

## Small Islands, Big Ideas.

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### Abstract

Small Island Developing State governments such as in British Virgin Islands cover local council-sized populations with federal responsibilities. Although government is a major employer, skilled GIS staff are spread thinly across several departments. To minimize effort duplication, streamlining data production and data quality improvements, a National GIS was established through informal cross-departmental linkages, with central coordinating nodes that deal with metadata, resale, communication and strategy. Separate technical and policy committees have been established. In one year, benefits from this approach are being reaped, but BVI may be best served by improving delivery of core functions; data, metadata, training and coordination.

### Introduction

The migration of many GIS from project based to corporate based models continues to spread to all corners of its applications. In local and federal government there has been an acceptance that this model helps to better organise information, avoid duplication and improve quality. While the establishment of a structure needs significant financial outlay, the long term cost savings throughout the organisation can be large.

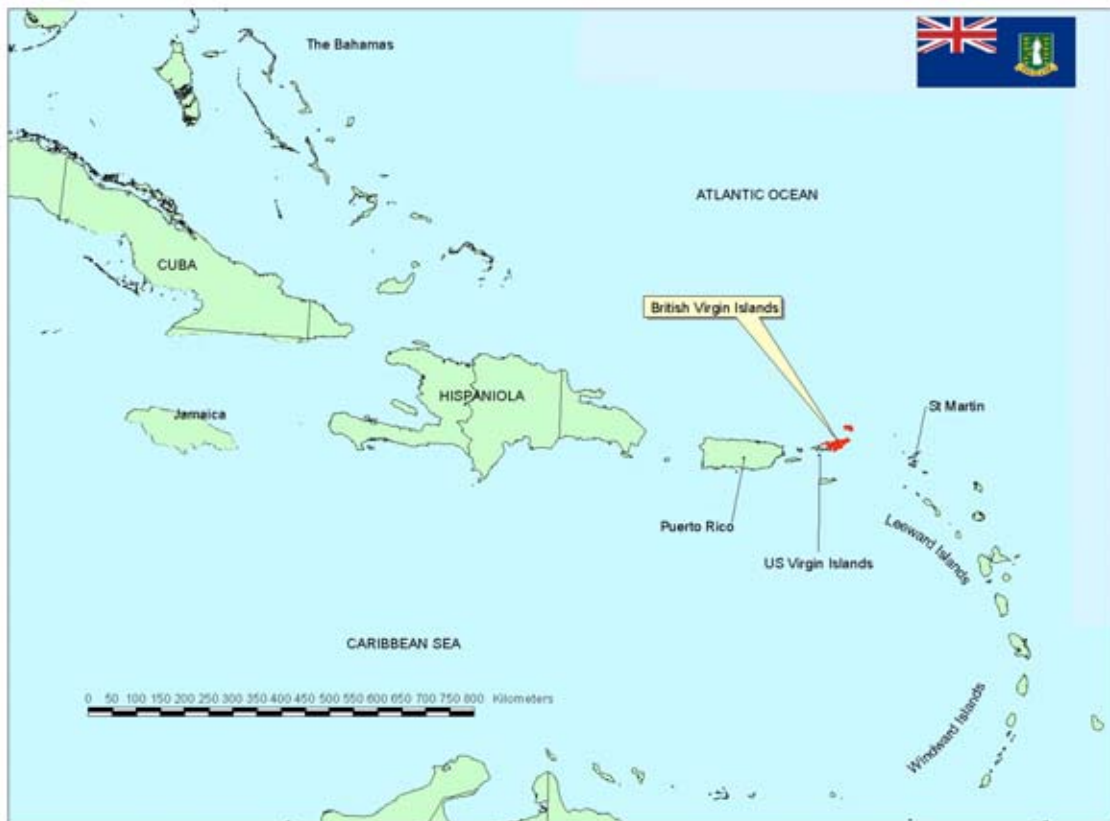


Fig. 1 the British Virgin Islands and their location in the Caribbean Sea.

Small Island States and Territories like the British Virgin Islands (BVI) have special need for Geographical Information. The territory has unique environments, limited land area and critical choices to make. The use of GIS helps to show the total picture and allow disparate arms of government make better decisions. For several years, BVI Government has realized coordination between departments is essential and has developed a National Integrated Development Strategy (NIDS) in response to that need (DPU, 2001), and GIS facilitation of the decision making and awareness processes in NIDS is seen as crucial (Mills et al, 2001).

