Caribbean Disaster Emergency Response Agency [Caribbean Disaster Management Project (CADM)]
&
World Bank / OECS Emergency Recovery and Disaster Management Project

Government of Saint Lucia

Saint Lucia National Flood Plan

Floodplain Management and Flood Response

Document of the Saint Lucia National Emergency Plan

Based on the CDERA Model Flood Plan - 2003

Approved by *[NEMAC]*	*Approved by* *[Cabinet]*
October 27, 2006 *[Date of Approval]*	*[Date of Approval]*


Cap Pt.
Pigeon I.
Rodney Bay
Gros Islet
CASTRIES
Grande Cul de Sac Bay
Babonneau
Anse la Raye
Roseau
La Caye
Canaries
Dennery
Mt. Gimie
Praslin
Soufrière
Micoud
Canelles
Desruisseaux
St. Lucia I.
Choiseul
Laborie
Hewanorra Int'l. Airport
Vieux Fort
Maria Is.

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Part I. General Information.

1.- Acronyms/Abbreviations.

ADRA	The Adventist Relief Agency
BFE	Base Flood Elevation.
CARITAS	Caritas Internationalis. Catholic Relief Organisation.
CDERA	Caribbean Disaster Emergency Response Agency.
CDMP	Caribbean Disaster Mitigation Project
CEHI	Caribbean Environmental Health Institute
CHA	Caribbean Hotel Association
CHAMP	Caribbean Hazard Mitigation Capacity Building
CIDA	Canadian International Development Agency
CMU	Crisis Management Unit (Ministry of Tourism)
DHA	United Nations Department of Humanitarian Affairs (OCHA nowadays).
DPRA	Disaster Preparedness and Response Act (Saint Lucia).
EOC	Emergency Operations Centre.
FAHUM	Humanitarian Allied Forces Exercise.
FAO	Food and Agriculture Organisation of the United Nations.
FBFM	Flood Boundary and Floodway Map.
FDR	Flood Damage Reduction Programme (Canada)
FEMA	United States Federal Emergency Management Agency.
FHBM	Flood Hazard Boundary Map.
FIRM	Flood Insurance Rate Map.
FIS	Flood Insurance Study.
GIS	Geographical Information Systems.
GOSL	Government of Saint Lucia.
HP	Saint Lucia National Hurricane Plan.
hPa	Hecto Pascals.
IGH	International Glossary of Hydrology.
LUCELEC	Saint Lucia Electricity Services LTD.
MOE	Ministry of Education.
MOH	Ministry of Health.
MOPD	Ministry of Physical Development.
MOW	Ministry of Works.
NEMA	National Emergency management Agency (Trinidad and Tobago).
NEMAC	National Emergency Management Advisory Committee.
NEMO	National Emergency Management Office.
NEOC	National Emergency Operations Centre.
NFIP	National Flood Insurance Programme (US FEMA).
NHC	National Hurricane Centre (US).
NHMC	National Hazard Mitigation Council.
NIF	National Insurance Fund (USA-FEMA).
OAS	Organisation of American States
ODPEM	Office of Disaster Preparedness and Emergency Management (Jamaica)
OECS	Organisation of Eastern Caribbean States.

OPAC	Oil Pollution Action Committee
OSC	On Scene Commander
PM	The Honourable Prime Minister of Saint Lucia.
PS	Permanent Secretary.
SFHA	Special Flood Hazard Area.
SLASPA	Saint Lucia Air and Sea Ports Authority
SLTB	Saint Lucia Tourist Board
RSLPF	Royal Saint Lucia Police Force.
SDA	Seventh Day Adventist Church.
SLSWMA	Saint Lucia Solid Waste Management Authority.
SLU-GIS	Government Information Services.
SLU-NEMP	Saint Lucia National Emergency Management Plan.
SOP	Standard Operating Procedure.
Southcom	The United States Southern Command.
TS	Tropical Storm.
TWA	Technical Working Group.
UN	The United Nations.
UNDP	United Nations Development Programme.
UNESCO	United Nations Educational, Scientific and Cultural Organisation.
USA	The United States of America.
WASCO	Water Supply Company (Saint Lucia).
WB	The World Bank.
WIBDECO	Windward Islands Banana Development and Exporting Company Ltd.
WMO	World Meteorological Organisation.

