

# **Report as of FY2010 for 2009GU159B: "Sustainable Well Yield Determinations Using Conductivity Probes on Active Wells"**

## **Publications**

Project 2009GU159B has resulted in no reported publications as of FY2010.

## **Report Follows**

# PROJECT SYNOPSIS REPORT

**Project Title:** Sustainable Well Yield Determinations Using Conductivity Probes on Active wells

## **Problem and Research Objectives**

The major source of drinking water for the island of Saipan is groundwater pumped from the karst (fractured limestone) aquifers by the local water utility, the Commonwealth Utilities Corporation (CUC). The most productive (most heavily pumped) well fields on Saipan are located over the basal lens aquifers, where the fresh water lens floats on salt water. Poor well construction (penetration through the fresh water lens), poor pump placement (too far below dynamic water levels), and over pumping have resulted in salt water intrusion at individual wells and well fields. The volume-weighted chloride ion concentration from the total amount of water pumped from wells on Saipan is about 1,100 mg/l, well above the USEPA recommended limit of 250 mg/l. In fact, the chloride ion concentration at individual wells can on occasions exceed 3,000 mg/l.

In order to improve the quality of the water pumped from the basal lens aquifers on Saipan, a reliable method needs to be developed to determine the sustainable yield for individual wells, while minimizing the chloride ion concentration. This project proposes to use conductivity probes in active production wells to measure electrical conductance (EC) of groundwater in three wells, to determine the highest sustainable yield while trying to keep the chloride ion concentration below 250 mg/l. The probes will also be used to determine the drawdown at each well, so that the pump intake can be placed at the highest possible elevation. This project also addresses the critical State water quality issue regarding a baseline for season and usage related changes in salinity in drinking water production wells.

The ultimate goals of the study are to develop a method to optimize the pump rate and pump depth setting for individual wells to minimize chloride ion concentration in the groundwater delivered to customers on Saipan.

## **Methodology**

Three active production wells in one well field will be studied simultaneously in the following manner: A 1-1/4 inch diameter sounding tube will be installed such that it penetrates the well cap and extends to 5 feet above the bottom of the hole. The sounding tube will be screened from 5 feet above the static water level to the bottom end of the sounding tube. A conductivity, temperature, depth (CTD) probe will be lowered into the sounding tube to measure and record the conductivity profile of the well during static conditions and compared with the profile measured later during pumping conditions. Recording conductivity values in two adjacent wells will help determine how pumping rates in one well affects nearby production wells.

The three wells selected for the study were IF-205, IF-201 and IF-101 which are in the Isley Field well field, located between the Saipan International Airport and the village of Dan Dan. These three wells were selected because they are in the heart of the Isley Well

Field, have average chloride concentrations higher than the surrounding wells, and have well casings large enough to accommodate the sounding tubes.