This paper describes the experience of BVI over the past two years in revitalizing its National GIS efforts to allow better coordination and streamline government; the importance of key concepts, the components that have been implemented and the special problems and solutions from internal and external influences that have been found in BVI that are of particular interest to other Small Island Developing States (SIDS).



Fig 2 Key features of the British Virgin Islands

The British Virgin Islands are a series of 60 islands 100 km east of Puerto Rico in the northeastern Caribbean (Fig. 1). The total land area is 151 km<sup>2</sup> and the Exclusive Economic Zone (EEZ) extends for an area of 86,000 km<sup>2</sup>. It is part of a shelf that includes the US Virgin Islands and Puerto Rico. Of a total population around 21,000 (BVI Development Planning Unit, 2000), c. 14,000 live on the largest island, Tortola, 20 km long and 3 km at widest. Virgin Gorda, Jost Van Dyke and Anegada and about 12 other smaller islands have residential populations; the rest are uninhabited (Fig. 2). The

BVI is an overseas territory of the United Kingdom of Great Britain and Northern Ireland (UK), but is self-governing for most internal matters. The government is the largest employer with some 4,000 jobs and is divided into six ministries and around 40 departments and units, statutory bodies and other concerns. Apart from the flat coral reef island of Anegada, all the islands are volcanic in origin, with steep terrain and dry scrub vegetation. BVI depends heavily on Offshore Finances and Tourism for its industry, and its higher than Caribbean average GDP of \$16,000 (2000) (CIA, 2002) has helped fuel a development peak, especially on Tortola, over the last ten years.

### **Concepts**

The creation of the National GIS (NGIS) in BVI will have some parallel to other organisations' moves to a corporate style GIS. The ability to share information, for example, provides several improvements over disparate datasets. First, it allows people best suited to create information to have responsibility over its development and maintenance. Second, it ensures less duplication of effort and data. Third, it helps (and even forces) various departments to coordinate and cooperate more than if they act alone. Fourth, it allows all agencies to discover just what data have been collected, and helps in planning to fill data gaps.

Documentation of data is increasingly seen as imperative, especially where there are exchanges of information within and between organisations. Metadata provide a record of what information exists, with its quality, currency and extent, and without having to explore the information itself. Metadata also assist in showing what data are available, identifying data gaps and where existing datasets can be improved upon. They can be used to determine responsibility for data, and establishing updating regimes.

A coherent National GIS can also be used to disseminate information in a more flexible manner. Moving from closed digital systems controlled by a few GIS technicians, where only certain outputs, such as paper maps and statistics, would reach key decision makers and general users of spatial information, now there are opportunities for information to be distributed to a broad user-body in various formats, in an interactive way, while maintaining internal security and integrity.

All organisations moving to a corporate GIS structure are benefiting from these advances, but there are special considerations for the BVI pertinent to other SIDS. The Government of the BVI not only covers most federal duties such as health, land registry, environmental welfare, national parks and agricultural/fisheries development, but also deals with affairs more normally attributed to local councils; such as physical planning, education and health. Small staffing levels in multiple departments, varying resource levels and expertise mean that to sustain the GIS in SIDS, the key concepts are to maintain a degree of flexibility (to the availability of data, technical staff, software and hardware resources), to provide as comprehensive yet manageable documentation system for data, procedures and policy, and to be continually focused on specific applications which can both meet the needs of government and champion the cause of integrated GIS.

### **Building on the existing history**

Geographical Information Systems has an extended history in the BVI. The Town and Country Planning (TCP) Department originally established its use in 1991, based on major digital cadastral and buildings layers integrated with land use information, and a supporting database containing many layers for other departments which impinged on the planning process (e.g. schools, health facilities, utilities).

The use of network facilities allowed the GIS to be placed on a central server and given access to several other departments. However, separate from this effort there were several projects which developed GIS capability in other departments. In the Conservation and Fisheries Department (CFD) a GIS was developed from a Coastal Resource Atlas (Blair Myers et al, 1992), mapping coral reef, seagrass, algae, mangroves and other coastal substrate. An evaluation of the vulnerability of the BVI was conducted in 1997 creating GIS layers of the results (Earle, 1997).

