Virgin Islands Water Resources Research Institute
Annual Technical Report
FY 2004

Introduction

The 2003-2004 program year (FY 2004) was a very active one for the Virgin Islands Water Resources Research Institute (VI-WRRI). Research activities included investigations of the hydrology of a small watershed for the purpose of developing guidelines for nonpoint source pollution management strategies, examination of pricing and distribution policies for expensive desalinated water, evaluation of the microbial quality of cistern waters and development of management measures for sediment and pollution reduction. At the same time, activities focusing principally on dissemination of VI-WRRI research findings through a conference and a demonstration project were conducted.

The role played by the VI-WRRI, located at the University of the Virgin Islands (UVI) is critical. The VI-WRRI is the only unit of its kind in the U. S. Virgin Islands where prudent utilization of the limited water resources from multiple sources is an absolute necessity. Rainwater, ground water, desalinated water and the very scarce surface water supplies must be managed in such a way that they meet high user demands. At the same time, disposal of wastewater and runoff water must be properly conducted in order to minimize adverse environmental impacts. This is necessary for preservation of the fragile tourism industry on which the economy of the Virgin Islands is based.

This report presents an overview of the accomplishments of the VI-WRRI using funds primarily from the U. S. Geological Survey. The activities described were conducted by investigators at UVI and also by those at other universities with greater and wider expertise than that available at UVI. The accomplishments reflect collaborations between the United States Geological Survey, UVI faculty, staff and students, community participants and the VI-WRRIs Advisory Council were all intended to foster a safe and sufficient water supply for residents of the U. S. Virgin Islands.

Research Program

Hydrology Modeling in Turpentine Run, St. Thomas

Basic Information

Title:	Hydrology Modeling in Turpentine Run, St. Thomas
Project Number:	2004VI18B
Start Date:	3/1/2004
End Date:	2/28/2005
Funding Source:	104B
Congressional District:	VI
Research Category:	None
Focus Category:	Hydrology, Non Point Pollution, Water Quality
Descriptors:	None
Principal Investigators:	R. Heath Kelsey, Henry H. Smith

Publication

1. Kelsey, R., H. Smith, D. Porter, G. Scott and T. Siewicki, 2005, Bacterial Loading, BMP Efficiency and Hydrology Modeling Turpentine Run, St. Thomas, Water Resources Research Institute Conference, University of the Virgin Islands, St. Thomas, USVI.

Problem and Research Objectives

Nonpoint Source Pollution (NPS) is an important source of water quality impairment in streams, estuaries, and near coastal ocean waters throughout the United States, including the Virgin Islands (DPNR 2003A). In order to quantify loading of nonpoint source pollutants from river and stream systems, it is generally necessary to have information on both the concentration of the pollutants and the water flow that transports the pollutant into the receiving waters. Hydrologic modeling is often used to estimate river discharge and stormwater flow based on rainfall, land use, elevation, soils, and other meteorological data. Concurrent with water quality studies, these models may present a powerful tool for estimating pollutant loads.

The recent Dissolved Oxygen TMDL for Mangrove Lagoon and Brenner Bay, St. Thomas, U.S. Virgin Islands (DPNR 2003B) notes that reductions in Biological Oxygen Demand (BOD) loading from nonpoint sources within Turpentine Run Gut system will be necessary to achieve the proposed TMDL BOD limits. The development of a detailed hydrologic model would allow coastal mangers to better estimate the loading of BOD and various additional pollutants from Turpentine Run into the Mangrove Lagoon, which affect water quality of both the lagoon and Brenner Bay, two important water-bodies for fisheries and recreational uses in St. Thomas. According to the TMDL (DPNR 2003B), the Mangrove Lagoon is currently impaired for fecal coliform bacteria and dissolved oxygen (Figure 1).

Additionally, previous research in the Turpentine Run watershed indicated that rainfall in the area is highly variable over space (Table 1). Rainfall measured or estimated for one area of the island may not accurately reflect the rainfall in other portions of the island. In order to adequately describe the rainfall that drives river and stream discharge in a particular watershed, rainfall estimates must take this spatial variability into account. This project was designed to address this need by installing a spatially distributed network of rain gauges in the Turpentine Run watershed.

Project objectives include beginning the development of a hydrologic model for the Turpentine Run Watershed. Spatially explicit rainfall and flow data are being collected and used to develop the model. This project also builds upon previous data acquisition for a small part of the upper portion of the Turpentine Run watershed (Kelsey and Smith, unpublished data). In October and November 2003, a limited effort was undertaken to examine fecal coliform removal rates from a detention pond located adjacent to Weymouth Rhymer Highway, across from the entrance to the Cost-U-Less and Cinema establishments. Although the project was able to evaluate the efficiency of the pond in removing fecal coliform bacteria from stormwater runoff, the project was unable to establish an overall loading rate for the Turpentine Run system, due to the unavailability of data describing the ultimate discharge into the Mangrove Lagoon, or the impact of spatially variable rainfall. Additionally, the previous work made it clear that semi-permanent monitoring for discharge and rainfall would be necessary for long-term assessments of hydrology.

Equipment was installed to monitor rainfall and discharge at four sites within the Turpentine Run watershed and gut system. Data acquisition will be continued throughout the project extension period (to 11/30/05).

Key components of the project have included:

1. Watershed modeling from DEM data for the Turpentine Run system,
2. Site determination and equipment installation,
3. Data acquisition and management, and
4. Development of the hydrologic model.

Watershed modeling of the Turpentine Run system was performed at the GIP Laboratory at the University of South Carolina Belle W. Baruch Institute for Marine and Coastal Sciences, in Columbia, SC. Digital elevation data for the analysis were obtained for this phase of the project from the Eastern Caribbean Center Conservation Data Center at the University of the Virgin Islands. Watershed modeling was performed to identify optimal locations for the installation of the discharge and rainfall monitors by evaluation of delineated watershed boundaries and locations of intermittent streams.

Permission to gain access for personnel and to permit the installation of necessary equipment was obtained by identifying and contacting the landowners at the locations identified above. Landowners were briefed on the basic components and reasons for the project, and were asked for permission to install the equipment on a semi-permanent basis. Although access was granted for each of these sites, the process of obtaining permissions was longer than originally anticipated. Instrumentation was installed in January, 2005, necessitating an extension of the project period to collect enough data for calibration of the hydrology model. The data collection phase of this project is scheduled to continue until November, 2005.

Methodology

Watershed Modeling

Watershed modeling was conducted at the Belle W. Baruch Institute Geographic Information Processing Lab located at University of South Carolina in Columbia, SC. GIS techniques in ArcMap™ and ArcView™ were employed to develop watershed boundaries for the Turpentine Run Watershed from digital elevation data previously supplied by the Eastern Caribbean Center Conservation Data Center. The watershed was divided into approximately six portions along the linear features of the Turpentine Run Gut stream network. Outlet points for each of these sections were identified as optimal sites to place the sampling equipment. Sites chosen were adjusted slightly to improve physical access to the equipment, site security, and permission to install and access the equipment.

Site Preparation and Equipment Installation

Following identification of optimal locations for equipment installation, permission to access the sites and install the equipment was sought. Landowners were identified using parcel information and were contacted to brief them on the project. Permission was requested for project personnel to access the sites and install the necessary monitoring equipment.

Equipment was purchased after site inspection and evaluation of the physical characteristics of each location. Rain gauges installed were Global Water RG600 tipping bucket rain gauges connected to a Global Water GL400 data logger. Water level indicators installed were Global Water WL15 data-logging water level recorders. A hand-held data transfer device was purchased to allow ease of data collection and management of the sensors in the field.

Sites were chosen for their location within the watershed system of the Turpentine Run Gut, ease of access, and security. Fortunately, each location provided some measure of inherent security as a result of fences or other security devices, or was a location where visibility was very low. Landowners were helpful in choosing locations where vandalism could be reduced.

Data Collection

Data collection was begun immediately following installation of the monitoring equipment. The data logging units were configured to record rainfall and water level at one-hour intervals to conform to the requirements of the hydrologic model time step, and to preserve battery life and storage space within the data logging devices. Data was downloaded from the units to the handheld device, for transfer to a desktop unit at UVI. The data has been stored in a Microsoft Excel™ Spreadsheet for input to the hydrologic model. Following collection, data are copied from UVI to the Baruch Institute for back-up and input into the hydrology model.

Hydrologic Model Development

The WinHSPF model, within the BASINS family of modeling applications developed for EPA, was chosen for the development of the hydrologic model. The model incorporates changes in land use, loading functions, and accounts for stochastic rainfall events in estimating discharge. The model also can incorporate modules for locally derived values for contaminant loading and transport. The model will be calibrated using available meteorological data, as well as spatially explicit rainfall and flow data collected as part of this project. As the data collection phase is still ongoing, the model has not yet been calibrated with observed data.

Principal Findings and Significance

Watershed Modeling

Watershed modeling was completed using the BASINS System obtained from EPA (EPA 2004). A Digital Elevation Model (DEM) for St. Thomas was obtained from the Eastern Caribbean Center Conservation Data Center and was used to delineate watershed and sub-watershed boundaries. Outlet points were manipulated to obtain six sub-watersheds within the Turpentine Run Gut basin, such that the outlets could reflect optimal locations for water level and rain gauge instrument locations (Figure 1). Confluences of streams and existing equipment (USGS Gage Station at Mt Zion, Turpentine Run) were also taken into account when choosing locations for outlets determining sub-watershed size and locations. A stream network was created from processing the DEM to create raster data sets representing flow direction, and flow accumulation. The flow accumulation raster was reclassified to derive the stream network. The stream network was visually inspected for accuracy, and was subsequently used during the delineation of watersheds within the BASINS system.