2.- Glossary/Definitions.

Definitions marked (IGH) are from the WMO/UNESCO International Glossary of Hydrology, though some have been simplified. Those from FEMA documents are marked (FEMA). Those marked with (CDERA) are taken from the CDERA web-page and flood fact sheet (See Reference 1 on Section 27 on page 58 of this Plan.)

100-Year Flood. The flood that has a 1-percent chance of being equalled or exceeded in any given year. (FEMA).

Approximate Study. A flood hazard study that results in the delineation of floodplain boundaries for the 1-percent-annual-chance (100 years) flood, but does not include the determination of BFEs or flood depths. (FEMA).

Base Flood. The flood that has a 1-percent chance of being equalled or exceeded in any given year. (Also called the 100-year flood) (FEMA).

Base Flood Elevation (BFE). The elevation of a flood having a 1-percent chance of being equalled or exceeded in any given year. (FEMA).

Catchment or River Basin. The area drained by a river.

Direct Runoff. That part of the precipitation that flows directly to the river, without infiltrating to the soil.

Design Flood. Flood hydrograph or instantaneous peak discharge adopted for the design of a hydraulic structure or river control.

Detailed Study. A flood hazard study that, at a minimum, results in the delineation of floodplain boundaries for the 1-percent-annual-chance (100) year flood and the determination of BFEs or flood depths. (FEMA).

Dyke: Embankment built to protect low-lying areas from inundation.

Encroachment. Construction, placement of fill, or similar alteration of topography in the floodplain that reduces the area available to convey floodwaters. (FEMA).

Evapo-transpiration. Quantity of water transferred from the soil to the atmosphere by evaporation and plant transpiration. (IGH).

Flash Flood.- A sudden and extreme volume of water that flows rapidly and causes inundation and which, because of its nature, is difficult to forecast. (CDERA).

Flash Flood. Flood of short duration with a relative high peak discharge. (IGH).

Flood. Abnormal progressive rise in the water level of streams or rivers that may result in overflows. (CDERA).

Flood. Relatively high flow as measured by water level or discharge. (IGH).

Flood. A general and temporary condition of partial or complete inundation of normally dry land areas from (1) the overflow of inland or tidal waves or (2) the unusual and rapid accumulation or runoff of surface waters from any source. (FEMA).

Flood Boundary and Floodway Map (FBFM). The floodplain management map issued by FEMA that depicts, based on detailed flood hazard analyses, the boundaries of the 1-percent-annual chance (100 years) and the 0.2-percent annual chance (500) year) floodplains and, when appropriate, the regulatory floodway. The FBFM does not show flood insurance risk zones or BFEs. (FEMA).

Flood Hazard Boundary Map (FHBM). The initial insurance map issued by FEMA that identifies, based on approximate analyses, the areas of the 1-percent-annual chance (100-year) flood hazard within a community. (FEMA).

Flooding. (synonym inundation). Overflowing by water of the normal confines of a stream. (IGH).
Flood Insurance Rate Map (FIRM). The insurance and floodplain management map produced by FEMA that identifies, based on detailed or approximate analyses, the areas subject to flooding to

a 1-percent-annual-chance (100 years) flood event in a community. Flood insurance risk zones, which are used to compute actuarial flood insurance rates, also are shown. In areas studied by detailed analyses, the FIRM shows Base Flood Elevations (BFEs) to reflect the elevations of the 1-percent-annual-chance flood. For many communities, when detailed analyses are performed, the FIRM also may show areas inundated by 0.2-percent-annual-chance (500 year) flood and regulatory floodway areas. (FEMA).

Flood Insurance Study (FIS). The initial study of flood hazards performed for a community that does not have an effective Flood Insurance Rate Map (FIRM) or a Flood Boundary and Floodway Map (FBFM). (FEMA).

Floodplain. Any land area that is susceptible of being inundated by water from any source. (FEMA).

Floodplain Management. The operation of a programme of corrective and preventative measures for reducing flood damage, including, but not limited to, emergency preparedness plans, flood-control works, and floodplain management regulations. (FEMA).

Hurricane. The name given to a tropical cyclone in the Caribbean.

Infiltration. Flow of water through the soil surface into the soil pores below.

