Water utilities that have rapidly growing service populations and/or rely upon surface water supplies must plan for supply expansions under conditions of uncertainty and cost risk. Ideally, new supplies would be brought online as demand emerges. However, high growth often implies high growth uncertainty. In planning for supply expansions in these cases, it is most appropriate to acknowledge and quantify uncertainty. This acknowledgement produces a new planning objective; to bring new supply online just-in-time to mitigate risk of shortfall, or *future need*.

Incorporating Future Need Analysis (FNA) in new supply source planning can have several advantages. FNA determines when it will be necessary to make new supply sources available and how large those sources should be, allowing efficient matching of demand growth with "just-in-time" supply upgrades. By describing future need probabilistically, supply timing and size assessments can be made in terms of risk mitigation, such as the likelihood of need at a certain future time and the potential range of sizes for that need. For large utilities experiencing long-term demand growth and requiring large capital expenditures for supply upgrades, an understanding of future need uncertainty is therefore critical to efficient planning of new supply resources.

Within FNA, a probabilistic demand forecasting methodology is developed to estimate a utility or region's future demand as a function of future customer population, socioeconomic characteristics, and weather. Projected ranges of these values are supplied to the demand model as probability distributions; a Monte Carlo simulation then uses the demand model to generate corresponding distributions of forecasted demand over the forecast horizon. A probabilistic supply simulation is also developed for variable surface water supply components. First, source flow variability is characterized through statistical models. Then, source flow models are coupled with surface water system operational models within a Monte Carlo simulation, generating simulated probability distributions of supply availability that reflect seasonality, flow persistence, and drought occurrences over the forecast horizon. Finally, distributions of forecasted demand and simulated supply are combined, producing corresponding distributions of demand minus supply; the positive portions of these distributions reflect future need. These distributions characterize risk of shortfall over the horizon; as risk grows to unacceptable levels (as judged by decision makers), supply expansion goals can be timed and sized to address increasing risk.

Hazen and Sawyer has extensive experience performing FNA for Tampa Bay Water, a wholesale water provider that serves six member governments in the Tampa Bay Region. Tampa Bay Water regularly experiences high population growth due to heavy in-migration; furthermore, their historical groundwater supply has become more heavily regulated, requiring development and heavy reliance on new, variable surface water sources. Tampa Bay Water's FNA forecasts the size and potential variability in its future need over a 25 year time horizon. In 2003, Tampa bay Water used its initial FNA results to set a supply expansion goal of 8-12 MGD by 2012. This goal has remained in place through the present day; subsequent expansion plans were successfully assembled to meet that goal and system expansions are currently under way. Currently, Hazen and Sawyer is extending to methodology to include four improvements, including 1) explicit modeling and forecasting of drought dynamics and climate modes, 2) redevelopment of demand forecast models to incorporate new billing data collected since 2003, 3) revisions to surface water system models to include system upgrades, and 4) inclusion of

Tampa Bay Water's new Water Shortage Mitigation Plan in the analysis, representing demand curtailment and emergency supply measures during simulated droughts.

The Future Need Analysis methodology may be significantly applicable in South Carolina. Several areas of the state, such as the Grand Strand, have always experienced significant in-migration and seasonally variable population. Several other areas, such as the Piedmont and Blue Ridge Escarpment, have recently seen a significant new increase in in-migration. These areas should benefit significantly from the risk management basis of Future Need Analysis.