Installation Equipment

Five water level indicators and three rain gauges were purchased and installed at the outlet points along Turpentine Run Gut (Figure 2).

Data Collection

Data collection was begun on January 13, 2005 and is scheduled to continue through November 2005 (Figure 3, and 4).

Hydrologic Modeling

The hydrologic model has been created but has not yet been calibrated with observed precipitation or flow time series data from installed instruments. Existing precipitation data obtained from nearby weather stations further indicates that accounting for the spatial variability of precipitation in this system will be important. Figure 3 shows large discrepancies between the predicted and observed discharge. These discrepancies may be attributable to several potential sources, including inaccurate precipitation data from spatial variability, or inaccurate values for other model parameters and inputs. Spatially and temporally explicit precipitation data will be useful in model calibration.

Significance

The model may be valuable to watershed and coastal mangers in assessing the loading of various pollutants into Brenner Bay and the Mangrove Lagoon (DPNR 2003B). Potential future assessments of loading rates for fecal coliform bacteria, nutrients, BOD, and sediments will be assisted by the development of such a model. Specific estimates for loading rates of these pollutants may be particularly beneficial to managers in evaluating management strategies to reduce nonpoint source pollution.

Additional benefits of the project include the support of monitoring efforts for the current Dissolved Oxygen TMDL, and the establishment of procedures necessary to develop hydrologic models elsewhere on St. Thomas and in the Virgin Islands.

A student, Paul Adjodha (UVI Class of 2005, Computer Sciences), was supported by this project. Training was provided in the areas of data acquisition and management, experimental study design, hydrology, and Global Positioning Systems (GPS) techniques. This project also was part of a lecture for "Environmental Regulation and Planning", Course Number ENHS 775 in the Environmental Health Sciences Department, Arnold School of Public Health, University of South Carolina. The guest lecturer was R. Kelsey, and the course instructor was D. Porter.

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Environmental Protection Agency (EPA), 2004, *Better Assessment Science Integrating point and Nonpoint Sources, BASINS Version 3.1 User's Manual,* EPA-823-C-04-004.