Infiltration Capacity. The maximum rate at which water can be absorbed by a given soil per unit area under given conditions. (IGH).

Levee. A manmade structure, usually an earthen embankment, designed and constructed in accordance with sound engineering practices to contain, control, or divert the flow of water so as to provide protection from temporary flooding. (FEMA).

Recurrence Interval. The average interval of time within which a given flood will be equalled or exceeded once. (FEMA).

Return Period. Average interval in years between successive occurrences of some event, such as flood exceeding a certain level of discharge.

Special Flood Hazard Area (SFHA). The area delineated on a National Insurance Flood Map as being subject to inundation by the base flood. SHFAs are determined using statistical analyses of records of river flow, storm tides, and rainfall; information obtained through consultation with a community; floodplain topographic surveys; and hydrologic and hydraulic analyses. (FEMA).

Storm Surge. Elevation of sea or estuary level caused by the passage of a low pressure centre. (IGH).

Tropical Cyclone. A cyclone of tropical origin of small diameter (some hundreds of kilometres) with minimum surface pressure in some cases less than 900 hPa, very violent winds and torrential rain.

Typhoon. The name given to a tropical cyclone in the North-West Pacific.

3.- Introduction.

The Saint Lucia National Flood Contingency Plan is part of the Saint Lucia National Emergency Management Plan (section 03, subsection 07) as it can be seen in table 3.1 below:

Table 3.1 The Saint Lucia National Emergency Management Plan SLU/NEMP

Name of section	Name of Sub-section
The Saint Lucia National Emergency Management Plan	
Policies & Guidelines	
	Donations and Importation of Relief Supplies Policy
	Emergency Shelter Management Policy
	Emergency Housing Policy
	Mitigation Policy
	Travel Policy
	Management and Disposal of Dead Bodies in Disasters Policy
National Emergency Plans	
	The Saint Lucia National Hurricane Plan
	The Saint Lucia National Earthquake Response Plan
	The Saint Lucia National Volcanic Eruption Response Plan
	The Saint Lucia Oil Spill Contingency Plan
	The Saint Lucia National Mitigation Plan
	The Saint Lucia Stress Response Team Plan
	The Saint Lucia National Flood Plan
Sectoral Plans	
	The Ministry of Communications, Works, Transport and Public Utilities Plan
	The Saint Lucia National Emergency Health Sector Plan
	The Hospitality Industry Crisis Management Plan
	The Saint Lucia Private Sector Response Plan
Specific Plans	
	Mass Crowd Events Plan
	Plan for Evacuation of Anse La Raye
	Model Plan for the District Disaster Committees in Saint Lucia
	The Saint Lucia Prison Emergency Plan
	The Port Authority Cruise Line Ships Plan
	The Saint Lucia Seaports Contingency Plan

The Saint Lucia National Flood Plan will also be referred to as 'The Flood Plan' or 'The Plan', or by its acronyms:

- SLNEMP/FP, or
- FP.

This version was designed in May-June 2003 as part of the terms of reference of the consultant Mr. Arturo López-Portillo, Emergency Planning and Mitigation Advisor to the NEMO within the World Bank/ OECS Emergency Recovery and Disaster Management Project.

The Flood Plan also responds to the need to adapt to the Saint Lucia situation the CDERA's Model Flood Plan designed by consultants from Trinidad and Tobago in October 2002 and presented in Saint Lucia in November 2002 (See Reference 2 in Section 27, References, in page 58 of this Plan).

Regarding the Model Plan designed by the consultants of Trinidad and Tobago for CDERA, besides its presentation in Saint Lucia, a simulation exercise was held in Saint Lucia in April 2003. From the Model Plan and from the Simulation Exercise After Action Report it was found that:

a.- The Model Flood Plan duplicated the Saint Lucia National Hurricane Plan (Reference 4) approved in June 28th, 2002 by the NEMAC.

b.- The Model Flood Plan only considered tropical cyclones as the only cause for flood.

c.- There was no need to design new response procedures for the case of floods as the Model Flood Plan suggested, since Saint Lucia already has the Hurricane Plan Emergency Procedures approved in June 29th, 2002 by the NEMAC, and tested successfully during tropical storm 'Lili' in September 2002.

