



# LAND USE, RUNOFF AND RECHARGE ON SELECTED WATERSHEDS IN THE U.S. VIRGIN ISLANDS

By

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## INTRODUCTION

Rain water and groundwater are the only significant "natural" water sources on St. Thomas. An examination of available records reveals that streamflows in St. Thomas have declined over the years. The changes in the availability of groundwater are not readily apparent as groundwater records are rare. It is believed, though, that changes in land use have adversely affected the quantity of groundwater available. This has been demonstrated elsewhere by researchers to be true, but it has never been verified for the Virgin Islands. The primary objective of this study was to examine the effects of various land use practices in the Virgin Islands on groundwater availability.

## METHODOLOGY

Three small basins were investigated as part of this study. Since available data was extremely limited, monitoring of groundwater levels at all three basins was initiated to establish the correlation between groundwater recharge and rainfall events.

## GENERAL HYDROLOGY OF THE VIRGIN ISLANDS

The average rainfall of 44 inches is the principal source of potable water in St. Thomas. In Figure 1, rainfall data for the period 1920-1967 at Charlotte Amalie is presented. As rain showers are often of short duration and followed by sunshine and the continual trade winds, the evaporation rate is very high. Also, through the process of transpiration, the vegetation moves soil water through the leaves while deep-rooted plants withdraw water from the lower depths.

The principal groundwater supplies are contained in a mantle of fractured and weathered rock approximately 300 feet thick. The annual recharge for 43, 31 and 13 percent of St. Thomas is estimated to be 0.7, 0.2 and 1.1 inches respectively. These estimates were determined based on the geology, soil, topography, rainfall and exposure of the regions.

## THE STUDY SITES

**SITE I.** The area around the Lockhart Elementary School was the first of two sites selected. This site was separated into two regions for descriptive purposes: the flat lower region or meadow in which the well under study was located and the upper region which was covered with thick scrub and dense forest. Water levels in the well was monitored monthly from March 1982 until April 1983 and monitored weekly from April 1983 until June 1983.

An analysis of the data showed that the water level in the well rose rapidly in response to rainfall. Two methods were used to estimate the water crop at the site. (The water crop is defined as combined runoff and groundwater replenishment.) One method gave 19.44 inches while the other method gave 8.78 inches. This discrepancy resulted from the "global" nature of the formulas used, neither of which has been proven valid locally and the lack of actual data on evaporation, runoff, soil porosity and extent of the groundwater basin.

**SITE II.** Two small watersheds in the vicinity of the College of the Virgin Islands were also investigated. Area I is approximately 165 acres and is mostly undeveloped in the upper reaches. This area, around the Reichhold Center, has been landscaped and planted with ornamental trees and shrubs. Area II contains most of the campus development and is roughly 140 acres, including a grass covered golf course on about 30 percent of the site.

An analysis of the data showed that both the rainfall, 69 inches and the water crop, 34.30 inches, were the same for both areas during the study period. What was different in the areas was the amount of runoff. Despite similarities in topography and the smaller size of Area II, the runoff for Area II was 19 inches while the runoff for Area I was only 16 inches. This can be attributed to the greater development on Area II as compared to Area I. The potential groundwater recharge at Area I was approximately 81 million gallons and the potential groundwater recharge at Area II was 61 million gallons. These results indicated that, as expected, the slightly more developed Area II received less water for groundwater recharge and generated more runoff than the less developed Area I.

## CONCLUSIONS AND RECOMMENDATIONS

1. Urbanization has negatively affected the quantity of groundwater recharge.
2. Further research should be conducted to more specifically define the role not only of land use effects on groundwater recharge, but also the effects of various types of vegetative cover on groundwater recharge in the Virgin Islands.
3. Priority should be given to the establishment of an extensive hydrologic data collection network in the Virgin Islands. Without data from these sources, water resources planning efforts are pointless.

Condensed by Yahaya Bello from: "Water Resources of the College of the Virgin Islands Area, St. Thomas" by Owolabi Ajayi and Fernando Gomez-Gomez, Technical Report No. 11, Water Resources Research Center, Caribbean Research Institute, CVI, St. Thomas, September 1983.

The research on which this report is based was financed in part by the United States Department of the Interior, Geological Survey, through the Water Resources Research Institute. Contents of this publication do not necessarily reflect the views and policies of the United States Department of the Interior, nor does mention of trade names or commercial products constitute their endorsement by the United States Government.

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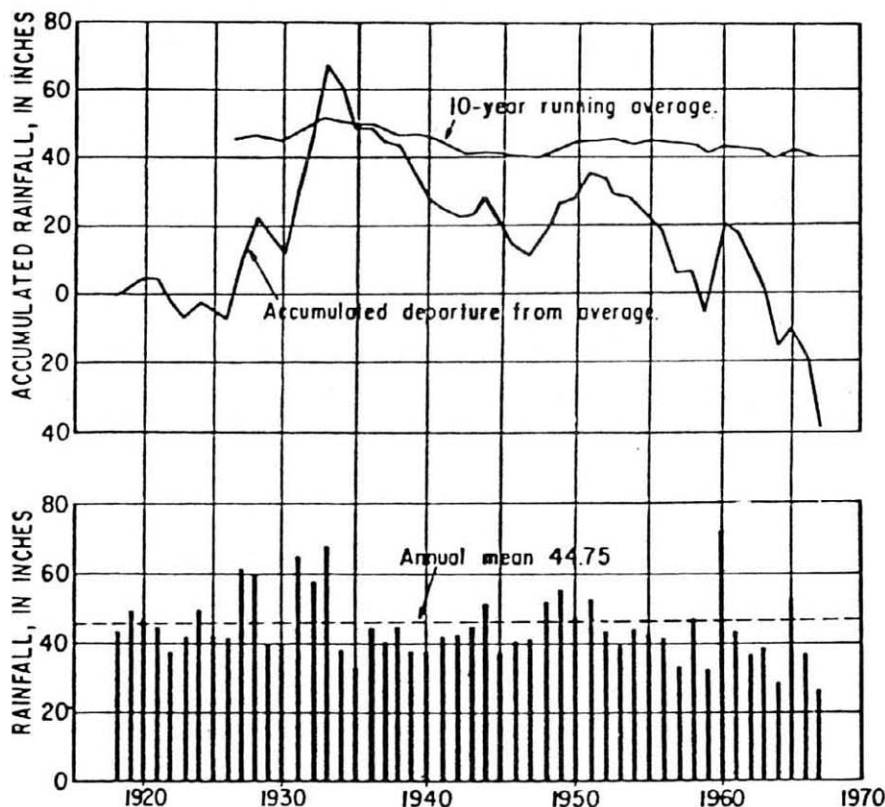


FIGURE 1.

*Rainfall Running Average, Accumulated Departure from the Average and Annual Rainfall at Charlotte Amalie, St. Thomas*