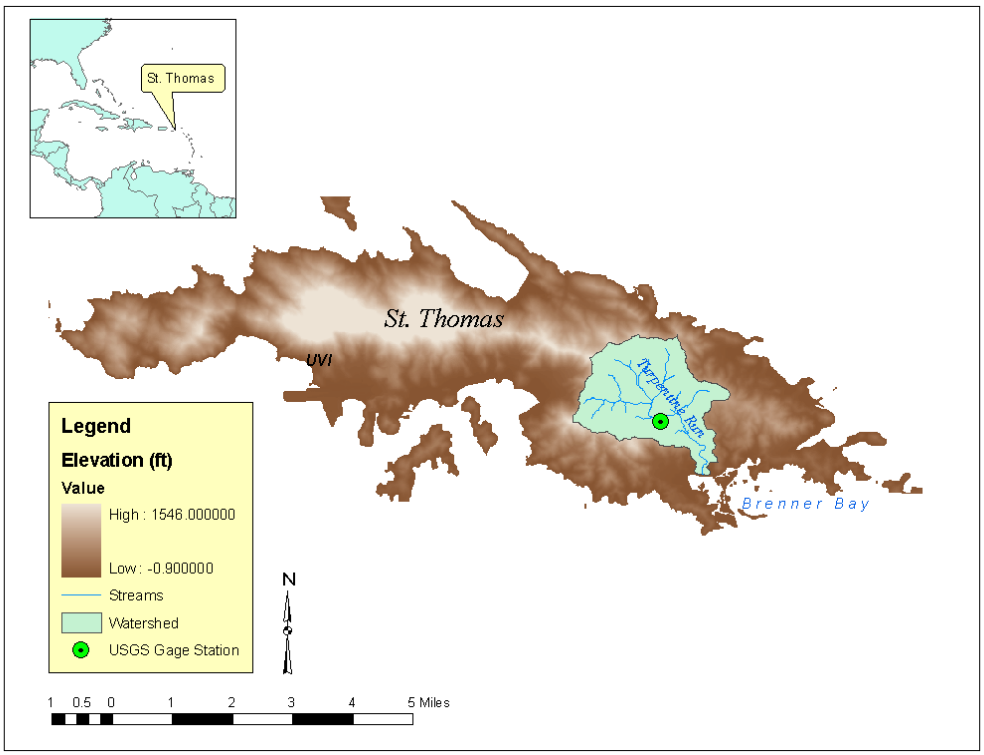

Figure 1. Study Area Location

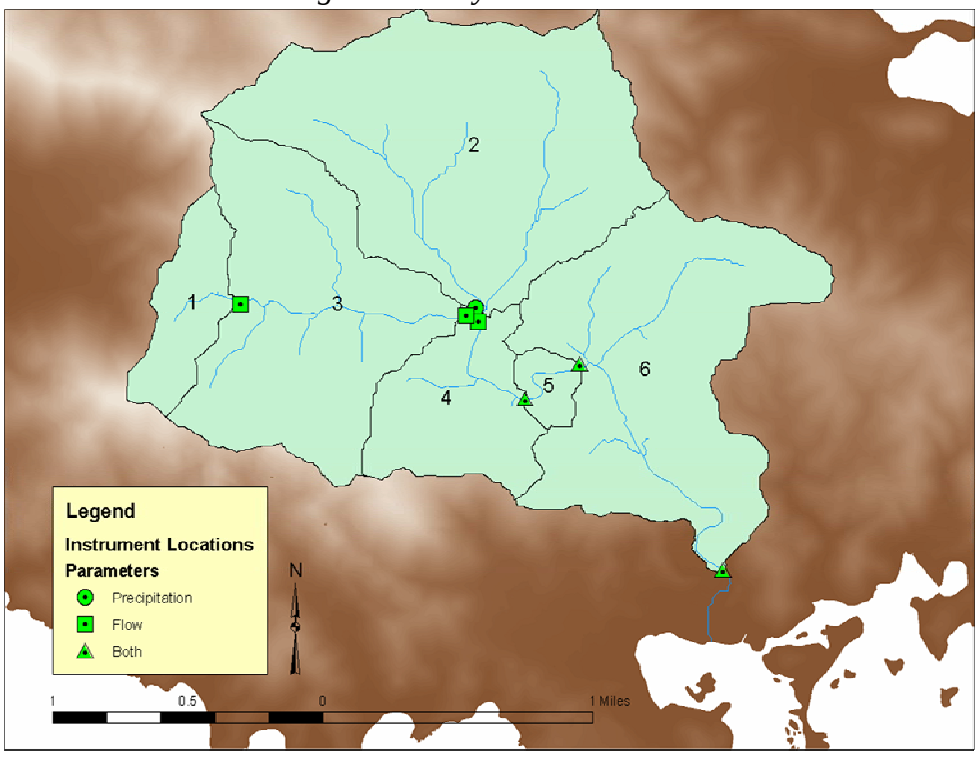

Figure 2. Location of Instrumentation and Sub-Watersheds

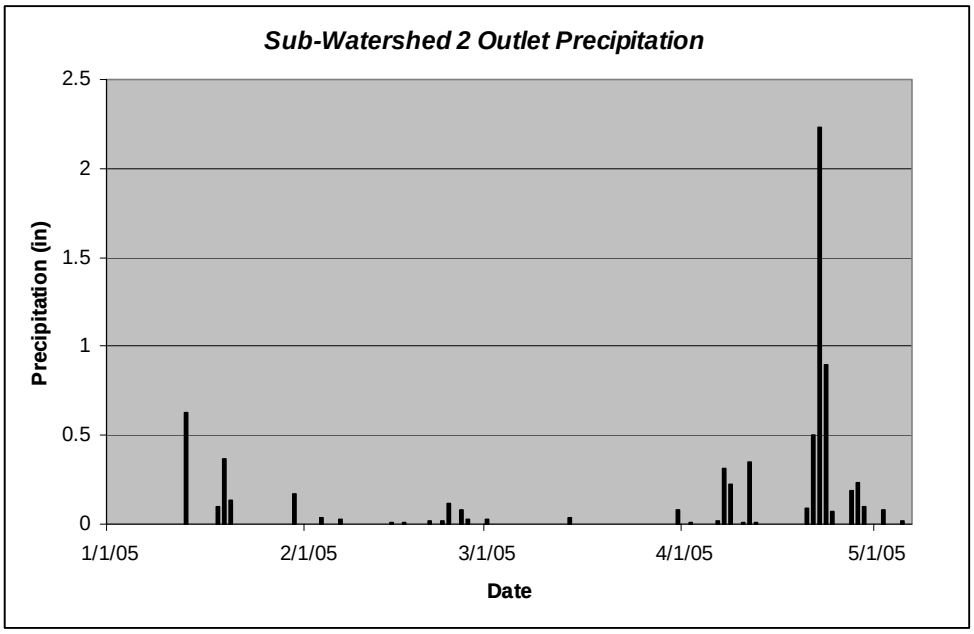

Figure 3. Example Precipitation Data

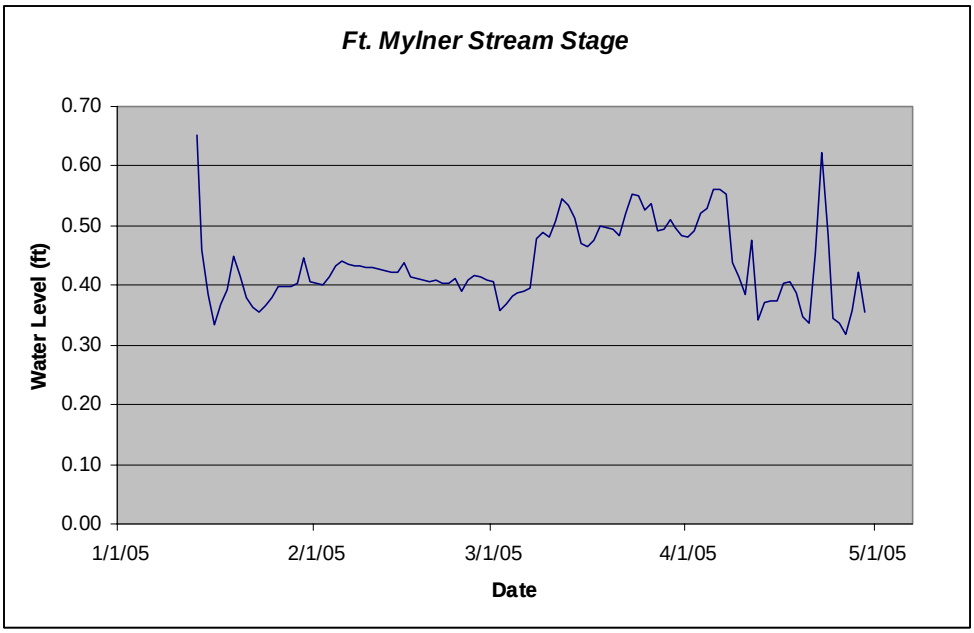

Figure 4. Example Stream Stage Data

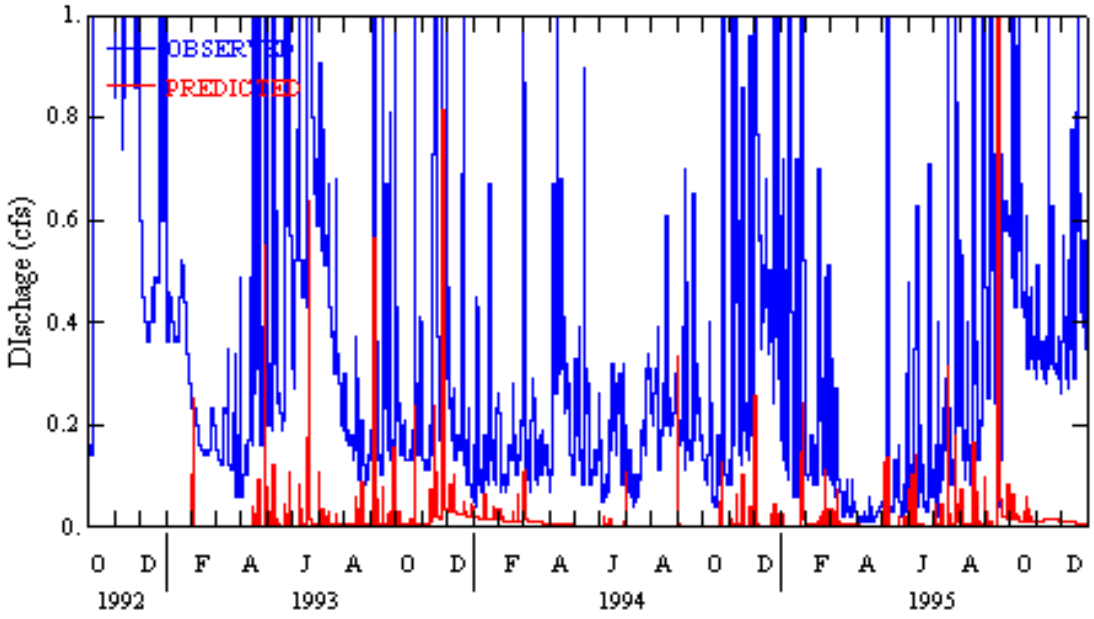

Figure 5. WinHSPF Output for Observed and Modeled Discharge at the USGS Gage Station

	Rainfall by Location (in)	
Date	UVI	Gaging Station
11/12/2003	2.09	1.78
11/13/2003	2.67	3.29
11/14/2003	4.08	2.71
11/15/2003	2.78	0.15
Total	11.62	7.93

Table 1. Selected Storm Rainfall Data 2003

Development of a Water Budget for a Model, Integrated Farm in the U.S. Virgin Islands

Basic Information

Title:	Development of a Water Budget for a Model, Integrated Farm in the U.S. Virgin Islands
Project Number:	2004VI28B
Start Date:	3/1/2004
End Date:	2/28/2005
Funding Source:	104B
Congressional District:	N/A
Research Category:	Not Applicable
Focus Category:	Agriculture, Water Quantity, Water Use
Descriptors:	
Principal Investigators:	James Rakocy, Henry H. Smith

Publication

This research project has been cancelled.

Production, Pricing and Distribution Policies of Public Water in St. Thomas, U. S. Virgin Islands

Basic Information

Title:	Production, Pricing and Distribution Policies of Public Water in St. Thomas, U. S. Virgin Islands
Project Number:	2004VI39B
Start Date:	3/1/2004
End Date:	2/28/2005
Funding Source:	104B
Congressional District:	NA
Research Category:	None
Focus Category:	Economics, Education, Law, Institutions, and Policy
Descriptors:	None
Principal Investigators:	Hossana Solomon

Publication

1. Solomon, Hosana, 2005, Production, Pricing and Distribution Policies of Public Water in St. Thomas, U. S. Virgin Islands, Water Resources Research Institute Conference, University of the Virgin Islands, St. Thomas, USVI.

Problem and Research Objectives

Historically, rainwater during the wet season provided the only major sources of fresh water caught on the roofs and stored on cistern. However, due to the irregularity of the rainfall, and high runoff associated with the hilly topography of the islands, there was a constant necessity for establishing a larger and more satisfactory supply. Major population growths in the 1960s and '70s due to tourism and increased standard of living have increases the per capita demand of water in the territory out stripping the traditional supply of rainwater. The search for adequate water supply for the territory, lead to the distillation of seawater which is costly but readily available as the dependable alternative fresh water source for the islands. The first distillation plant was installed in the Virgin Islands in 1962 by the government run by the Water and Power Authority (WAPA). Since then distillation plants have expanded in the three islands public sectors providing almost all the portable water supply to the islands.

Despite a significant cost of producing water in the islands, research information on cost and prices do not exist in the territory. The few studies on water supply situation in the islands by Water Resources Research Center of the Caribbean Research Institute College of the Virgin Islands date back to early 70's. There is no rigorous evaluation of the effectiveness of water pricing and distribution undertaken in the territory. As government funds become scarce, it is important such programs be evaluated in order to correct inefficient activities and to expand activities that have greater potential for the use of water. The objective of this study is critically examine the cost of production and pricing policy of water to achieve the desired policy objectives set by the public authorities. The intense competition for water between various sectors that results from population growth, area expansion, and life style changes, may affect various decisions associated with water allocation and long-term investments.

In addition to the local water problem of the Virgin Islands, there are global water problems in many areas of the world where distillation of seawater could be an option of various small islands and other costal territories. The experience of water production and pricing policy in the Virgin Islands could have global implications in areas where the water demand exceeds the supply from other traditional sources like streams, fresh water lakes and under ground water sources.

Methodology

1. Monthly historical cost data of WAPA's operation of water production, distribution, depreciation and administration for the period of 1993-2004 collected in summer 2204.

2. Monthly ales data of water to various WAPA customers, commercial, residential, standpipe, VI Government and other Government 1993-2004 collected in summer 2004.

3. Cost of water delivery by trucks from various venders gathered in summer 2005.

Data in the process of collection summer 2005.

4. Monthly rainfall data collected from Weather Research Station at UVI for the island collected.

5. Data on cistern construction and capacities of dwellings are collected.

Principal Findings and Significance

Preliminary analysis of the data was conducted in Fall 2004 and in Spring 2005. A preliminary study reported was presented on February 24, 2005 at the 2005 Water Resources Conference organized by VI-WRRI.

Based on the preliminary research findings WAPA's water customers are VI Government (48 %), commercial (29%), residential (19%), standpipe sales (4%) and Federal government agencies (1%). Over the study period WAPA's customer numbers have grown steadily at an average of 5% per year. The study also indicated that the costs of water production and WAPA revenue from sale of water have declined over the study period.

About 90 % of dwellings in the island have cisterns and depend on rainwater collected from rooftops. From the data, standpipe sales indicate only 5% of the sales from WAPA that indicate most of the dwellings to depend on cistern water. The cost of water delivery by trucks contributes significantly to the price of water about three times the cost of water.