Therefore, the Saint Lucia National Flood Plan is not based in the CDERA Model Plan, instead it focuses on aspects such as:

a.- Floods originated by tropical cyclones and also by other phenomena. (Cause of floods).

b.- Activities to determine frequency of floods and delimitation of flood prone areas. (Flood mapping).

c.- Specific mitigation, response and recovery activities for the case of floods. (Floodplain management and flood response).

The Plan is divided in four parts:

a.- Part I. General Information. Definitions and general information about the plan.

b.- Part II. Floods and Floodplain Management. Describes the general causes and characteristics of floods and the main activities for mitigation and response.

c.- Part III. Floods and Floodplain Management in Saint Lucia. Describes the characteristics and consequences of floods in Saint Lucia and current flood mitigation and flood response activities.

d.- Part IV. Floodplain Management and Flood Response Plan. Describes the activities needed in Saint Lucia to achieve an adequate floodplain management and a better flood response.

At the end of this Plan we will find a list of documents referred in the Plan (See Section 27, References, page 58), Attachments (Section 28, Emergency Procedures) and Appendices (Section 29).

Special thanks are given to Mr. Alan Warren, Senior Engineer, from Halcrow Group Limited for his revision of the document and his valuable comments.

4.- The Flood Plan and the Hurricane Plan.

As mentioned earlier, the Flood Plan is part of the National Emergency Management Plan. Since floods can also be a consequence of tropical cyclones we intend not to overlap with the National Hurricane Plan (Reference 3). So, in the following figure we can see the relation between the two plans.