Although initial NGIS layers were an excellent resource and attempts were made to ensure this information was kept in a central repository, efforts to update the database were disjointed, and a lack of data documentation, no written procedures on how to update information, and patchy distribution to non-GIS experts gave it limited success.

In 2000, the Organisation of Eastern Caribbean States (OECS) Natural Resources Management Unit (NRMU) commissioned a project in BVI to update the Coastal Resource Inventory of 1992. Part of the project was developed a coherent GIS to store, document and distribute the inventory. Its key components were a structured database, metadatabase, and GIS Interface, called the Coastal Resource Information System or CRIS (Mills et al, 2001). This model was seen as a suitable pilot for a rejuvenated National GIS, and the government sanctioned the extension of the CRIS to an NGIS.

### **The architecture of a National GIS**

#### ***Technological components***

To achieve a National GIS, a series of technical issues had to be solved, including an overdue restructuring of the database, and creation of a comprehensive cataloguing system. More, important was a necessity to change the way GIS was functioning amongst stakeholders. The general perception was that TCP was responsible for creating, managing and distributing all information. So more than a technical revamp, an organisation change was needed to understand how all departments interacted with GIS throughout the chain of information provision.

Dealing first with technological changes; the **database** restructure was determined by the need for different agencies to be responsible for data creation and maintenance. Each agency has a folder in the main database within which any data they contribute to the National GIS can be stored, and they have sole responsibility for additions to, and management of, that folder. Moreover, there are two folders containing baseline topographical information (contours, roads, ghuts or temporary watercourses, islands) and general information (satellite archive, aerial photography, gazetteer of placenames).

These folders contain information useful to all users and are maintained by the National GIS through TCP and the NGIS coordinator. As well as vector and raster information, widespread use of the Open Database Connectivity (ODBC) functionality in Windows allowed other databases to be integrated with the GIS.

The cataloguing of information through a **metadatabase** occurred before Arcview 8 Architecture was commercially available. There being no metadata capabilities in the old software, an Access Database was used to store metadata along US Federal Geographic Data Committee (FGDC) standards. These contained all geographical, descriptive and usage requirements. To work in conjunction with the interface (see below), extra fields storing location information, filename and type, as well as vector and field information, made it a comprehensive documentation of the available data. The metadatabase has functions that allow new additions to the database to be reported, as well as showing which connections were available (Mills et al., 2001).

An easy to use GIS **Interface**, now called the Complete Resource Information System (CRIS) was created with Avenue Programming in Arcview 3.2 (Fig 3). This allowed non-GIS experts to add data of all types to views (using functionality in the metadatabase to simplify the procedure of adding and symbolizing data), navigate around the territory, perform simple analysis (measuring areas and lengths, point in polygon analysis etc) and output statistics and maps in a simple layout template (Mills et al, 2001).

