:00 PM
Session 22: Climate Change Adaption-Integrating Projections into Water Planning and Management

1. Climate Change Adaptation for a Coastal Watershed: Identifying Risk and Costs for Culvert Infrastructure - Michael Simpson, Resource Management and Conservation Program, Keene, NH (co-authors: Latham Stack, Thomas Crosslin, Derek Sowers, Colin Lawson)

Numerous studies have detected intensification of precipitation events consistent with climate change projections, as reported in the Fourth Assessment of the International Panel on Climate Change (IPCC). Communities may have a window of opportunity to prepare water resources infrastructures. However, information sufficiently reliable and specific to support local-scale adaptation programs is sparse The Piscataqua Region Estuaries Partnership (PREP) is one of twenty-eight National Estuary Programs administered by the U.S. Environmental Protection Agency (EPA). The National Estuary Program is developing climate change adaptation strategies through its “Climate Ready Estuaries” initiative. As part of this initiative, PREP convened a technical team to conduct a climate adaptation project in the Oyster River watershed in southeast New Hampshire. The study built upon methodologies developed for an water conveyance infrastructure impact study in Keene NH. This particular analysis utilized geographic information system watershed modeling techniques to examine the hydrologic impact of climate change and land use scenarios on existing culvert infrastructure. All culverts in the watershed were assessed and mapped with a standardized protocol. Data on culvert capacity and land use were used to create a nested GIS model that calculates current and projected runoff volumes for the 24-hour, 25-year precipitation event. Based on current zoning ordinance regulations, two build-out analyses were developed for the study watershed. These build-out scenarios were combined with an estimated, mid-21st century storm magnitudes and return intervals based upon the IPCC’s B1 and A1F1 global greenhouse gas emission scenarios. The output of these analyses demonstrated which culverts were at risk for each modeled scenario. Utilizing the model results, the project team developed recommendations for culvert improvements based on risk, cost, and infrastructure lifespan considerations. This study demonstrates the implementation of a quantified, local-scale, and actionable protocol for maintaining historical risk levels for communities facing significant impacts from climate change and population growth.

2. Quantifying the Impacts of Climate Change in Water Supply Planning for the City of San Diego - Tim Cox, CDM, Denver, CO (co-authors: Enrique Lopez-Calva, William Davis)

Climate change has become an important consideration in long-term urban water supply planning studies. California has been particularly proactive in this area in hopes of better enabling themselves to adapt to these changes. In this study we have directly incorporated climate change forecasts into a long-term water supply planning numerical model previously developed for the City of San Diego. We used downscaled Global Climate Model (GCM) predictions of temperature and precipitation, specific to the San Diego catchment, to predict local water supply availability and water demands for the City’s 2030 planning horizon. In order to capture some of the uncertainties associated with GCM predictions, we used output from six different climate models and two emission scenarios. For each emission scenario, data from the six models were pooled and sampled randomly, while maintaining appropriate correlations and couplings of data points, to generate a synthetic and stochastic 1000-year timeseries of monthly climate predictions. We translated these data into key stream flows, reservoir evaporation rates, and water demand climate adjustment factors using empirical regression models developed from historical observations. Statistically significant regression models were developed to quantify the relationships between the following parameters: reservoir inflows vs. monthly or water year total precipitation; monthly reservoir evaporative losses vs. monthly mean air temperature; and monthly City water demand modification factors vs. a combination of temperature and precipitation variables. We used the generated timeseries of flows and demand factors as input to our water supply planning model to investigate future water supply needs in light of climate change and subject to a greater range of hydrologic variability. Results of these simulations point toward an even greater need for imported or new water supplies and/or demand management in San Diego and an increased reliance on supplies other than local surface waters compared to previous forecasts.

3. A Simple Framework for Incorporating Climate-Driven Streamflow Forecasts into Existing Water Resource Management Practices - Lucien Wang, Columbia University, New York, NY (co-authors: Gavin Gong, Upmanu Lall)

Climate-based streamflow forecasting, coupled with an adaptive reservoir operation policy, can provide decision-support benefits for water suppliers and watershed stakeholders alike. However, water suppliers are often wary of straying too far from their current management practices, and prefer forecasts that can be incorporated into existing system modeling tools. We present a simple, straightforward framework for utilizing streamflow forecasts that works entirely within an existing traditional management structure. Climate-based seasonal inflow forecasts are simply coupled with daily historical inflow timeseries, current reservoir system states and existing reservoir system modeling software, to provide a forecast of anticipated reservoir system states. This future information is then used to inform existing operational policies during the forecast period, so that decisions are based on the forecasted rather than current states. As an example, this framework is applied to the upper Delaware River Basin in the northeast United States, and evaluated via a series of long-term continuous reservoir system simulations informed by historical hindcasts during the forecast period each year. Results indicate that tangible water management benefits can be achieved when forecast information is incorporated into reservoir management operations according to the framework developed here, in that additional releases are made available during predicted wet conditions, and drought events are mitigated during predicted dry conditions. However, the results are sensitive to the precision of the seasonal streamflow forecasts and the specifics of the incorporation framework. This sample application demonstrates the potential of this framework, and also highlights several limitations that could be improved upon in future applications. Overall, this simple approach offers a more easily adoptable alternative to the more intensive decision support applications that have been developed previously.