Water Delivery by Truck to Residential Dwellings	**5200 Gallon Truck**	**3200 Gallon Truck**
Average Price per load to Fortuna	$287.50	$ 183.00
Price per 1000 gallon	$ 55.29	$ 57.19
WAPA price per 1000 gallon	$ 16.67	$ 16.67

Evaluation of the Microbiological Quality of Cistern Waters in the Virgin Islands

Basic Information

Title:	Evaluation of the Microbiological Quality of Cistern Waters in the Virgin Islands
Project Number:	2005VI47B
Start Date:	9/6/2004
End Date:	2/28/2005
Funding Source:	104B
Congressional District:	NA
Research Category:	Water Quality
Focus Category:	Water Quality, None, None
Descriptors:	
Principal Investigators:	Gary A. Toranzos, Henry H. Smith

Publication

1. Toranzos, Gary, 2005, Evaluation of the Microbiological Quality of Cistern Waters in the Virgin Islands, Water Resources Research Institute Conference, University of the Virgin Islands, St. Thomas, USVI.
2. Lasalde Clarivel, Roberto Rodriguez, Henry Smith and Gary A. Toranzos, 2005, Heterogeneity of uidA gene in environmental Escherichia coli populations, Journal of Water and Health, August (In press).
3. Sánchez Elia E., Mayra Suárez, Rebelto Harrigan, Henry Smith, Gary A. Toranzos, 2005, Traditional indicators of microbial quality in bathing beaches and their usefulness in the Caribbean. International Microbiology (Submitted)
4. Lasalde Clarivel, 2005, M.S. Dissertation, Heterogeneity of uidA gene in environmental Escherichia coli populations, Biology Department, University of Puerto Rico Rio Piedras Campus, Rio Piedras, Puerto Rico, 50 pages.
5. Lasalde Clarivel, Roberto Rodriguez, Henry Smith and Gary A. Toranzos, September 2003, Genotypic analyses of Escherichia coli isolated from tropical soils in Internacional Water Association Symposium on Health-Related Water Microbiology, Capetown, South Africa.
6. Rodríguez Eillen, Giovelly Santos, Maria Rivera, Gary A. Toranzos, Henry Smith. October, 2004 Occurrence of Aeromonas spp. in treated and non treated waters in Puerto Rico. in the PRSLAMP Junior Tech. University of Puerto Rico, Mayaguez Campus.

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13. Rivera Maria del Mar, Eileen Rodríguez, Giovelly Santos, Gary A. Toranzos, Henry Smith, November, 2004, Presence of Aeromonas in tropical waters, Poster presentation in Annual Biomedical Conference for Minority Students, National Institutes of Health. Dallas, Texas.

Problem and Research Objectives

Water distribution in St. Thomas, United States Virgin Islands is difficult because of its lack of resources and mountainous landscape. Because of these reasons and under the Virgin Islands Code, each new building (except for those buildings exempt from the local code) must have its own cistern, including hotels and guest houses (Ruskin et al., 1990). Approximately two-thirds of the residents of the U.S. Virgin Islands are not served by a filtered water distribution system, and almost 80 percent of those residents use rainwater as their potable water (Ruskin et al., 1988).

Cisterns are tanks used for the storage of water, and may be incorporated into the configuration of the house, or may be separated from the house (Ruskin et al., 1988). The microbiological quality of these cisterns is under discussion because they are generally not sealed and are exposed to the environment. The water of the cisterns may often be contaminated with leaves, dirt, insects, frogs, animal droppings (Rinehart et al., 1983), and the associated microbiota. The best manner of controlling the presence of microorganisms, and most importantly pathogens, is by using disinfection (usually via household bleach). However, after three to five days, it must be replenished. In addition, proper maintenance is essential such as trimming overhanging trees from roofs; set up screens over all the openings of the cistern, and other general cistern maintenance practices (Ruskin et al., 1988). Studies on the microbiological quality of cistern-stored water have shown that the water frequently fails to match the established standards (Isquith et al., 1981). During two cistern studies it was found that 74 % of the samples from privately owned cisterns, and 49 % of the samples from public housing cisterns were not in compliance with the Safe Drinking Water Standards. This means that the water contained more than 1 total coliform per 100 mL of sample. Another study revealed that water samples in large hotels were in compliance with SDWS more after than the small hotels and guesthouses (Ruskin et al., 1990).

The present study is designed to determine the presence (or absence) of total coliforms, thermotolerant coliforms including Escherichia coli, Aeromonas ssp., enterococci, Pseudomonas spp and coliphages in the cistern-stored water. The presence of one fecal indicator bacteria in a sample of water indicates that the water has been subjected to fecal pollution, and the water may thus contain bacterial pathogens which might initiate sickness in anyone who consumes that water (Duncan, 1995). Water samples from different cisterns will be evaluated to determine its microbiological quality through four years. Although fecal contamination is of concern, this contamination may be minimal in properly constructed cisterns. The only problematic fecal matter may be from bird droppings on the catchment areas of the cistern. The most likely problem may be the presence of naturally-ocurring microorganisms such as Aeromonas spp. which are currently being proposed for regulation under the Candidate Contaminant List (CCL) of the U.S.E.P.A. Little, if anything is known about the presence of these naturally-occurring microorganisms in cistern waters. The incidence of Pseudomonas spp. has also been addressed in previous studies in the U.S. Virgin Islands, thus our studies will be centered on the presence of indicators and Aeromonas spp. as a possible emerging

pathogen. To the best of our knowledge, the incidence of the latter microorganism has not been previously reported in cistern waters.

Additionally, the prevalence of Aeromonas spp. In Puerto Rico is virtually unknown, except for a few studies. In fact, no data exist on the prevalence of enterotoxigenic strains. We will also sample different types of waters in different areas of Puerto Rico in order to have these important data which will have a direct impact on the U.S.E.P.A. Candidate Contaminant List.

The data from this project will allow for a better understanding of the impact of the microbiological quality of cistern waters on public health. This in turn may result in better management practices that may ameliorate this problem. The data on the prevalence of Aeromonas in Puerto Rico and the Virgin Islands will also have a long term impact on the current U.S.E.P.A. Candidate Contaminant List.

The objectives of this research are to:

a. Determine the presence (or absence) of total coliforms, thermotolerant coliforms including Escherichia coli, enterococci, Pseudomonas spp and coliphages in the cistern-stored water.
b. Determine if Aeromonas ssp. represent a microbiological risk in cisterns waters
c. Study the effect of age of the cisterns over the microbiological quality of water storage in them
d. Study the effect of the treatment and cleaning of the cisterns over the microbiological quality of the water storage in them.
e. Determine the prevalence of Aeromonas and the possible presence of virulence factors in the isolates from the Virgin Islands and Puerto Rico.

METHODOLOGY

For this study we have recruited stakeholders (residents and other interested individuals) to carry out the most intensive and most representative sampling of cisterns in St. Thomas. The study so far has included random cisterns spread across St. Thomas. Any chemical or physical treatment given to their cisterns and the general maintenance of the cisterns has been taken into consideration for the study. The sites in Puerto Rico include ground waters, freshwater lakes, springs and treated as well as untreated drinking waters.

Samples are taken in sterile 1L bottles containing Sodium Thiosulfate from the cisterns selected in the study.

Water quality variables are analyzed according to APHA (1992, and will include: Temperature, pH and turbidity as well as chlorine concentrations in the samples will be determined.

Bacteriological analyses were conducted using the membrane filtration technique using 47-mm filters with a 0.45 mm pore size (HAWG047s3, Millipore) according the Standard

Methods (APHA et al., 1992) and COLILERT 18 TM (IDEXX, Westbrook, Maine). Different volumes of the water will be analyzed depending in the concentration of microorganisms present in the water samples.

In the coliphage analyses, direct grab samples are used for single layer virus plaque assays (Grabow and Coubrough, 1986). A 100 ml volume will be analyzed. The plaques are counted after 6 h to eliminate the problem of background bacterial overgrowth, which mask the viral plaques. The E. coli C3000 (ATCC 15597) is being used in all assays in order to detect somatic as well male specific coliphages.

Molecular fingerprinting technique using the 16S rDNA gene will also be used to determine total microbial population diversity. If any sample results positive for the presence of E. coli, the uidA gene will also be utilized. If any samples are positive for Aeromonas ssp., the genes Act, Alt and Ast, which code for the currently known enterotoxins within this genus will be amplified by PCR in order to determine the presence of enteropathogenic Aeromonas. As this is the most crucial, and the most critical part of the study, we are in the process of training the students carrying out amplifications only on the positive and negative controls.

It is envisioned that this project may continue in order to determine the effect of cistern water use on public health. With this in mind, two sets of questionnaires will be designed to identify the health history of the water cisterns users. The first one will be used in the microbial sampling date and the second one in the follow up interview by telephone. This will be performed to identify gastrointestinal symptoms in users and to observe any correlation with the presence of microorganisms in the waters. This portions of the study will be carried out with the help of the proper Public Health authorities in the Virgin Islands.

FINDINGS AND SIGNIFICANCE

Table 1. Concentrations (CFU/100 mL) of Indicators of Fecal Contamination and Aeromonas in Cisterns Waters in St.Thomas