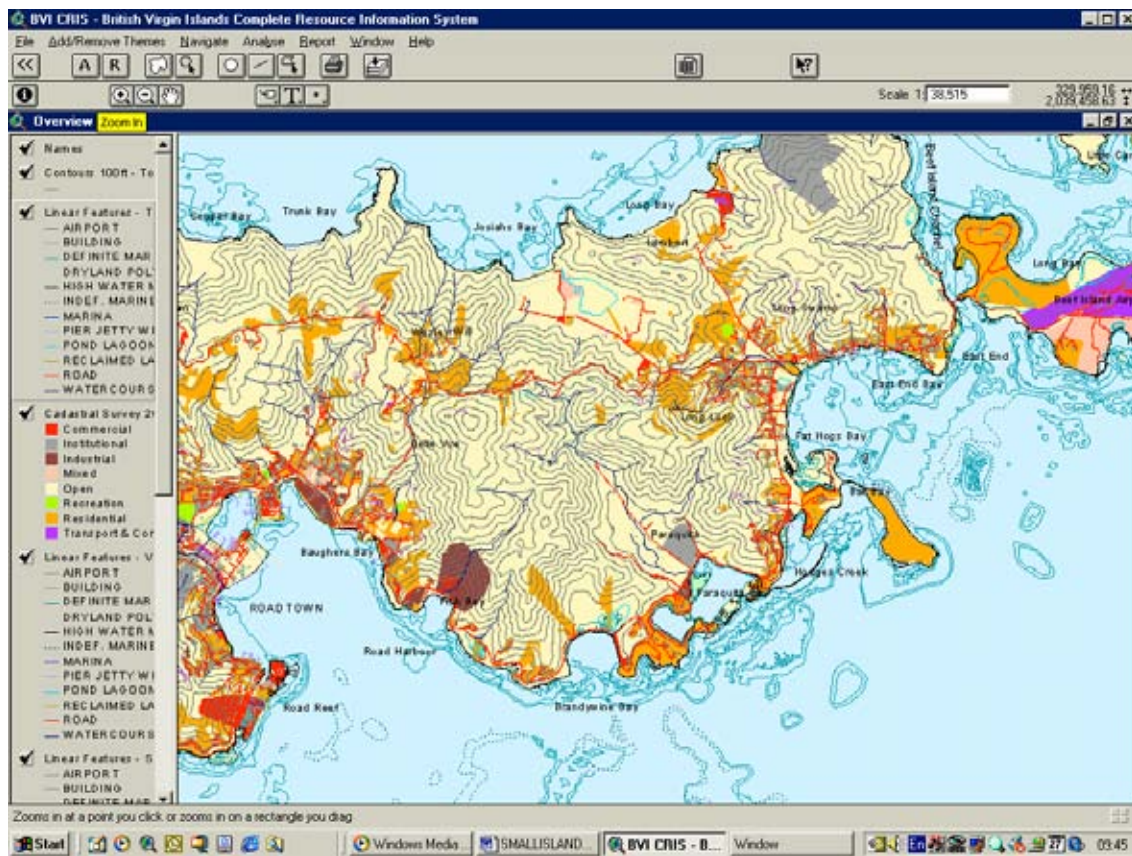


Fig. 3 sample screen shot of BVI Complete Resource Information System (under Arcview 3.2) showing simplified menus.

### *Human components*

<b>Group Name</b>	<b>Technical Steering Committee</b>	<b>Head Of Department Policy Committee</b>	<b>Government GIS User Group</b>
Remits	<ul style="list-style-type: none"> <li>▪ Hardware and Software installation</li> <li>▪ Dataset provision</li> <li>▪ Guide the Head of Department Committee in Policy and Organizational issues</li> <li>▪ Coordinate training activity</li> <li>▪ Implement the GIS</li> </ul>	<ul style="list-style-type: none"> <li>▪ Guide policy on data provision, copyright</li> <li>▪ Find projects funding</li> <li>▪ Assist in awareness raising in and outside of government</li> <li>▪ Steer the overall development of the NGIS.</li> </ul>	<p>A communication network to ensure wider government keeps in touch with GIS developments, and can support action.</p> <p>Can provide some data to GIS</p>
Composition	Mix of technical GIS staff and keen users of information and GIS	Mixture of heads of departments, Permanent Secretary, from GIS and Govt. Coordinating Departments	All Government staff who have are using GIS at any level, or have an interest in using GIS.
Skills of staff	High level of technical skill, day to day usage of GIS	Awareness of GIS	Occasional users of GIS

Table 1 – comparison between the personnel in the Technical Steering Committee, the Policy Committee and General User Group

Although the benefits from sharing data and resources in a SIDS government are clear in principle, good organisation and policy is needed to be able to do that objectively, fairly and efficiently. Informally, a National GIS Coordinator was appointed, who established three groups to interact with the GIS in different spheres. Table 1 gives some characteristics of these committees.

#### *Technical Staff*

GIS is a broad subject and no single person can manage a corporate system themselves. In terms of technical ability, there is a need for expertise in database design, inputting (digitizing and data entry), analysis, data provision, hardware, software, networks, programming and cartographic/output skills. In management there is the need to understand the creation of a coherent structure, the organizational needs, training, publicity, policy and protocol issues.

In any organisation this can be a challenge but the nature of the current NGIS in BVI makes these jobs exigent. Staff exclusively dealing with GIS are rare in BVI government; indeed even those staff who are allocated to the role also double up as Systems administrators, IT experts and database managers, as well as creative designers, mailmen, drivers, field workers and (when called upon) chefs. Senior personnel often play other management roles in their organisation. Especially if the GIS person is the sole representative in their department, GIS is often only one of the tasks for their job, it leaves little time to build up expertise and keep up to date with new concepts and technology.

