



# Response of Well Heads of the Northern Guam Lens Aquifer to Rainfall and Sea Level Fluctuations at Daily Resolution



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This project makes an in-depth study of the response of the wellheads of the Northern Guam Lens Aquifer (NGLA) to rainfall and sea-level fluctuations at daily resolution. A characterization of the observed responses has immediate applicability to ongoing modeling efforts of WERI and USGS researchers of NGLA wellheads with SUTRA. One of the weaknesses of the SUTRA simulations is computation of water movement through an unsaturated zone more than 100 m thick. It is hoped that the analysis of the observed response of the wellheads to short-term variations of rainfall and sea level will help to calibrate the model, and determine the rate and time-lags at which the rainfall moves through the thick unsaturated zone of the NGLA. A goal of both the observational studies and the modeling studies was to elucidate the geological and hydraulic properties of the NGLA to better manage the resource.

The project included an intensive study of newly acquired daily values of wellhead, rainfall, and sea level. Data was obtained for other wells that were not available in previous research efforts. Recent acquisition of rainfall, sea level, and wellhead data at daily resolution, plus the acquisition of data for considerably more wells than used in previous studies, have allowed for a more in-depth analysis of the well hydrograph responses to variations in the rainfall and sea level. A major effort was required to properly inspect and organize all data for ready analysis and inter-comparison. The known timing of extreme short-term variations of rainfall and sea level helped to validate each time series.

The immediate objective of the project was to obtain a set of statistical model predictions of the daily value of the head at each selected

well using the values of the daily rainfall and daily sea level. The parameters of the statistical model that optimize these predictions give insight into the hydraulic and geological properties of the NGLA.

Of particular interest are the well responses to pulses of heavy rainfall, and the nearly step-function drops of sea level that occur after the close passage of typhoons. There are several historical pulse occurrences of substantial rainfall and several rapid changes of sea level in response to typhoons and also to El Niño. The responses of the wells to these extreme events are benchmark tests of any numerical model simulation of the NGLA. The information gained from the statistical models will enable researchers to develop appropriate boundary conditions for the numerical simulations of the aquifer, and to calibrate the model to reproduce the observed behavior. This study provides baseline information for identifying the physical properties of the aquifer and their implications for numerical simulation of the NGLA and for Guam's water management plan. The project addresses the following issues identified by the Guam Advisory Council:

- Develop water budgets for Guam's surface and groundwater watersheds.
- Develop a three dimensional groundwater flow model for the Yigo-Tumon trough aquifer for use in water quantity studies
- Continue studies to determine the response of the Northern Guam Lens to various rainfall events
- Re-evaluation of the North Guam Aquifer sustainable development estimates will also be evaluated.

