

## **Report for 2002VI5B: Environmental Influences on Cistern Water Quality**

There are no reported publications resulting from this project.

**Report Follows:**

## *Summary Report on*

### **Environmental Influences on Cistern Water Quality**

#### Problem and Research Objectives

About two thirds of the residents of the U. S. Virgin Islands are not served by public water distribution systems. About eighty percent of Virgin Islands' homes rely on rainfall harvesting as their main water supply. This practice generally involves using a house's roof area for catchment of the rainfall, which is conveyed by gutters to a masonry cistern that forms a part of the house's foundation. The water is pumped to a pressurized tank for use upon demand.

Collection and storage of water by these means expose the harvested water to many sources of contamination. These may include atmospheric and other depositions on the catchment's surface, as well as contamination after entering the storage system which is generally not tightly sealed. While the United States Environmental Protection Agency has set water quality standards for all public water supplies, individual cistern systems are not considered public water supplies and are not subject to these regulations. Cistern water supplies then, may pose significant health risks to users in the Virgin Islands.

In this study, a broad survey of water quality in Virgin Islands cistern water supplies will be conducted to assess the influence of surrounding environment on water quality of cistern water supplies. Findings will provide information that will help to identify factors that contribute to the degradation of cistern water quality. Having this information will allow users of cistern systems to take steps to safeguard the water supply and reduce the health risks associated with using water from these systems.

#### Methodology

Homes located on St. Thomas and St. John were selected in a way that they represented areas influenced by as many different factors as possible. These included population density, varying degrees of annual rainfall, proximity to industry, shorelines and vegetal cover. These homes were surveyed and information recorded on the physical construction of the catchment, conveyance and containment structures, environmental factors, and maintenance and management practices affecting the systems.

The most common form of contamination of cistern water supplies is by coliform bacteria. Most of these bacteria are harmless and are free-living commensal organisms that live in soil and water as well as the gut of animals. These bacteria then may be used

to indicate the general quality of water they are found in and are often used to estimate the likelihood that the water is fecally contaminated. In this study, tests were made for the presence or absence of total coliform and *E. Coli* bacteria. For sites where positive results of any of these tests were obtained, the following months' tests involved enumeration counts until negative results were obtained. The analysis procedure used was the IDEXX's Quanti-tray enumeration method using the Colilert-18 and Entralart media test kit for thermotolerant coliform and enterococci respectively. Media trays were incubated for at thirty-five degrees Celsius (35°C) for eighteen (18) hours. The results were interpreted by a count of positive wells according to a most probable count table.

Physical characteristics of the samples recorded were temperature, pH and turbidity. These were measured consistent with procedures proscribed (prescribed) by the American Public Health Association and others in *Standard Methods for the Examination of Water and Wastewater*.

### Principal Findings and Significance

Sampling was conducted during the period June to September 2002 on St. Thomas and St. John. While plans were initially to include St. Croix in the study, this was not due primarily to logistically and related cost consequences. Most samples in the study were taken three times, though this varied due to accessibility to the site, availability of suitable water from harvesting in the system and so on. Not surprisingly, the cisterns monitored tested generally positive for both Coliform and *E. Coli* during the study period. While at some site chlorination was practiced, it was not done in such a systematic manner that the stored water remained contaminant free during the monitoring period. This is fairly typical for most Virgin Islands' homes.

Obvious roof contaminants were found most commonly to be leaf litter, droppings from birds and other animals and dirt, soot and other sediments. Ponding due to blockages were not unusual in the guttering systems. Cisterns examined revealed insects, dust and debris floating on the water's surface and accumulation of sediments and other foreign items on the bottom.

Management practices to maintain water quality were for the most part lacking. Roofs were often easily accessible and overhung by vegetation. Cisterns too were easily accessible due to poor-fitting manhole covers and inflow and overflow ports that were inadequately screened. Devices to divert the first-flush of harvested water or in any other way provide for rinsing the catchment's surface were not present and there were no regular programs for adding disinfectants or cleaning conveyance or storage surfaces with which the water came in contact.

The data gathered, as intended, not only provided a snapshot assessment of cistern water quality and management practices associated with these supplies but also allowed establishment of a database on several water quality parameters and site characteristics

that would be very helpful in future studies. Among these studies might be determination of variances in cistern water quality with time, examination for correlation between cistern water quality and overall public health in the Virgin Islands.