Staff turnover in the BVI is high, especially in technical jobs. Not only are several senior technical staff on ex-patriot contract and not able to work past four years, but also local junior staff use the opportunity to train in subjects to gain a broader experience that ultimately sees them leave government and work in the private sector, or move away from the BVI altogether. Those left behind are struggling with increasing workloads; the need to multitask and be multidisciplinary limiting the expertise and institutional capacity needed to meet fully effective GIS is unavailable. The importance of succession in the organisation has to be addressed with this volatile workforce.

### *Management*

NGIS management is steered by the Policy Committee and conducted by the National GIS coordinator, as one of his roles as GIS officer in the Conservation and Fisheries Department. The coordinator runs the Technical Steering committee, acts as liaison and secretary for the Policy Committee, and point of contact for the user group. He coordinates a series of tasks between the stakeholders that deal with organizational, training, data, policy and technical issues, and currently manages the metadatabase.

The establishment of the HOD policy committee helps ensure that key decision makers influence steering the NGIS, but attendance at these meetings of deputies, juniors, and in some cases, the same people who attend the Technical Review Committee undermines the terms of reference of this body to get politicians and the senior civil service more on track with the needs and benefits of the NGIS. This results in an inconsistency of managerial support (partly due to conflicts with other issues such as elections, annual celebrations and events and reorganization of government). These problems are not peculiar to BVI but have been documented elsewhere; for example in Fiji (Britton, 2001).

### *Users*

Users of GIS in the BVI range from those directly using the program to those who use the information from a map. There are several services that the NGIS give to users. Without a regular cycle of training, guidance, implementation, the interest of these users wanes, so the NGIS coordinator and Technical Steering Committee, with limited resources, are trying to keep new initiatives, seminars and training on the table for the wider GIS community in government. At present, the major challenge is to establish the level of usage for these general clients and choosing the most appropriate software. In the longer term, many users would be best served with IMS technology, but the core organisation is not yet at the correct level at this stage to implement this.

### ***Other components***

#### *Training*

Options for training are various, but satisfying the various levels needed and finding time to implement them in a coordinated way has been a predicament. In some cases a general awareness-raising is all that is necessary (decision makers and Heads of Department); in other cases a general software overview (staff who need to use GIS for simple tasks such as querying and mapping). The ESRI Virtual Campus provides self-teaching, but also needs trainees' self discipline to be able to get best use from it. For a smaller number, technical training for more in depth applications' specialism (e.g. modelling,

programming and application development) or strategic management issues is required. It is a serious challenge to meet all these requirements of training, and moreover, ensure that any training done is utilized effectively to ensure the skill base has been raised by the experience (Britton, 2001).

#### *Dataset creation*

With the low staffing levels, data creation has been a slow process, and both the extension of basic datasets and routine updating of data has been a challenge. New data derived from an aerial photography survey in 2002 will provide an updated, accurate, topographical base, but several alternative base datasets are also necessary to serve different agencies with varying needs. For example, for Fire Service, Postal and land use planning, a national address system is being constructed (Baggie et al, 2003). For land ownership issues, which also impinges on development, planning, land use and a host of other applications, an up to date cadastre is essential. For environmental management, the existence of watershed boundaries, corresponding marine units, and *de-jure* management boundaries for national parks, marine protected areas and fisheries areas are useful (Lettsome and Mills, 2003).

In many cases, the use of MS Access to develop monitoring databases has helped appreciably in getting people to enter their own data and see it integrated in the GIS on a regular basis. In other cases, though, map layers have had to be created, and the only GIS digitizing tablets available on the islands are in TCP.

#### *Establishing Data flows*

Much data is being routinely or periodically updated. If datasets are being used by other agencies it is essential to ensure new data are synchronized in a useful way, and passed from source department to the National GIS Database in a timely and consistent manner. For example, TCP would like to conduct an annual land use survey to assist with strategic planning. In order to do that they must synchronize with the Cadastre from Survey Department and the Land Registry's ownership records.