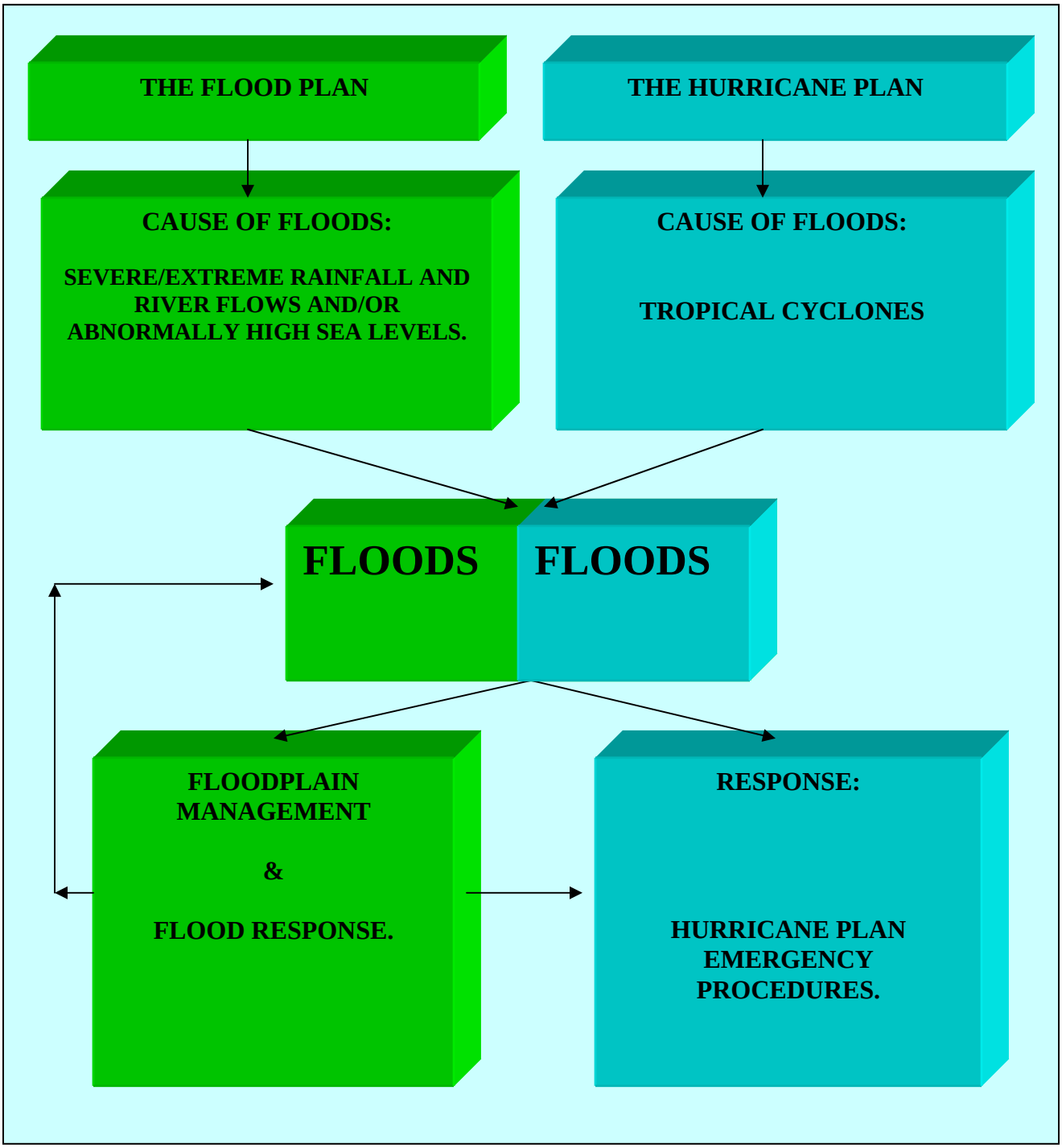

Figure 4.1.- Flood Plan versus Hurricane Plan

From the previous figure, we can see that the Flood Plan fills the gaps regarding floods that the Hurricane Plan has (floodplain management) but at the same time reinforces the response activities included in the Hurricane Plan that are the same for the Flood Plan if a flood is predicted or occurs as a consequence of a tropical cyclone or other phenomenon.

Attending to the need highlighted by CDERA's Model Plan (Reference 2) to establish response functions and assign responsibilities, in table 4.2. below, we reproduce the emergency response functions (Emergency procedures and responsibilities) as they are in the Hurricane Plan. The same functions and responsibilities are valid for the Flood Plan since it is compatible with the Hurricane Plan.

Table 4.2. Responsibilities Matrix for Emergency/Recovery Functions in the Case of a Tropical Cyclone

Hazard/ Function	**Main Responsible Organisation**	**Key Support Organisations (secondary)**	**Sectoral Plans**
1.Warning/ Monitoring	Meteorological Office Ministry of Works	Ministry of Agriculture	
2.Notification	NEMO	National Committees, District Committees. Government Ministries.	
3.EOC	NEMO	Disaster Committees, District Committees, Ministries, Private Sector	Sectoral EOCs, MOW, MOH, CMU, Private sector plan
4.Comm-unications	Telecommunications Committee	Private sector. Amateur radio operators.	MOW. Private Sector Plan
5.- Transportation	Transportation Committee	MOW, volunteers. Private sector.	MOW
6.Evacuation	Royal Saint Lucia Police Force	District Committees, Transportation Committee	
7.Shelter Management	Shelter Management Committee.	MOE, District Committees, Social Organisations. MOH. Supply management Committee.	
8.Search and Rescue	Fire Service. Police. (land) Police (maritime)	Transportation Committee, MOW.	
9.Security	Police		
10.Medical attention	Health and Welfare Committee	MOH. Private sector. Transportation committee. Fire service, police.	MOH Plan.
11.Environmental Health	Health and Welfare Committee	MOH. Shelter Management Committee.	MOH

Hazard/ Function	Main Responsible Organisation	Key Support Organisations (secondary)	Sectoral Plans
12.Damage & Needs Assessment	Damage Assessment Committee	Ministry of Works	MOH, MOW, Private Sector Plan
13.External Assistance	Ministry of External Affairs	NEMO	
14.Supply Management.	Supply Management Committee	Governmental Ministries. Private sector. Transportation Committee	Private Sector Plan
15.Public Information	Information Committee (SLU-GIS).	NEMO, The media, All Committees.	
16.Protection and Rehabilitation of Infrastructure	Works/Rehabilitation Committee	MOW, Private sector	MOW, Private Sector Plan
17. Environmental Protection and Rehabilitation	Saint Lucia Solid Waste Management Authority	MOW. Transportation Committee.	
18.Reconstruction	Ministry of Planning	NEMO, MOW. All Ministries, Private Sector.	

Table 4.2. Responsibilities Matrix for Emergency/Recovery Functions in the Case of a Tropical Cyclone (cont.)

