STATUS OF HAZARD MAPS VULNERABILITY ASSESSMENTS AND DIGITAL MAPS

BRITISH VIRGIN ISLANDS REPORT

THE CARIBBEAN DISASTER EMERGENCY RESPONSE AGENCY (CDERA)

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Preface

From 2002 – 2005, the Caribbean Disaster Emergency Response Agency (CDERA) is implementing two major regional initiatives which are designed to reduce vulnerability to natural and technological hazards. These are the Japanese International Cooperation Agency (JICA) supported Caribbean Disaster Management (CADM) Project and the Canadian International Development Agency (CIDA) supported and Organization of American States executed Caribbean Hazard Mitigation Capacity Building Programme (CHAMP). The hazard mitigation planning component of the latter is being implemented in close collaboration with the Caribbean Development Bank's Disaster Mitigation Facility for the Caribbean. Hazard maps, vulnerability assessment studies, and digital maps are critical inputs to both initiatives.

This survey reviewed the status of these thematic activities in sixteen (16) CDERA Participating States, Haiti, Martinique, Suriname and Puerto Rico over the period August – October 2003. The objectives of the Survey were as follows:

1. To determine the status of hazard maps and vulnerability assessment studies and their use in the socio-economic planning and management of the Caribbean.
2. To determine critical success factors, gaps and best practices in the preparation and use of hazard maps and vulnerability assessment studies in the Caribbean.
3. To compile a database of hazard maps, vulnerability assessment reports, and digital maps available in the Caribbean.

Hazards considered under the survey included natural hazards such as floods, hurricanes, landslides, coastal disasters (surge, wave, and erosion), earthquakes, and volcanic eruptions as well as technological hazards. The types of vulnerability assessment considered were structural, economic, and human assessments.

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Status of Hazard Map, Vulnerability Assessments and Digital Maps in the Caribbean: British Virgin Islands

1.0 Introduction

1.1 Physical and socio-economic background

The British Virgin Islands (BVI) is located in the Virgin Islands archipelago to the east of Puerto Rico. BVI is made up of more than forty islands grouped into four clusters which are separated by channels. The total area of BVI is 59 sq miles. The largest islands are Tortola, Virgin Gorda, Anegada and Jost Van Dyke. Tortola is the largest island and is the location of central government and the capital of Road Town.

Most of the islands except Anegada are hilly with steep coastal slopes. The highest point is in Tortola at Sage Mountain that rises to 1,780ft. Numerous spurs divided by steep drainage channels called “ghuts” characterize the topography of the islands. In contrast to the other islands, Anegada is a very flat limestone island of which salt ponds occupy one quarter.

The 1991 census indicated that the population of BVI was 16,115 and that 13,200 (82%) of those persons lived in Tortola. The population doubled between 1984 and 1994 largely due to migration. It was estimated that in 1997, 45% of the population were migrants.

The BVI economy is stable. Most goods are imported and the island has close ties with the US Virgin islands and Puerto Rico. The economy is heavily dependent on the services sector. Offshore company registration is the largest earner of foreign exchange. Tourism is the largest single employer in the private sector and the charter boat industry is an important feature of BVI tourism. There over 650 charter boats that create demands for accommodation, boat repair and servicing facilities. BVI has over 200,000 visitors and 80,000 cruise ship passengers annually.

1.2 Major disaster issues confronting the country

The BVI is exposed to both natural and manmade hazards. Hurricanes and earthquakes are the natural hazards that are considered to be the greatest threat. The effects of hurricanes and tropical storms such as wind damage, inland flooding and coastal surge are of significant concern. Hurricane Hugo severely affected the BVI in September 1989. Losses were estimated to be US$40 million and 30% of the country’s housing stock was destroyed.

Seismic research indicates that the northeastern Caribbean has the potential to experience an earthquake of between 7.5 to 8.5 magnitudes. Earthquakes of

this magnitude occurred during the 19th century. More recently, the Leeward Islands experienced an earthquake of 7.5 magnitude on 8th October 1974.

The islands are also prone to manmade hazards such as exposure to hazardous chemicals, explosions and transportation accidents. Oil spills are considered to be the greatest manmade threat to BVI.

2.0 Hazard Mapping Initiatives

There have been two hazard mapping initiatives in the BVI. The first initiative occurred over the period 1996 to 1997 as a component of the Hazard and Risk Assessment Project (HRAP). The second initiative was a Biodiversity Study conducted by the United States National Oceanic and Atmospheric Administration [NOAA]. The primary source of all the hazard maps is the Department of Disaster Management. Table 1 indicates the details of the hazard maps available for BVI.

The HRAP produced five hazard maps, wind, surge, waves, flood and liquefaction. The project considered only the four main islands of Tortola, Virgin Gorda, Anegada and Jost Van Dyke. Liquefaction risk was produced only for a reclaimed site in Road Town. Specialists in each field produced the HRAP maps from a 1:25,000 scale input map.

The output of the Biodiversity Study was a coastal sensitivity hazard map, which identified shoreline habitats at risk to incidence of oil spill. The map is used to assist in the prevention of oil spills and covers the entire BVI.