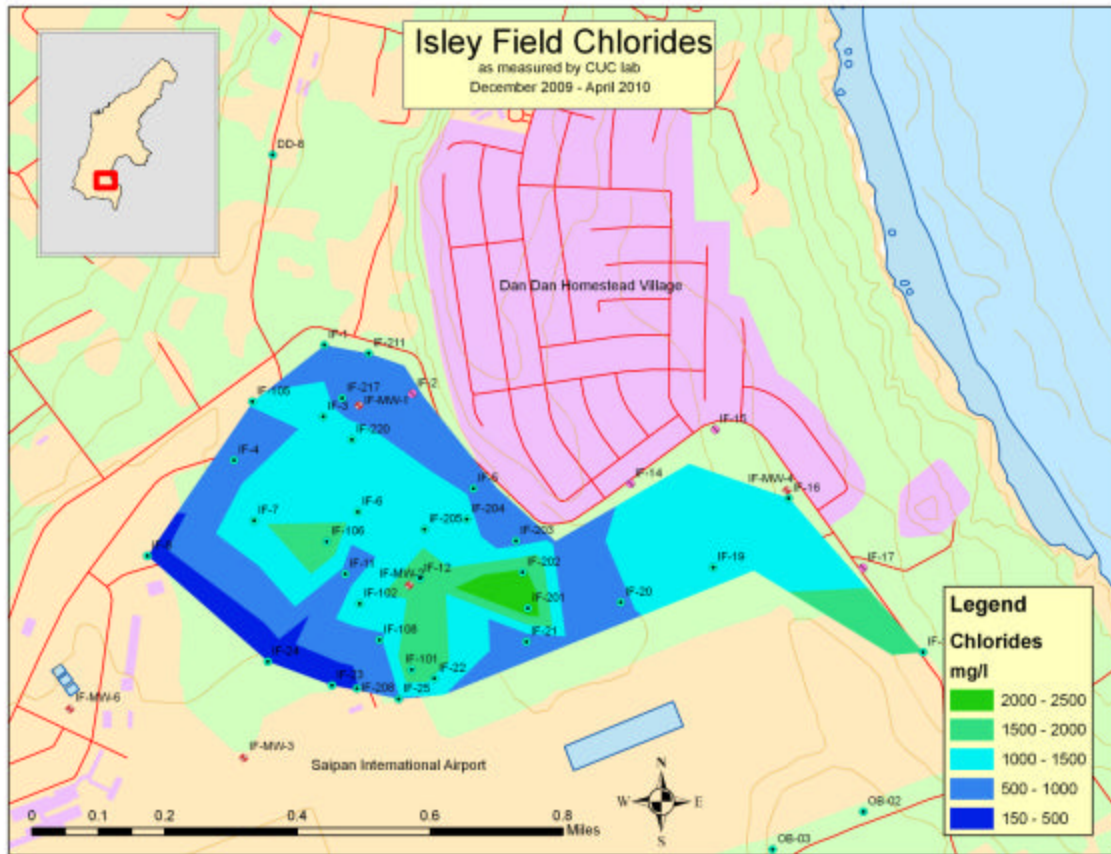
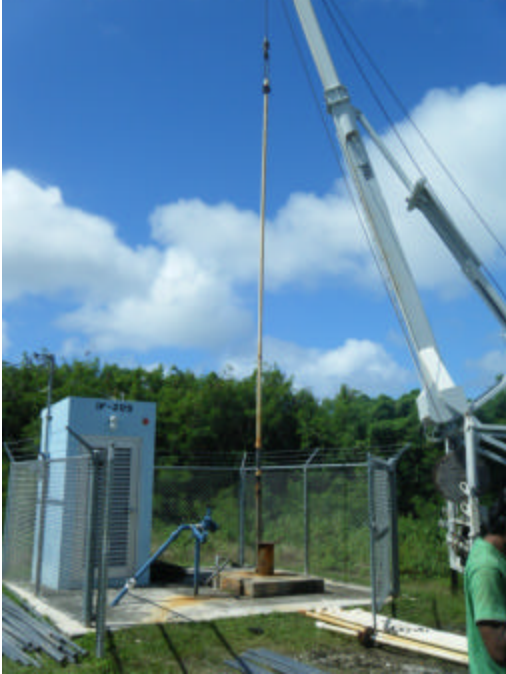


Figure 1: 2010 Average Chloride Concentration in Isley Field Wells

1-1/4 inch diameter PVC well casing and well screen to be used as sounding tubes for the conductivity probes were ordered from a vendor in Oregon and arrived on Saipan in February 2010. The conductivity probes were ordered from a vendor in Ontario, Canada and arrived on Saipan in March 2010. Sanitary well caps were fabricated on Saipan to accommodate the sounding tube, the drop pipe and electrical wiring. The sanitary well caps were completed in December 2010. The Commonwealth Utilities Corporation well pump maintenance crew installed the sounding tubes in the three wells in late January 2011.