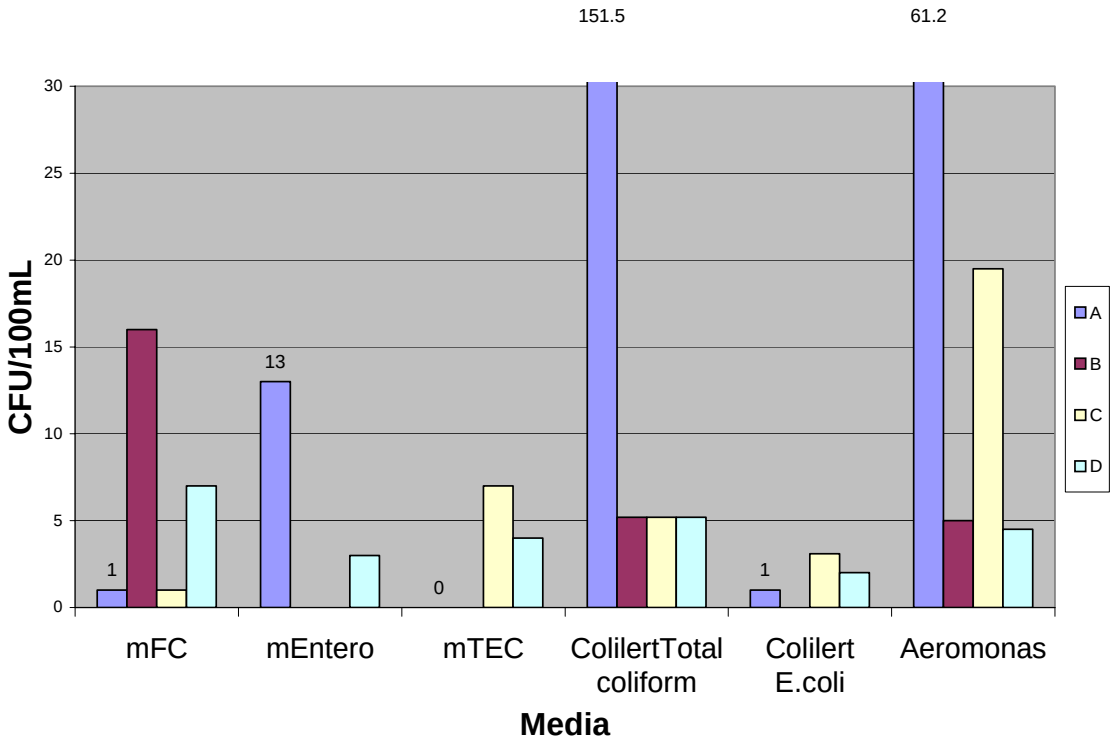
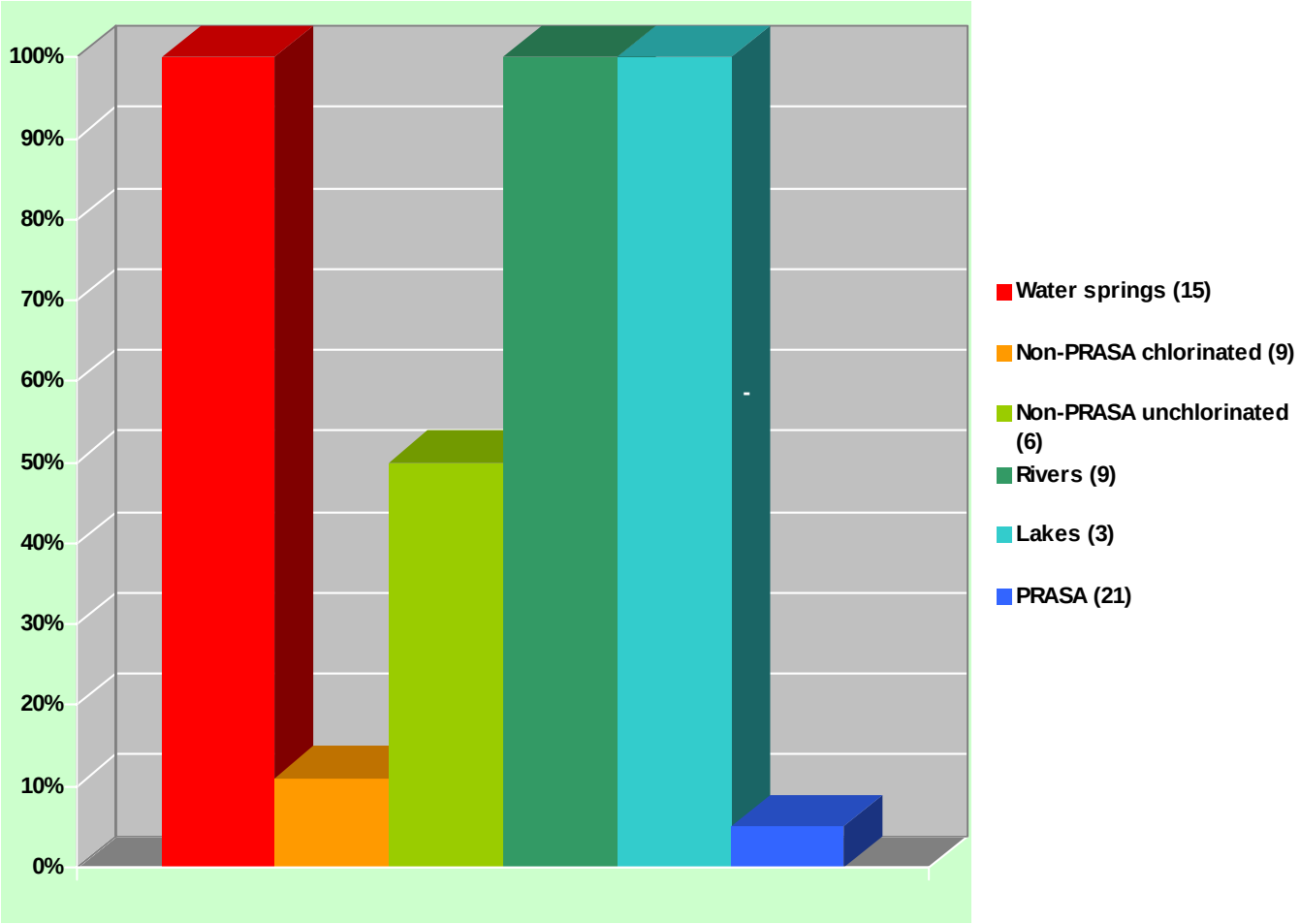


Table 2. Percent of Samples Containing *Aeromonas spp.* in Different Water Types in Puerto Rico



As can be observed, most sites were positive for the presence of Aeromonas spp. However, we are in the process of determining if there are any temporal variabilities to the prevalence. Additionally, the data to date has been qualitative rather than quantitative. We hope to have quantitative data in the next few months.

What we can draw from the current results is that in fact Aeromonas is present in most samples at different locations. In drinking waters, few isolates were found in chlorinated samples indicating that perhaps current levels of chlorine may be enough to prevent any possible infections. However, the presence of virulence factors together with disease prevalence data will allow us to draw better conclusions as to whether Aeromonas should be included as part of the CCL in tropical areas.

Coral Bay Watershed: Development of Management Measures for Sediment and Pollution Reduction - Phase II

Basic Information

Title:	Coral Bay Watershed: Development of Management Measures for Sediment and Pollution Reduction - Phase II
Project Number:	2003VI11B
Start Date:	6/1/2003
End Date:	2/28/2004
Funding Source:	104B
Congressional District:	NA
Research Category:	None
Focus Category:	Water Quality, Conservation, Non Point Pollution
Descriptors:	None
Principal Investigators:	Dayle Barry, Barry Devine

Publication

1. Coldron, S. and B. Devine. 2004. Coral Bay Community Council brochure and membership information. CBCC, 8-1 Estate Emmaus, Coral Bay, St. John, V.I.
2. Devine, B. and S. Coldron. 2004. Coral Bay Watershed Resources and Issues. CBCC, 8-1 Estate Emmaus, Coral Bay, St. John, V.I.
3. Devine, B. et al. 2005. Guiding Principles of Sustainable Green building Design and Construction. Island Green Building Association. c/o Friends of the Virgin Islands National Park. P.O. Box 811, St John, V.I.
4. Myers, K., Devine, B., and S. Coldron. 2004. Outline for a Coral Bay Area of Particular Concern Marine Inventory. Coral Bay Community Council. 47pp.
5. Schwartz, L., and D. Honour. 2005. Conceptual Stormwater Management Plan: Coral Bay Watershed, Final Letter Report (May 2005). Eastern Caribbean Center, University of the Virgin Islands. 27pp.

Problem and Research Objectives

Non-point source pollution of coastal embayments resulting from runoff contamination, sediment deposition and the health hazards caused by dumping of unregulated human waste is a common problem in the Virgin Islands and in most small, mountainous, tropical islands throughout the Caribbean and Pacific regions.

The Coral Bay watershed, St. John, United States Virgin Islands, with the highest population growth rate in the Virgin Islands, is typical of many watersheds throughout the Virgin Islands and the Caribbean, having a large watershed to bay area ratio. Many miles of unpaved roads and inappropriate land uses cause runoff and sedimentation, leading to poor water quality and deterioration of marine resources in waters extending well offshore and into the benthic zone.

A Phase I study within this watershed and the surrounding marine waters, funded by the Non-Point Source Pollution Program at the Virgin Islands Government - Department of Planning and Natural Resources, has investigated sediment deposition rate, sediment deposition history and the impact on water quality, fisheries diversity and coral reef health. The proposed study will complete Phase II of this project by developing and demonstrating management procedures applicable to many small, mountainous tropical islands trying to preserve the natural environment as well as gathering natural resource data and putting these data into a GIS watershed atlas.

The primary objective of this project is to use the previously collected data to educate and organize the critical audience of residents, businesses and visitors to non-point source issues affecting water quality in their watershed and to assist them in organizing a Watershed Residents Association with a primary objective of educating and encouraging the larger general population and visitors to use best management practices for water resource protection. The methodology of a watershed focus, where residents have a common identifiable interest in quality of life, has a high impact and transferability within small watershed communities typical of many Caribbean and Pacific locations.

Methodology

A variety of methodologies will be used to meet the objectives of this project. Several of the objectives are associated with organizing people in the community, developing educational information and providing educational meetings to share this information. Other objectives for this project will require more specific methods to gather information.

Coral Bay Watershed Residents Association - Previous projects have demonstrated the need for a community organization to respond to non-point source water quality threats. Using standard methods of community communication (flyers, brochures, newspapers, radio ads and word of mouth) a residents association was organized to meet and discuss activities to protect water quality of Coral Bay. Stakeholders were organized to form committees to address specific issues. The Coral Bay Community Council formed and

elected a board of directors, began a membership drive, held monthly information and educational meetings and focuses on community issues.

Island Green Building Association – Using a model developed by the National Green Building Association, a group of concerned residents, both professional and lay persons, formed, elected a Board and began the effort to develop Green Building Standards for use in the USVI as well as on nearby islands. Methods for this organization included development of membership, local advertising, Sustainable Green Building standards and educational events to inform the public and private organizations about the impact of inappropriate land use on coastal water quality.

