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

**Monday, June 29**
**3:30 PM – 5:00 PM**
**Session 11: Water Supply and Demand Adaptive Management II**

**1. Evaluating Future Physical Water Supply in Oklahoma - Travis Bogan**, CDM, Denver, CO (co-authors: John Rehring, Kyle Arthur, Gene Lilly, Cynthia Kitchens)

The Oklahoma Water Resources Board (OWRB) has initiated a major update of the Oklahoma Comprehensive Water Plan, which is being developed under a partnership between the United States Army Corps of Engineers (USACE) and OWRB. The plan organizes the state into watersheds in order to conduct an in-depth analysis of future water demands and available resources. The project team developed a Microsoft Access and GIS-based tool that identifies watersheds in which demands are expected to exceed physical supplies, indicating areas of potential "wet water" shortages and a need to more closely examine demands, supplies, and evaluate potential water supply solutions. Water rights data, hydrologic data, and demand forecasts are used to evaluate the "wet water" supply, i.e., physical water availability through the 2060 planning horizon using a monthly time step. The state was subdivided into 82 subwatersheds based on United States Geological Survey (USGS) Hydrologic Units 12 (HUC12) boundaries. An "incremental" methodology was developed to compare the incremental demand (i.e., difference between baseline condition and future condition) and the availability of incremental sources of water supply (i.e., the remaining sources of supply after meeting the baseline demands). The sources of supply evaluated include surface water stream flow, alluvial groundwater, and bedrock groundwater. Water demands considered in the gap analysis include municipal and industrial, rural residential independent, self-supply industrial, thermoelectric power, agriculture, livestock, mining, and oil and gas demands. For each sub-basin, the stream flow availability is estimated based on the historical flow records of a USGS gage at the basin outlet. The basis of the analysis assumes that the gaged flow record includes the water demand under the baseline conditions, and therefore, the gage data represents the remaining surface water that can be used to meet future demands. The gap analysis tool was programmed using Visual Basic in Microsoft Access to facilitate information management and provide a centralized database for input data and output results. The Access and ArcGIS systems were linked to quickly analyze and display the results of "what if" scenarios, in turn helping the user identify potential solutions to projected water supply needs.

**2. Will Water Rights Allocation in the Western United States Need to Adapt to Climate Change Impacts? - Gordon McCurry**, CDM, Denver, CO

Water allocation in the western United States is administered under the Prior Appropriation system of water rights, which allows the older or senior rights to be completely satisfied before the more junior rights are allowed water. Irrigated agriculture is the largest water user in the region with over 80 percent of the consumptive use and most of the senior water rights. Climate change predictions of earlier snowmelt runoff and less summer precipitation in the region will change the historic pattern of streamflows on which the senior water rights were developed. This will have the effect of altering the patterns of irrigation diversions, leading to changes in when, where, and how much water can be diverted. It is unclear how the Prior Appropriation system will need to adapt to these climate change impacts. The dynamic nature of runoff, diversions, infiltration and return flows in areas administered under the prior appropriation make it difficult to predict the effects of climate change on water use in irrigated watersheds. A watershed model calibrated to historic conditions was simulated with streamflows predicted by wet and dry end-member of General Circulation Models. The modeling results showed that the diversion patterns changed significantly under the climate change-induced flow regimes. Without adapting to climate change impacts, the senior water rights were affected the most, which is counter to the principles of the prior appropriation doctrine. The findings suggest that senior appropriators may not be as immune to hydrologic variability as previously thought. However, if historic water use patterns based on seniority are to be maintained, the

prior appropriation system may need to be revised to adapt to the changing hydrology resulting from a changing climate.

**3. Use of Optimization Modeling in Adaptive Management of Water Resources: A Case Study from Walawe River Basin, Sri Lanka - Neelanga Weragala**, Utah State University, Logan, UT (co-author: Jagath J. Kaluarachchi)

As reliability of water resources in river basins is challenged by climate change and population growth, the water demands keep increasing. For successful management of available water resources, supply and demand needs to be carefully accounted in the decision-making process, while considering socioeconomic and ecological impacts. A range of mathematical tools are available for the decision-makers in water resources management. Optimization models are often used to allocate limited water resources among competing water users. Systematic use of optimization models allows managers to assess the need for adaptation to change and evaluate the effects of such adaptation. This paper analyses the applicability of such an approach to the water resources management of Walawe River Basin in Sri Lanka. The water users in the Walawe River Basin are dependent on monsoonal rainfall. The seasonal river flows are stored in multiple reservoirs to be allocated for irrigation, hydropower generation, municipal use, and industrial use. Increased population, urbanization and industrialization have necessitated major changes to the water uses of the basin. One of these changes is the expansion of the irrigation area in the past decade. The increased irrigation demand has aggravated the competition for water and has consistently produced shortages. This work proposes to use the Water Evaluation And Planning model (WEAP) to identify potential changes needed to the existing water allocation scheme to reduce the stress due to increased water demand. The application of WEAP will consider several attributes such as seasonal water deficits, economic productivity, food security, and socioeconomic implications. The results of the analysis will provide insight to the available adaptive management options for effective water resources allocations than currently practiced in the basin. Key Words: water resources, adaptive management, optimization modeling, WEAP model

**4. Crisis Averted: How Collier County used a Programmatic Approach to Overcome a Water Supply Shortfall and Secure its Water Future - Jason Sciandra**, AWWA, Fort Myers , FL (co-authors: Phil Gramatges, Alicia Abbott, Paul Pinault)

In 2004 Collier County Public Utilities was facing a twofold water supply shortfall. First, the existing wellfield was not capable of producing enough water to meet peak system demands; forcing the Water Department to use demand side management to prevent the utility from running out of water. Second, while Collier County was one of the fastest growing areas in Florida there was no plan in place to locate, secure and develop the long-term water resources needed to meet the growing demand. By January 2004, it was evident to the County that if something was not done immediately, not even demand side management would allow it to meet the projected 2006 peak season demand. Collier County implemented the Wellfield Reliability Improvements and Expansion Program to meet their immediate water supply needs and secure their long-term water resources. The Program provided two main solutions to the County. First, it provided the program and construction management approach necessary to coordinate the multiple design engineers and numerous contractors. Second, the Program supplied the County with the strategic vision to streamline its wellfield development process through changes to the land development code and the implementation of standardized design, permitting, and land acquisition procedures. As a result of the implementation of this management approach, the program management team designed, built and brought on-line the 8 new wells needed by the County to meet the 2006 peak season demand. Beyond addressing the short-term water needs of the County, the true innovation of the Program has been the strategic planning projects implemented to secure the future water needs of the County. Among these projects was the development of a Potable Water Supply Development Plan, a unique, standalone planning document that summarizes the water sources, quantity and quality available for meeting the County’s future needs. The value of this document is that the County’s Water Master Plan and linked Capital Improvements Plan are now grounded not only in how much water is needed, but also how much water is available and how expensive that water will be as less expensive source waters are exhausted.