**Figure 2: pulling drop pipe and pump**



**Figure 3: installing sounding tube**



**Figure 4: lowering drop pipe, sounding tube, well cap**

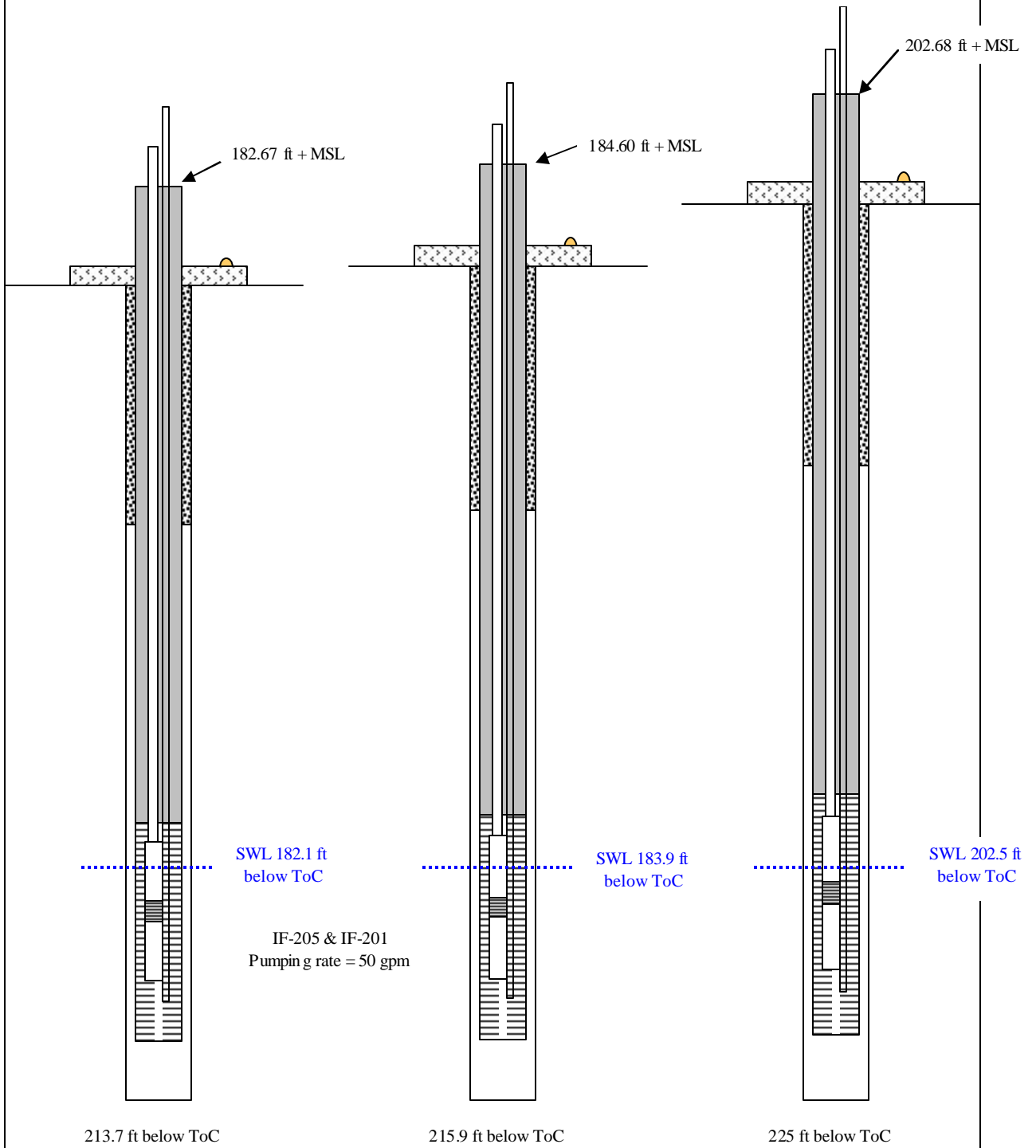


**Figure 5: new well cap and sounding tube**

**IF-205**

**IF-201**

**IF-101**



In May 2011 the barometric probe was installed in the control room for IF-205, and CTD probes were installed in the sounding tubes for wells IF-205 and IF-201.



Figure 6: installing probe in IF-205



Figure 7: unwinding probe cable

The probes hang from communication cables which allow access to the probe without raising it out of the well. The probe information can be read in real time, or data can be logged and downloaded at a later date.

### **Principal Findings and Significance**

As of May 18, 2011, the probes are collecting data on the tidal influence of the dynamic water level in the wells, and the change in conductivity at the level of the probes. The data has yet to be downloaded or analyzed.