Table 1 – Hazard Mapping of BVI

Type[1]	Purpose	Coverage	Date Produced	Author
Wind	Identify areas vulnerable to wind	Four main islands: Tortola, Virgin Gorda, Anegada and Jost Van Dyke	1996	Watson Technical Consulting
Surge	Identify areas vulnerable to storm surge		1996	Watson Technical Consulting
Waves	Identify areas vulnerable to storm waves		1996	Watson Technical Consulting
Flood	Identify areas at risk to flooding		1996	Hernan Solis
Liquefaction	Identify areas vulnerable to liquefaction	Road Town	1997	Seismic Research Unit, UWI
Oil Spill	Oil spill prevention	Entire BVI	2000	NOAA

Note 1: The Dept. of Disaster Management is the primary source of these hazard maps

2.1 Methods of preparation and distribution

All the hazard maps, with the exception of the oil spill map, were produced from the HRAP project. Specialists in the relevant fields conducted separate studies to produce each hazard map. Both the HRAP and oil spill hazard maps are available in published and digital format. The oil spill hazard map is primarily distributed in published format. The HRAP maps are primarily distributed to users within the project reports.

The HRAP tropical cyclone study was conducted over the period 1995 to 1996. It examined the nature of hurricanes in the region and assessed their threat to BVI. The Arbiter of Storms (TAOS) model was used and hurricane frequency analysis determined return periods on the basis of the US National Hurricane Center's "best fit" track data. The effects of wind, waves and storm surge were considered separately for various return periods.

The HRAP seismic assessment was conducted using the SEISRISK computer program. This program executes a probabilistic analysis based on geology, neotectonics and seismicity. The analysis also examined the characteristics and statistics of the seismicity in each zone using an earthquake energy dissipation model. The microzonation of Road Town, East End Tortola and Spanish Town was conducted using micro tremor data.

The flood hazard map was produced from an analysis of drainage channel water flow conditions. The analysis was conducted using the US Corp of Engineer HEC-2 model, which considered channel configuration, channel surface and the nature of channel obstructions. Channel configuration was determined from a detailed field survey and field investigations were used to collect data for other characteristics.

NOAA produced the oil spill hazard map using a standard US methodology and NOAA's Environmental Sensitivity Index. This analysis considered geology, biodiversity and socio-economic factors.

2.2 Users and uses

The Department of Disaster Management is the main user of hazard maps in the BVI. The Department uses the maps for contingency and mitigation planning. The maps are also used by a number of other public and private agencies to support their activities. The public agencies include Town and Country Planning Department (T&CPD), Public Works, Heath Services, Conservation and Fisheries Department and the Port Authority. One example of private sector hazard map use is that of architects using the maps to inform design specifications.

The Conservation and Fisheries Department and the Port Authority are the main users of the Oil Spill map. They use this map to identify the endangered habitats and prepare policies to prevent oil spills.

2.3 Current condition and limitations

The HRAP and oil spill hazard maps have not been revised or updated since they were first produced. The maps are fairly current. There are plans to prepare maps of actual oil spills and a map of the locations of hazardous chemical storage.

The HRAP flood project documentation indicated that the accurate delineation of flood prone zones was affected by the small quantities of floodwater and a lack of detailed topographic data.

The National GIS coordinator indicated that there are issues with regards to the updating of maps and consistency between maps. Some errors exist in the base data for the oil spills map and the format of the identifier used makes updates very difficult.

2.4 Critical success factors

Three factors that contributed to the successful preparation of the maps were:

a. Use of specialists in each of the hazards to produce the maps
b. Collaboration with the Department of Disaster Management
c. Existence of a National GIS database

2.5 Respondents

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Two interviews were conducted in BVI on August 13th 2003. The interviews were with the National GIS Coordinator, Conservation and Fisheries Department and the Department of Disaster Management. Personal and contact information is listed below:

a. Alan Mills, National GIS Coordinator, Conservation and Fisheries Department, Road Town, Tortola, Government of the British Virgin Islands. Telephone: 1-284-494-5681; Fax: 1-284-494-2670; email: alanpmills@hotmail.com
b. Jose DeCastro, Senior Technical Planning Officer, Department of Disaster Management, Macnamara Road, Road Town, Tortola. Telephone: 1-284-494-4499; email: bviodp@candwbvi.net

3.0 Vulnerability Assessment Studies

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BVI has had one major vulnerability assessment study which is the Hazard and Risk Assessment Project (HRAP) of 1997. The Government has also recently begun (2003) a Quantitative Risk Assessment Project (QRAP) of natural hazards.

The HRAP study was a structural and human vulnerability assessment. It includes hazard assessment, impact evaluation and loss reduction recommendations. It consisted of four main activities: hazard mapping, the production of an inventory of the elements at risk, vulnerability analysis and loss, and the development of mitigation strategies. The study was done for the four main islands of Tortola, Virgin Gorda, Anegada and Jost Van Dyke. The project manager, Aedan Earle, conducted the vulnerability assessment for all hazards except wind. The project extended from 1995 to 1997 and had a budget of US$90,000. The primary source for the project is the Department of Disaster Management.

