



Spatial and Temporal Nitrate Variations in Groundwater from Southern Saipan



Funded by:
US Geological Survey, Water Institute Program

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Funding: \$29,900

Ingestion of water containing high nitrate or nitrite concentrations can be fatal to infants. Nitrate and nitrite are rarely a problem for people older than six months. However, long term exposure to nitrate and nitrite can lead to diuresis, starchy deposits, and hemorrhaging of the spleen. In fact, nitrate and nitrite are such a significant health threat that public water systems are required to monitor delivered waters for these constituents at regular intervals, no less than once a year, with increasing sampling frequencies required if concentrations fluctuate significantly over time. The maximum contaminant level (MCL) for nitrate and nitrite is 10 mg/l and 1 mg/l respectively.

The major source of drinking water for the island of Saipan is groundwater pumped from the karst (fractured limestone) aquifer by the local water utility, Commonwealth Utilities Corporation (CUC). The groundwater is susceptible to nitrate contamination from the numerous on-site septic systems that exist in many villages on Saipan, and possibly from the use of nitrate based fertilizers on agricultural plots. CUC monitors for nitrate and nitrite at 45 sites throughout the distribution system. In June of 2006, one water sample from the CUC southern water distribution system exceeded the nitrate MCL. While this was the first exceedence since monitoring began in 2001, one additional violation was noted in December 2006 and eight in June 2007 with levels as high as 14 mg/l. CUC was required to notify their customers of nitrate contamination and the risks from consuming the contaminated water.

The concentration of nitrates in the groundwater of the southern end of Saipan appears to fluctuate rapidly. Three sites with nitrate concentrations a little over 14 mg/l in June 2007, had concentrations between 6 and 8 mg/l two weeks later. Notably, during the timeframe when nitrate levels were high there was little rain, and several days of heavy rain in the following two weeks resulted in lower nitrate concentrations. Accordingly, this project aims to further investigate the potential relationship between rainfall and nitrate concentration in the groundwater of the southern end of Saipan. To this end, weekly samples will be collected from approximately 20 wells in southern Saipan, over a one year period, and analyzed for nitrate at the CNMI Division of Environmental Quality (DEQ) lab, following EPA-approved methods. Additional analysis (pH, conductivity, temperature, dissolved oxygen or turbidity) may be conducted in the field at each sampling site as deemed necessary. Electronic rainfall gauges will be installed at four sites in the watershed of the southern Saipan well field and the data downloaded monthly.

The objectives of the study are to conduct regression analyses to determine the dependence of nitrate levels upon rainfall, and if so, to quantify the negative relationship (e.g. rates and concentrations). The result of this project will provide regulatory guidance to CUC on how frequently the monitoring for nitrate concentration should be conducted for southern Saipan's aquifers.