Coral Reef and Natural Resource Assessment – This effort will use the Coral Reef Video Transect Sampling methodology currently in use by U.S. Geological Survey, National Park Service and the University of the Virgin Islands to survey the natural resources of the inner harbor and greater bay area and develop a map of these resource locations for use in planning and management of bay waters.

Conceptual Stormwater Management Plan , Coral Bay Watershed - A professional Engineering Firm was hired to complete the task of gathering, modeling and evaluating hydraulic studies of the watershed using the TR55 methodology and physical data supplied by the University's Conservation Data Center's Geographic Information System data layers. From these data, preliminary sediment retention and detention ponds and end-of pipe structures were sized sited and proposed for reducing inputs to bay water quality. Drainage computations once completed, and preliminary calculations will determine the stormwater alternatives available to address the sedimentation and runoff problems using standard and new, innovative approaches to protecting water quality in steep, tropical watersheds.

Watershed Atlas – Using existing GIS methodology, all data layers useful for watershed planning will be gathered into a hardcopy and digital atlas of the Coral Bay watershed. This will include data layers for topography, vegetation, marine communities, slope analysis, watershed bounds, National Park bounds, Coral Reef National Monument bounds, Area of Particular Concern bounds, soils, bathymetry, flood hazard, existing and proposed zoning and land use changes.

Coral Bay Roads Mapping and Rescue Locator System

Using Geographic Information System technology, road types (primary, secondary, paved and unpaved) were mapped throughout the watershed to understand the extent of pervious and impervious surfaces and their potential impact on water resources.

Principal Findings and Significance

This project commenced on February 1, 2004. Activities and efforts conducted to date have completed the following:

1. Watershed Residents Community Organization- A Residents Association, *the Coral Bay Community Council* was organized in February 2004 and membership to date is over 185 of 700 residents. Four committees have been formed, *Land Use and Watershed Protection, Ocean Use and Protection, Infrastructure and Services, and Watershed History and Preservation.* All committees are active in educating, informing and organizing residents, making choices and implementing Best Management Practices (BMPs). Monthly meetings are held to provide educational programs for residents, Coastal Zone Management and Planning and Natural Resource issues are reviewed and recommendations made, and the group organizes data gathering efforts to provide water quality and natural resource strategies. A website (www. coralbaycommunitycouncil.org) provides current information on the group's activities.

2. Island Green Building Association (IGBA) – A Best Management Practices (BMP) organization was formed in August 2004. This group developed a publication, "Guiding Principles of Sustainable Green Building Design and Construction" for educating residents, contractors, and government staff in the best management practices. In addition, a website (www.igba-stjohn.org) was developed to provide current and innovative methods to protect the landscape and water quality around the island. The organization while new, has met monthly, gotten numerous articles published in several local newspapers and provided more than a dozen presentations to local businesses and groups.

3. Watershed Brochure – A watershed brochure has been completed. This publication has been made available to all residents and describes the resources and issues prevalent in Coral Bay watershed. Contact information for the community organization is also provided.

4. GIS Watershed Atlas – Strategic planning to protect water quality resources requires the latest information in a digital and printable hardcopy format. The initial data layers for the atlas were gathered and developed into a work-in progress atlas of physical, geographic and biological information. These include layers and maps of topography, vegetation, marine communities, slope analysis, watershed bounds, soils, bathymetry, flood hazard, existing and proposed zoning and land use changes, National Park bounds (VINP), Coral Reef National Monument (VICRNM) bounds, and Area of Particular Concern bounds (APC).

5. Preliminary Stormwater Management Plan – Final delivery of the *"Conceptual Stormwater Management Plan – Coral Bay Watershed, Final Letter Report (May 2005)"* has been received from Camp, Dresser, McKee Inc. This detailed report includes, background, data collection, preliminary engineering analysis, hydrologic model, conceptual design alternatives analysis and recommendations for addressing stormwater management from a watershed perspective.

6. Natural Resource Inventory and Reef Assessment – A preliminary report "Outline for a Coral Bay Area of Particular Concern Marine Inventory" was

completed. GIS maps were generated of all existing marine resources will be used to assist in long term planning for the bay and to provide the necessary data for addressing CZM applications within the watershed.

7. Coral Bay Road and Home Maps – The location, size and type of roads in the watershed are critical factors for determining problematic sediment locations. The GIS road and residence data layers have been completed. These data will be incorporated into the Atlas, but the data will also be used to identify problem areas within the watershed for priority restoration. This information was developed into a GIS database and hardcopy mapping of problem areas, guts, home locations, drainage structures took place. The information is used to assist in determining priorities for development of the stormwater management plan. In addition, as the island has no mapping for rescue due to lack of maps and street names, the system is being adapted by St. John Rescue, emergency medical technicians, fire and police as a means of locating and reaching residents in medical emergencies.

Information Transfer Program

The University of the Virgin Islands prides itself on being a University of place and the Virgin Islands Water Resources Research Institute puts priority on having its research activities being relevant to local water resources issues and concerns. Dissemination of research findings then are an integral part of each activity even if the project does not have training or information sharing as its main objective. Two of the FY 2004 projects were focused on information dissemination and they are described in the pages that follow.

Additionally, the WRRI maintains a website that has among its features real-time data from the VI-WRRIs meteorological station. This site is located at http://rps.uvi.edu/WRRI/wrri.htm and is used by the news media, professionals and the general public to obtain current and historical information on the weather in the Virgin Islands. The VI-WRRI also contributes to several publications originating in the University. The Research and Public Service Newsletter is published quarterly and focuses on the Universitys research activities. The VI-WRRI usually contributes several articles to this publication.

The VI-WRRI also provides speakers to classes, workshops and meetings at the University and in the wider community. These talks may cover general topics in island hydrology, focused examination of current water and environmental problems or even discussions on career opportunities in environmental fields. They are often supplemented by visits to the VI-WRRI meteorological station and to other research sites. The VI-WRRI is not only a unit that conducts research but is also an information resource for the Virgin Islands.

Water Resources Education at Virgin Islands Environmental Resource Station

Basic Information

Title:	Water Resources Education at Virgin Islands Environmental Resource Station
Project Number:	2004VI30B
Start Date:	3/1/2004
End Date:	2/28/2005
Funding Source:	104B
Congressional District:	NA
Research Category:	None
Focus Category:	Water Use, Conservation, Education
Descriptors:	None
Principal Investigators:	Randy Brown, Katherine Flanagan

Publication

1. Flanagan, Katie, 2005, Water Resources Education at Virgin Islands Environmental Resource Station, Water Resources Research Institute, University of the Virgin Islands, St. Thomas, USVI.
2. Flanagan, K, 2004, Clean Islands International's 13th Annual General Meeting of the Board of Directors, VIERS, Lameshur Bay, St. John, US Virgin Islands.
3. Brown, R., 2005, St John Rotary Club meeting, Cruz Bay, St. John, US Virgin Islands.
4. Flanagan, K, 2005, Virgin Islands Environmental Resource Station Advisory Council Meeting, VIERS, Lameshur Bay, St. John, US Virgin Islands.
5. Flanagan, K, 2005,Poster Presentation at ReCaribe 2005 Curacao: 11th Annual Wider Caribbean Solid Waste Management Conference, May 11-13, 2005, Curacao.

Problem and Information Transfer Objectives

The U.S. Virgin Islands are small mountainous volcanic islands with limited ground and surface fresh water resources. Without available aquifers and only 45 inches of rainfall annually, the majority of the U.S. Virgin Islands water supply is provided from 1) the desalination of seawater or 2) rainwater collected from house roofs and stored in cisterns (which are large water storage tanks).

With a population of more than 108,000 year round residents and an ever increasing tourist industry, the availability of reliable and safe water supplies is a major concern for human activities and health reasons. With limited space and close proximity to marine habitats, the proper treatment and disposal of wastewater is crucial to the coastal environment not only in the U.S. Virgin Islands but also similar small islands of the Caribbean and elsewhere.

The project will focus on developing water conservation information for distribution to U.S. Virgin Islands students, students from other small island communities, and other interested individuals. The project will be conducted on site at Virgin Islands Environmental Resource Station (VIERS) and in Virgin Islands classrooms. VIERS, situated on the southside of St. John within the Virgin Islands National Park, is a facility of the University of the Virgin Islands and is operated as a self-supporting environment learning center by Clean Islands International, a nonprofit organization. The project will be conducted by VIERS staff.

Five fact sheets and relating lessons will be developed by the VIERS Environmental Education Coordinator (hereafter referred to as the VIERS educator). The fact sheets will focus on water resources, environmental education and water conservation practices. The objectives include providing students with understandable information on the topics. The fact sheets and relating lessons will be provided to students who visit VIERS (approximately 15 groups) and in 10 school classes on St. Thomas and St. John. The VIERS educator will make 10 presentations as a guest speaker to students in their classrooms. The classes selected will be determined by their inability to visit VIERS.

Participants of this project will consist of visitors to VIERS and Virgin Islands students. VIERS has approximately 700 visitors per year. Approximately half of VIERS visitors are students from St. Thomas, St John and St. Croix. The other half are students from universities, colleges and high schools from other Caribbean islands and the US mainland as well as researchers primarily from the US mainland.

Virgin Islands students visiting VIERS are usually between the ages of 8-14 years old. There are approximately 30,000 students, grades K-12, attending 88 public and private schools in the U.S. Virgin Islands. There are approximately 7,000 students between the ages of 8 and 14 year old attending school on St. Thomas and St. John. It is expected that approximately 300 students from VI schools will visit VIERS and receive project information in lessons presented onsite. It is expected that approximately 250 additional students from six St. Thomas schools and four St. John will receive classroom

presentations by VIERS staff. The students also have access to the library's resource materials.