The QRAP is in its initial phase and is expected to place emphasis on drainage and flooding. It is a structural assessment to identify areas at risk from natural hazards and is expected to commence in late 2003. The project cost is approximately US$10,000.

3.1 Methods of preparation and distribution

In the HRAP project, the elements at risk were established by conducting an inventory of the elements affected by each hazard. The vulnerability of each element to damage was evaluated. Based on degree of vulnerability estimates of potential damage were calculated. The results of the HRAP project are distributed in report format.

The QRAP is on-going and details on the methodology were not available.

3.2 Users and uses

The main user of the HRAP is the Department of Disaster Management. The Department has used the study to support the development of contingency disaster plans and a disaster mitigation plan. The HRAP is also used by the T&CPD, Public Works, the Health Services, architects and private contractors. These public and private users use the information to inform their activities. The results of the vulnerability study are widely used.

The Drainage Division is expected to be the main user of the results of the QRAP. They will use the results to identify drainage and infrastructure at risk and determine remedial works required.

3.3 Current conditions and limitations

The results of the HRAP have not been updated. The results of the QRAP will be used to update and supplement the HRAP where possible. The HRAP suffered from "unexpected and prolonged" delays that resulted in the project manager completing the project. He conducted most of the vulnerability assessments and developed the GIS.

3.4 Critical success factors

The input of experts in each hazard area contributed to the success of the map preparation. The collaboration of numerous agencies on the project contributed to the successful use of the results.

4.0 Digital maps

Digital mapping and GIS activities are distributed throughout a number of agencies in the BVI. A National GIS Coordinator is responsible for the development and maintenance of the National GIS and coordinates the GIS related functions of the agencies. The Surveys Department has the responsibility for preparing and maintaining key layers of the National GIS. These layers include topographical, cadastral and infrastructure data. The Department of Disaster Management is responsible for mapping related to hazards, geology and critical facilities. Town and Country Planning is responsible for land use and social facility mapping. Each agency is responsible for developing and maintaining its digital mapping and related databases. Table 2 indicates the details of the digital mapping available in BVI.

Table 2: Digital Maps Available in BVI.

Data Theme[1]	*Input map Scale*	*Year input map was produced*	*Area covered*	*Primary Source*	*Digital File format*	*Datum*
Wind, Storm surge, waves, flood, liquefactions	1:50,000	1997	BVI	Dept. of Disaster Management	Shapefile	Puerto Rico
Contours	1:2,500	2002	BVI	Survey Department	.dxf	NADS83
Land Use	1:2,500	2000	BVI	Town & Country Planning	Shapefile	Puerto Rico
Geology	1:50,000	2003	BVI	Dept. of Disaster Management	Shapefile	Puerto Rico
Roads	1:2,500	2002	BVI	Survey Department	.dxf	NADS83
Rivers	1:2,500	2002	BVI	Survey Department	.dxf	NADS83
Buildings	1:2,500	2002	BVI	Survey Department	.dxf	NADS83
Bridges and	1:2,500	2002	BVI	Survey Department	.dxf	NADS83

Culverts						
Electricity Lines	1:2,500	2002	BVI	Survey Department	.dxf	NADS83
Telephone Lines	1:2,500	2002	BVI	Survey Department	.dxf	NADS83
Population	1:25,000	1991	BVI	Survey Department	.dxf	NADS83
Social Facilities	1:25,000	2002	BVI	Town & Country Planning	Shapefile	Puerto Rico
Critical Facilities	1:25,000	2002	BVI	Dept. of Disaster Management	Shapefile	Puerto Rico
Liquefaction	1:25,000	1997	Road Town	Dept. of Disaster Management	Shapefile	Puerto Rico

Note 1: The Transverse Mercator is the map projection of these maps

In 2002 the Surveys Department commissioned a new map series for BVI. The Department then made the decision to standardize the datum and projection of BVI mapping to NAD83 and Transverse Mercator UTM Zone 20. Other pre-existing mapping is to be transformed to this datum and projection.

5.0 Conclusions and Remarks

After Hurricane Hugo in 1989, the Government of BVI shifted its approach to disaster management from one of response to one of mitigation. Projects of this type included the 1997 Hazard Risk Assessment, the 1999 Building Regulations, revised development standards, environmental protection measures and the Mitigation Strategy.

Several factors have contributed to the success of disaster management in the BVI. These factors include political support and an emphasis on public awareness and education. An integrated approach to disaster management has been adopted by government agencies. Disaster management and vulnerability assessment have been integrated into physical and economic planning.

The HRAP is the main vulnerability assessment project that has been conducted for the BVI. It examined the four main islands and produced hazard maps for wind, storm surge, waves, flood and seismic activity. This data is currently being supplemented by an ongoing risk assessment, which will place emphasis on flooding and infrastructure vulnerability. The hazard mapping and vulnerability assessment results are widely used in the BVI by both public and private agencies. In addition they have been integrated into a national GIS.

References: Office of Disaster Preparedness, 1997. Hazard and Risk Assessment Project – Hazards of the British Virgin Islands.