#### *Applications*

The driving force for making the NGIS work is the applications to which the data are used for. Table 2 gives examples of the current and projected uses of the NGIS.

There still remains a lot of work to change the perception of what GIS is or what it can do for government. In BVI the primary perception of GIS is as a glorified mapping tool, or as a data repository. The application of GIS to day-to-day work of government, from education and awareness raising of our geography, through resource assessment, strategic planning and development to daily management, monitoring and evaluation still need development. In many departments GIS is seen as a luxurious extra and at higher levels of government some do not see GIS as a priority to ensure better communication. Certain case examples are now being used to try to show how GIS is not just about gaining a data repository, but aiding decision making by combining datasets.



<b>Application type</b>	<b>Agencies involved</b>	<b>Examples</b>
Environmental Impact Assessment	CFD, TCP,	Assessment of impact of reclamation scheme
Strategic Planning	TCP, DPU, CMO	Land Use Zoning, Road Town Master Plan
Planning application for Development Control Authority	TCP, CFD, SU, PWD	New hotel development
Resource assessment	NPT, CFD	Mapping coral reef extent and health
Conflict resolution	NPT, CFD, TCP	Mapping touristic (dive sites, moorings) with fisheries protection and priority areas
Construction planning	PWD, ELEC, C&W, WSD, TCP	Joint Utilities Committee
Oil Spill Assessment	CFD, Ports Authority, DDM	Assessing oil spills impact on environment.
Disaster Preparedness	DDM	Location of critical facilities
Vulnerability assessments	DDM, CFD,	Mapping vulnerability of critical facilities to storm surge, high winds and earthquake.
Island Systems Management	CFD, DOA, TCP, NPT	Monitoring sediment flows though from watershed to coral reefs.
Public Awareness	All Depts.	Maps used for publicity, tourism, explaining environmental or land ownership issues.
<b>Future Applications</b>		
Public Works AM/FM	PWD	Road construction and maintenance
Water and sewerage monitoring	W&S	Pipe usage, quality
Fire and Rescue	Fire Department	Hydrant location
Dengue Fever monitoring	EH	Mapping distribution of cases of Dengue and potential mosquito breeding grounds.
Agricultural Land Use	DOA, TCP, CFD, SU	Understanding extent and production of agricultural systems

Table 2. Existing and near-future applications of the BVI NGIS. Key to Agencies: C&W – Cable and Wireless Telephone., CFD – Conservation and Fisheries Department, CMO – Chief Minister’s Office, DDM – Department of Disaster Management, DOA – Department of Agriculture, DPU – Development Planning Unit, EH – Environmental Health, ELEC – Electricity Corporation, NPT – National Parks Trust, PWD – Public Works Department, SU – Surveys Department, TCP - Town and Country Department, WSD – Water and Sewerage

### **External Influences**

While trying to internally reorganize, work out better cooperative strategies and improve the quality of the baseline and application databases, there have been additional system stresses caused by external influences. These range from the BVI private sector, software dealers and creators (ESRI) and international agencies conducting regional projects.

Many private companies in BVI express an interest in GIS and the data available. The major market in BVI for data comes from architects and surveyors designing new roads, buildings or reclamation schemes, some of which are working under contract for government. A similar sized market (although smaller monetary volume) comes from students from high school to university age conducting projects. Depending on the

department people go to, type and scale of information, the service required and the media output, varying prices and effort exist for information provision. Private companies are concerned with having up to date information, and this is not necessarily available as yet from the NGIS datasets. Two decisions have to be resolved in the NGIS. First, should there be effort to sell data to the private sector, or should the government resolve to concentrate on delivering products internally only. Second, what is the best way to vend; through individual departments who take responsibility and earn revenue, or through a core facility of the NGIS where revenue is shared amongst all agencies and better management can be conducted on the facility?