There are approximately 350 other visitors to VIERS annually. The visitors have access to the library's resource materials. They will have the opportunity to review the resource publications and materials at the Library. Extra copies of the fact sheets will be available to interested individuals at the VIERS library.

This project will provide opportunities to resolve some of the challenges of 1) providing safe and reliable water supplies and 2) providing safe and healthy waste water disposal on small islands to Virgin Island students and other interested individuals through conservation and alternative practices. The materials developed can be used for any small community with similar water concerns. Education materials will be developed and presented to students who visit VIERS and for presentation as a guest speaker to students in school classes on St. Thomas and St. John by VIERS staff.

Water resources is one of the top priorities of any island community. The proper treatment and disposal of wastewater is crucial to the coastal environment not only in the U.S. Virgin Islands but also similar small islands of the Caribbean and elsewhere. By educating students about water resources, water conservation, waste water disposal and treatment alternatives, the community will receive long term benefits such as reduced water usage per person, less water to be treated and disposed, and an appreciation for the limited resource.

Methodology

In developing the fact sheets, the VIERS educator researched water resource materials for appropriate information. This was accomplished by using the University of the Virgin Islands Library, St. Thomas and St. John libraries, internet searches on the world wide web and contacting the Caribbean Water and Wastewater Association which forwarded a large packet of printed materials developed for Caribbean communities. The VIERS educator contacted local water resource experts to assist in providing information for this project. This included contracting representatives from the University of the Virgin Islands Cooperative Extension Service, Virgin Islands Department of Planning and Natural Resources, US National Park Service, VI Department of Education and others. The VIERS educator provided drafts of the facts sheets to Mr. Brown for approval. The information for the fact sheets was also reviewed by an independent water resources expert prior to final approval.

The lessons were developed and reviewed by the marine advisor to the UVI – Marine Advisory Service, Elizabeth Ban, and others. The VIERS educator contacted all elementary schools on St. Thomas and St. John and received a positive response from most schools. She spoke with principals at Gomez, Oliver, Kirwan, Lockhart and Muller Elementary Schools and reported that those schools were interested in setting up presentations. She then planned with class teachers to conduct the lessons. She

participated in an Environmental Jobs Fair day on November 23, 2004 at a school on St. Thomas.

The VIERS educator researched reference books available for purchase on the internet and submitted a preferred list of publications to the VIERS Administrator for approval. The 31 books that relate to water conservation, pollution control and the recycling of water were purchased and delivered in January 2005. They are available for use in the VIERS library and classroom.

Principal Accomplishments and Significance

The five fact sheets proposed were developed by the VIERS Environmental Education Coordinator. The fact sheets focus on water resources, environmental education and water conservation practices. The objectives included providing students with understandable information on the topics. We had planned to distribute the fact sheets during the lessons, but the time for development, verification and printing were longer than anticipated. Once the fact sheets were received, they were distributed to the classes visited. The fact sheets are being made available to other classes (as supplies last). A quantity of fact sheets will be reserved for use by students visiting VIERS. Copies will be reserved for the VIERS library for future use.

Water conservation lessons were provided to students in school classes on St. Thomas and St. John and who visited VIERS. It was planned for the VIERS educator to make 10 presentations as a guest speaker to students in their classrooms. The VIERS educator actually made ten however several of the presentations were to multiple classes. The classes were selected by response to our contacts, mostly new to VIERS. While the scheduling of in class presentations was later in the school year than originally planned, the presentations were well received and many new contacts were made for future classroom visits. The lessons developed are written in lesson plan format so that the VIERS educator or other educators can present the lessons in the future. The VIERS educator was available to present additional in-class lessons if requested for the remainder of the school year.

It was proposed that participants of this project would consist of approximately 300 students between the ages of 8 and 14 from VI schools. Thus far, approximately 161 students have received lessons pertaining to water resources and conservation. (Classroom size may have been overestimated.) The VIERS educator is available to present additional in-class lessons for the remainder of the school year and several classes will be visiting VIERS prior to the end of the school year and lessons will be presented.

It was proposed that participants of this project would consist of approximately 300 students between the ages of 8 and 14 from VI schools who visit VIERS. Thus far, approximately 226 have received lessons pertaining to water resources and conservation and it is expected that approximately 120 additional students from St. Thomas and St. John will receive this information prior to September 2005.

There are approximately 350 visitors (other than VI school students) to VIERS annually. The visitors have access to the library's resource materials. They will have the opportunity to review the resource publications and printed materials at the VIERS Library. Extra copies of the fact sheets will be available to interested individuals at the VIERS library.

Several reference books were purchased for use in developing the lessons and fact sheets and will be available in the VIERS library for use by students. Multiple copies of a few of the books were purchased to use in workgroup sessions with students visiting VIERS. The VIERS educator researched reference books available for purchase on the internet and submitted a preferred list of publications to the VIERS Administrator for approval. The books were purchased and delivered in January 2005. They are available for use in the VIERS library and classroom. The following is a list of 31 books that have been purchased that relate to water conservation, pollution control and the recycling of water:

1. Water Conservation (Environmental Action) [Paperback] by Leslie Crawford (Quantity: 6).

2. Clean and Green: The Complete Guide to Non-Toxic and Environmentally Safe ... [Paperback] by Annie Berthold-Bond (Quantity: 6).

3. Tapped Out: The Coming World Crisis in Water and What We Can Do About It... [Hardcover] by Paul Simon (Quantity: 2).

4. Create an Oasis With Greywater: Your Complete Guide to Choosing, Building and... [Paperback] by Art Ludwig (Quantity: 6).

5. Every Drop Counts: A Book About Water ing] by Jill C. Wheeler, et al (Quantity: 2).

6. Keeping Water Clean (Water) [Library Binding] by Helen Frost (Quantity: 1).

7. Water Wars: The Fight to Control and Conserve Nature's Most Precious Resource... [Library Binding] by Olga Cossi (Quantity: 4).

8. Composting Toilet System Book: A Practical Guide to Choosing, Planning and... [Paperback] By David Del Porto and Carol Steinfeld (Quantity: 1).

9. The Humanure Handbook: A Guide to Composting Human Manure (The Humanure Hand... [Paperback] by Joseph C. Jenkins (Quantity: 1).

10. Rainwater Catchment Systems for Domestic Supply: Design, Construction and... [Paperback] by Erik Nissen Petersen and John Goul (Quantity: 1).

11. Growing Clean Water : Nature's Solution to Water Pollution [Paperback] by: B. C. Wolverton and John D. Wolverton (Quantity: 1).

Summary

The VIERS staff is confident that the project was successful in meeting its goals to develop water conservation information for distribution to U.S. Virgin Islands students both in classrooms in St. Thomas and St. John and in printed form.

The VIERS educator was able to receive support for this project from many other organizations. This was very beneficial in developing relationships for future VIERS programs.

This project provided opportunities to resolve some of the challenges of 1) providing safe and reliable water supplies and 2) providing safe and healthy waste water disposal on small islands to Virgin Island students and other interested individuals through conservation and alternative practices. The materials developed can be used for any small community with similar water concerns. The education materials developed were presented to students who visited VIERS and were presented to students in school classes on St. Thomas and St. John by VIERS staff. The written lesson plans can be used in the future by VIERS staff and other educators.

Water resources is one of the top priorities of any island community. The proper treatment and disposal of wastewater is crucial to the coastal environment not only in the U.S. Virgin Islands but also similar small islands of the Caribbean and elsewhere. By educating students about water resources, water conservation, waste water disposal and treatment alternatives, the community received long term benefits such as reduced water usage per person, less water to be treated and disposed, and an appreciation for the limited resource.

VIERS has greatly appreciated being able to present conservation information to students in the classroom and to students who visit our facility. This type of outreach is important for VIERS as it serves as a community resource. The development of the environmental education program at VIERS is an important commitment that we plan to expand in the years ahead.

Virgin Islands Water Conference and Sixth Caribbean Islands Water Resources Congress

Basic Information

Title:	Virgin Islands Water Conference and Sixth Caribbean Islands Water Resources Congress
Project Number:	2004VI37B
Start Date:	3/1/2004
End Date:	2/28/2005
Funding Source:	104B
Congressional District:	NA
Research Category:	None
Focus Category:	Water Supply, Management and Planning, Education
Descriptors:	None
Principal Investigators:	Henry H. Smith

Publication

Problem and Information Transfer Objectives

In the U. S. Virgin Islands, responsibility for management of the water resources is split between several agencies. The Virgin Islands Water and Power Authority (WAPA) is responsible for desalination of seawater and distribution of water. The Department of Planning and Natural Resources (DPNR) has responsibility for the monitoring the quality of public water supplies and for enforcement of water quality standards. Wastewater management is currently the responsibility of the Department of Public Works but will soon be under the jurisdiction of a newly created wastewater management authority. The Virgin Islands Water Resources Research Institute (VIWRRI) at the University of the Virgin Islands conducts research on water resources issues in the Virgin Islands and executes information dissemination and training programs. Additional there are several non-governmental organizations in the Virgin Islands including the Environmental Association of St. Thomas and St. John (EAST), the League of Women Voters, the St. Croix Environmental Association (SEA), the Virgin Islands Conservation Society (VICS) and several others that concern themselves with water resources matters.