Like many public bodies, the NGIS remit is at the whim of local and international initiatives. While there are core local programmes needing attention; establishing database structure, metadata, training, core datasets, and monitoring and thematic layers, there is pressure from international agencies to fit their agendas for collaboration in region wide data gathering or modelling exercises. Like many states, BVI has international obligations and is asked to join regional mapping projects several times a year; and when fulfilling these the BVI can get donors or organisations' assistance. Unfortunately, many organisations do not take due note of the current national system. They are quite content to obtain data from the GIS providers in country, but they make little attempt to integrate any new information into our existing systems. The problem arises that they will give training and a nice package of information, but it cannot be easily updated from existing monitoring or other data systems, or does not synthesise well with the existing GIS. A case study here can be taken from the NOAA (2000) Environmental Sensitivity Index (ESI). NOAA created a marvellous product for BVI to evaluate the sensitivity of coastline to oil spills and assess ease of cleaning. BVI can use GIS directly to predict where an oil spill might extend and look at the resources it may affect. However, ESI datasets are not directly comparable to the ones collected by the NGIS stakeholders, so to transform updates and rectify errors would mean significant duplication of effort. NOAA is neither being singled out here or blamed, but for international agencies to completely satisfy their remits of effectively building capacity in the country, there should be more consideration of existing in country systems before implementing new ones. Often in projects of this nature, changing the process would be more useful than delivering the product.

There is a role for International Agencies to help in NGIS development, and BVI actively seeks support of these agencies. They provide better expertise, better access to technological resources and greater capacity for doing the work that BVI government staff cannot find the time to address. In many cases there have been successful collaboration to create datasets, create a specific application or build capacity to do a particular line of work.

BVI signed up to the Global Mapping Project (GMP) and associated Global Spatial Database Initiative (GSDI) in 2002. It was seen as a method for getting the necessary software that could better organize information, and contribute to the global map. The implementation of the project has been hampered for various reasons. One is the training necessary for implementing the project has not been conducted, partly due to budget cuts

in BVI government, partly due to inconvenient locations and times of sessions. Also, the hardware to implement the system has not been established as existing hardware needs took priority over future projects. The imposition of GSDI on the ongoing NGIS establishment has caused some problems in determining the best site to house the system. However, BVI still sees this as a useful framework to take the NGIS further to a distributed Internet Map Server System and begin the process of releasing data into the public realm.

The relentless pace of software development makes it difficult for BVI to build institutional experience with the technology. The on going switch from Arcview 3.2 to Arcview 8.2 has caused some problems:

1. The simplified interface created in Avenue for the CRIS is not transferable to the new software without total rewrite.
2. The new software is very different from the old. While one can see the benefits in having the interface with more compatible MS Windows functionality, it has proved a steep learning curve for those with minimal existing Arcview experience.
3. Other products available through ESRI that may provide a more accessible tool for non-expert users will need more development by the limited BVI technical team (ArcReader, ArcIMS, ArcExplorer). On top of their current duties there is limited time to do the research into the most effective methods, the preparation for such a move and conduct that move.
4. The current metadatabase (in Access) cannot be directly transferred to Arc Catalog – so significant rewrite of data has had to take place to add to the new catalogue.
5. The previous metadatabase stored a lot of properties information on the theme so it could be used directly within the CRIS without the user having to set properties manually. The new system relies upon layer files to do the same job – all these have also had to be created manually (for 250 datasets).
6. The layer files can only be sourced to a particular drive. Because the networked GIS is still only partially complete in BVI, several departments rely on remote hard drive versions. Different versions of the Layer files for different platform configurations (e.g. c:, D: , P: , K:, J:) are necessary to allow the layers to be used effectively. The new layer files are not portable across platforms.

The basic conclusion of this has been that Arcview 8.2 has caused more problems than solutions at this stage. It will take considerably more time before the new software is fully integrated within departments and the NGIS. And in the mean time, how far forward does ESRI software move? With multiple solutions available, which is the best model for BVI to follow for its corporate GIS? The optimum solution for BVI would be to move to an Intranet GIS serviced from a core unit using IMS. Unfortunately, this is a giant leap for the NGIS that cannot be serviced in the immediate future, and there are still database, procedural and policy issues which must be resolved before we should throw more technology at the problem.

The legacy of having an established GIS assists in building on a foundation to move faster to a corporate GIS, but has also hindered that development as certain structures and

procedures had already been put in place before commercial solutions were available. The NGIS is helping BVI stakeholders to come on board, but the new ArcGIS suite has actually broken some rules of small island GIS, the need to be flexible and adaptive, and to provide the ability to build easily on existing legacies.