These various units effectively carry out their identified responsibilities however there is no provision for facilitation of the synergy that could occur due to these agencies sharing information and lessons gained in a meaningful, systematic manner. Organizations in many cases are not aware of each others existence and collaborations might occur in a piecemeal opportunistic fashion. It is not unusually for these units to at times be competing for the same resources to execute programs that have a common worthy goal. There is need for local discussion among groups with water resources interests to share information, develop priorities and possibly develop plans for ongoing collaboration.

The problem of insularity is further compounded because while the local agencies may benefits from their associations with related agencies at the national level within the United States, they do not interact with similar agencies and groups in the neighboring Caribbean Islands with whom they might have more in common. This situation might be brought on by political affiliations and the associated difficulties of restrictions imposed by funding sources. For example, a researcher at the Virgin Islands Water Resources Research Institute in St. Thomas conducting work funded through a U. S. Geological Survey project, might travel around the globe to engage in consultation with a researcher thousands of miles away in Guam. However, in order to travel ten miles to consult with a researcher in the British Virgin Islands, special permission must be sought from the U. S. Geological Survey. An opportunity for regional dialogue on water resources is needed.

The activity proposed will result in water resources interests in the U. S. Virgin Islands and the Caribbean region:

1. Developing a familiarity with each others roles and responsibilities

2. Gaining knowledge of resources that may available directly from or through other local or regional agencies
3. Sharing and gaining of ideas and experiences among participating agencies
4. Developing an appreciation for the wealth of knowledge and resources available within the region
5. Developing and installing mechanisms for future collaboration and cooperation.

The project will consist of a two-day conference to be held in the U. S. Virgin Islands. The conference will be split in to two parts with one day focused principally on specific matters in the U. S. Virgin Islands and the second day on more general issues having to do with the Caribbean region. The conference is intended for a wide range of persons. These will include government officials, researchers, NGO's and private interests as well as students. The focus will be on general information sharing so formal presentations will be restricted to overviews and may cover topics including management responsibilities, research activities and implementation of highly successful practices. The objective of the conference is provide a forum in which persons in the U. S. Virgin Islands and the Caribbean region can exchange ideas and develop understandings and relationships that could promote better water resources management in the region.

Methodology

The conference will convened by the Virgin Islands Water Resources Research Institute in collaboration with local agencies such as the Virgin Islands Water and Power Authority and the Department of Planning and Natural Resources. Additionally, the University of Puerto Rico's Water Resources Research Institute and the Caribbean District Office of the United States Geological Survey – Water Resources Division will be invited to collaborate as they have in the past on the organizing of the section of the conference focusing on the water issues in the wider Caribbean – the Sixth Caribbean Islands Water Resources Congress.

Principal presentations will be invited from knowledgeable persons on subjects determined by the conference's organizing committee. A limited number of volunteered papers will also be considered. Papers will be presented as part of panel presentations. Each day will feature a keynote speaker at the luncheons. Conference proceedings will be made available on compact disks at the close of the meeting and also posted on the VIWRRI's web page. This CD will also include contact information for conference participants.

Poster presentations will be invited for the conference and field trips will be conducted to sites in St. Thomas that may be of particular interest to conference participants. Tentative sites are the desalination plant of the Virgin Islands Water and Power Authority and the new wastewater treatment facility on the eastern end of St. Thomas.

The first day of the conference will be focused on matters that are local to the Virgin Islands and the second day will address regional matters. With the guidance and active

participation of the Advisory Council of the VIWRRI, its Director will assemble a committee and lead the organization a meeting for government agencies, non-governmental organizations (NGOs) and others to assess the state of water resources management in the Virgin Islands. It is anticipated that there will be presentations made by representatives of the principal groups and discussions of individual plans for the future as well opportunities for collaborations. This session on water resources in the Virgin Islands will conclude with a meeting of persons interested in developing a mechanism for continuation of the dialog fostered by the conference.

The second day of the conference will be the convening of the Sixth Caribbean Islands Water Resources Congress. The first of these meetings was held in the Virgin Islands in 1984 and subsequent meetings were held in San Juan and Mayaguez, Puerto Rico and the Virgin Islands as collaborative efforts between the Virgin Islands and Puerto Rico Water Resources Research Institutes and the Caribbean District Office of the U. S. Geological Survey – Water Resources Division. As in the past, papers on water resources issues applicable to the Caribbean area will be invited for this conference.

Principal Accomplishments and Significance

During the planning process it was decided that the conference should be split in to two separate conferences occurring at different times and in different places. It was felt that the first conference would be focused principally on work done through the Virgin Islands Water Resources Research Institute. It would also provide a forum for a broad discussion of local water resources issues and for developing research direction for the VI-WRRI in the coming years. The second conference would be the Sixth Caribbean Islands Water Resources Congress and as planned would be targeted to a Caribbean-wide audience.

The first conference was held on Thursday, February 24, 2005 on the St. Thomas campus of the University of the Virgin Islands. A copy of the meeting's program is inserted at the end of this report. Participation in the meeting was good and from a wide cross-section of persons. The meeting permitted the usual desirable networking, allowed an exchange of information and facilitated dialoging among researchers, practitioners, government officials and the general public that might not otherwise have occurred. Very importantly, the VI-WRRI was able get a better sense of what the perceived water resources research needs in the Virgin Islands are.

Planning for the Sixth Caribbean Congress is currently underway. The University of Puerto Rico, one of the expected co-sponsors, is currently experiencing some internal difficulties but these are expected to be resolved shortly.

University of the Virgin Islands

2005 Water Resources Conference

Thursday, February 24, 2005
Sports and Fitness Center -West Mezzanine 2nd Floor

Agenda

8:30 – 9:00 am ***Breakfast***

9:00 – 9:30 am **Welcome**
James Rakocy, Ph.D.
Acting Vice Provost for Research and Public Service

Opening Remarks
LaVerne E. Ragster, Ph.D.
President, University of the Virgin Islands

Water Resources Presentations

Introduction of Water Resources Research Institute Principal Investigators
Henry H. Smith, Ph.D.
Director, Water Resources Research Institute

9:30 – 9:50 am **Ms. Katie Flanigan, Environmental Coordination Manager**
Virgin Islands Environmental Resource Station
Water Resources Education at VIERS

9:50 – 10:10 am **Ms. Marcia Taylor, Research Specialist**
Center for Marine and Environmental Studies
Environmental Education and Hands-On Training-Mangrove Restoration Techniques

10:10 – 10:30 am **Dr. James Rakocy, Acting Vice Provost, RPS**
Agricultural Experiment Station
Water Research Projects at the Agricultural Experiment Station

10:30 – 10:50 am **Dr. Barry Devine, Chief Scientist**
Eastern Caribbean Center/Conservation Data Center
Water Resources Management in Coral Bay Watershed

10:50 – 11:00 am ***Morning Break***

11:00 – 11:20 am	**Dr. Hosanna Solomon, Assistant Professor of Economics** Social Science Division ***Production, Pricing, & Distribution Policies of Water***
11:20 – 11:40 am	**Mr. Heath Kelsey, Environmental Health Studies** University of South Carolina ***Hydrology Modeling in Turpentine Run***

Virgin Islands Experimental Program to Stimulate Competitive Research Presentations

11:40 – 11:50 am	**Mr. Eugene Gottlieb, Outreach Coordinator** Virgin Islands Experimental Program to Stimulate Competitive Research ***Introduction of VI-EPSCoR/Dr. Nasseer Idrisi***
11:50 – 12:30 pm	**Dr. Nasseer Idrisi, Research Assistant Professor** VI-EPSCoR/Biocomplexity of Caribbean Coral Reef ***Iraq-Advancing Watershed Assessment, Research, & Education (AWARE): Restoring the Southern Iraqi Marshlands after a decade of devastation***
12:30 – 1:30 pm	***Lunch***

Presentations by Government Agencies

1:30 – 2:00 pm	**Mr. Stevie Henry, Data Manager, ECC/Conservation Data Center** in collaboration with **Department of Planning & Natural Resources** ***Wellhead Protection for the U.S. Virgin Islands/GIS Project***
2:00 - 2:20 pm	**Ms. May Cornwall, Director of Water Distribution, Alternate Engineering, and Grants** Water and Power Authority ***Water Distribution System, Capital Improvement Project, and Research Needs***
2:20 – 2:40 pm	**Ms. Sonia Nelthropp, Interim Executive Director** Waste Management Authority ***Water Management in the Territory***
2:40 - 2:50 pm	***Afternoon Break***
2:50 – 3:15 pm	**Dr. Henry H. Smith, Director** Water Resources Research Institute ***Future Plans and Priorities***
3:15 – 4:00 pm	**Open Discussion/Questions and Answers**
Closing Remarks	**Dr. Henry H. Smith, Director WRRI**

Student Support

Student Support					
Category	**Section 104 Base Grant**	**Section 104 RCGP Award**	**NIWR-USGS Internship**	**Supplemental Awards**	**Total**
Undergraduate	5	0	0	0	5
Masters	1	0	0	0	1
Ph.D.	2	0	0	0	2
Post-Doc.	0	0	0	0	0
Total	8	0	0	0	8

Notable Awards and Achievements

The project Hydrologic Modeling in Turpentine Run, St. Thomas and the VI-WRRI project by the same investigators, Fecal Coliform Bacteria Removal Efficiency for Stormwater Runoff BMPs in the Virgin Islands, were noted in the recommendation for two awards received by R. Heath Kelsey, including Outstanding Graduate Student of the Year, 2005, ENHS Department Arnold School of Public Health at the University of South Carolina and the 2005 National Oceanic and Atmospheric Administration (NOAA) Walter B. Jones Award for Outstanding Graduate Study in Coastal Management. Mr. Kelsey also received a NOAA Dean John Knauss Marine Policy Fellowship in part because of the research conducted during the course of these two projects.

Publications from Prior Projects