### **Solutions – What has worked and what would make it work better**

The development of the NGIS has relied on several pillars, and the substance of the current GIS has been built on the following:

1. A clear framework for development of a database structure, data bases and needs, metadata and interface.
2. An understanding that the system has to be flexible to cope with staffing levels, restaffing, levels of expertise, available budget.
3. An opportunistic attitude – within the understanding of a framework of needs, if an opportunity comes to get a new data source or information base without compromising the current work programme, it should be grabbed.
4. Not waiting for the perfect system to be in place before using it. There are many data gaps in the system, and we are relying on poor scale or out of date information for some of our applications. However, these data are the best we have, and as long as the data are properly catalogued in the Metadatabase with their quality and restrictions, the users of the data can take responsibility for whether the data are useful or not for that application. As a postscript, the NGIS has carefully put together a liability statement to cover abuse. (Mills, 2000).
5. An open attitude to involving all government stakeholders irrespective of their GIS needs and abilities. Only by getting the groundswell of support at the departmental level can inroads be made at the senior level.
6. Establishment of cross departmental lines of communication, including the split policy and technical committees, and separate user groups. This has been not only useful in ensuring information is shared and decisions are reached mutually, but builds an NGIS team which assists in each others' individual projects as well as those of the NGIS.
7. Establishment of documentation for procedures, catalogues, committee remits and visions. This process is a necessary hassle to ensure building institutional capacity.
8. Patience.

There are a number of lessons learnt in this process as well that may have been pre-empted:

1. A clearer outlook on both the purchase of, the installation and implementation of training in the new software.
2. Remove the feeling of isolation in the process by making better use of existing international agencies and resources. Much of this work has built on a small number of references or external personnel to determine the best policy. Some use of the Caribbean GIS email group has been made, but the personnel who use these are often not at a managerial or coordinating position. Stronger links with other SIDS doing the same process would help to share ideas and experiences, but

- as far as can be determined, BVI is the only Caribbean small island state of less than 250,000 people that is actively going through this process. The only parallel found has been American Samoa.
3. More work on financial implications, in the establishment and maintenance of the system, and in the cost/benefit to the government.
  4. Look for international agencies to come in to projects not to sell a project GIS but to work towards integrating their ideas, data, systems and expertise with the existing corporate framework.
  5. More upfront marketing of the idea of GIS to politicians and senior civil servants, although not to the extent of the oversell that some countries did that may have alienated political support for good.

### **Conclusions**

The British Virgin Islands sees GIS as a major component in joined-up government and the rejuvenation of the National GIS has broadened the imagination of what this small island state can achieve in mapping and GIS. Internal and external pressure on how that NGIS develops will continue, but the foundation of GIS for over ten years, with the commitment and understanding of those elements which work in such an environment as listed above, gives it great hope for continuing to succeed, and being able to withstand the uncertainty of the future.

Despite the successes of the open and informal model of NGIS, the need for a core facility is seen as essential, and the NGIS is lobbying politicians to create the remit for such a unit to coordinate GIS matters in the territory, much as BVI's general computing and telephone services are coordinated to date. The core unit would be implanted in an existing department and would be composed of a general manager, with a similar remit to the National GIS Coordinator, three applications specialists who would have both technical portfolios (e.g. being responsible for database, IMS and analytical tools) and one of three applications portfolios (planning and lands, environment and marine, and utilities and public works). An administrator would manage data sales and general metadata issues. It would have responsibility to manage the GSDI for BVI, advise steering committees, run training and help build databases and applications for stakeholder departments.

The model for the NGIS has been developed with minimal assistance from outside sources. More support regionally is needed for National GIS and GSDIs. USGS are planning some work here, but organisations such as CARICOM or OECS could also assist to build a regional support and resource group for the isolated GIS community in the smaller Caribbean islands, to give support, help share ideas, expertise and solutions.

The portrait depicted above demonstrates ambitious visions for an integrated NGIS in the BVI. There have been setbacks and pitfalls, and unexpected successes, but the major achievement has been a change in the attitude in the way those stakeholders involved have approached the National GIS. Beyond the main stakeholders, the NGIS is not just talked about as being out there somewhere, or just nice to make a few maps, it is

becoming part of the workings of government, and it has the right approach to how to deal with GIS as a small island in a big world.

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