Functions numbers 1 (Warning), 6 (Evacuation), 15 (Public Information), and 17 (Environmental Protection and Rehabilitation) are of particular importance for this Plan. They will be discussed further in this Plan as well.

Since the Hurricane Plan and the Flood Plan are related and the Flood Plan deals with one of the consequences of hurricanes (floods) it is recommendable to read first the Hurricane Plan before reading this Plan.

Part II. Floods and Flood Management.

Unless otherwise indicated, most of the information about floods in Part II is taken from 'Floods. people at risk, strategies for prevention." Published by the then United Nations Department of Humanitarian Affairs (DHA). (See Reference 4 at the end of this document.).

5. Floods.

Flooding arises from a number of different causes. River flooding results from long periods of heavy rain or the melting of snow over large areas. On the other hand flash floods are caused by short intense storms (typically thunderstorms) over a small river basin, producing a flood that rises rapidly to a relatively high peak. Though a flash flood affects only a limited area, the damage can be severe because of the high flow and sudden onset.

In the Caribbean, floods have caused a lot of damage. Just to mention a few recent examples of floods, (From reference 6, the Relief web and reference 7, NEMO report on Lenny) we have:

1. Floods due to Hurricane Floyd. September 13-14, 1999: floods and wind damage in Abaco, Eleuthera, Cat Island, San Salvador and Grand Bahama; minimal damage to New Providence, Exumas and Long Island.
2. Floods due to Hurricane Jose, October 20-21, 1999. heavy rains, high seas, and wind caused minor damage in Antigua & Barbuda, Dominica, St. Kitts-Nevis and Montserrat.
3. Floods due to Hurricane Lenny. November 1999. Hurricane Lenny impacted the northern Leeward Islands with both hurricane and tropical storm force conditions continuously over a three-day period. In the southern Windward Islands high seas and thunderstorms associated with the hurricane resulted in extensive damage to coastal areas and severe flooding. In Saint Lucia there was damage in Soufriere, Gros Islet, Choiseul, Canaries and Anse la Raye for $ 16, 894,900.00 EC.
4. Floods in Belize due to Hurricane Keith. Thirty two inches of rain fell on Belize in September 2000. At its peak, Hurricane Keith was a powerful Category 4 storm with 135-mph winds; but, perhaps, its most devastating effects were caused by days of torrential rains, which flooded homes and cropland. In all, more than 100,000 people were affected by the disaster - 40 percent of the population. Some 3,279 homes were damaged or destroyed and more than 1,200 people were forced to evacuate.
5. Floods due to Tropical Storm Chantal and Hurricane Iris in Belize and due to Hurricane Michelle in the Bahamas in 2001. More than US $ 500 M damage in Belize. Extensive flooding in Jamaica.
6. Floods in Jamaica due to a tropical wave in May 2002: Seven days of torrential outpour tapered off by May 28, 2002, but at least seven fatalities, over 500 inhabitants in shelters, and untold damage was suffered on the island.

Every year, the Caribbean is affected by one or several tropical storms and hurricanes and the winds and heavy rainfall that accompany them. In most of the cases, floods are the result with consequences such as destruction of roads, houses, coastal areas, etc. and the displacement of people and the activation of shelters. Therefore, there is an urgent need to be prepared to respond to these phenomena; i.e., there is a need to have hurricane and flood plans: in all the countries.

6. Causes of Floods.

The ultimate source of all river flow is rainfall or snowmelt, collectively termed *precipitation*, over the catchment area of the river. The catchment area or river basin is the area that the river drains. Some rain and snow can be intercepted by vegetation, particularly trees, and re-evaporated. Rain (and water from melting snow) reaching the soil surface can infiltrate into the soil or run off directly into streams and rivers. Soils have an *infiltration capacity* (the maximum rate at which they can absorb rainfall), and once this has been exceeded, the excess water runs off as *direct*, or *fast-response*, *runoff* or *overland flow*. The infiltration capacity depends on the soil type (sandy soils can absorb more than heavy clays) and the amount of water already held by the soil. During the course of a storm the soil may become fully saturated and any further rain would then all form direct runoff.

It will be appreciated that direct runoff is the major cause of floods. Human influences frequently reduce infiltration, causing more direct runoff and thus increase the likelihood of floods. Deforestation is a major influence in many countries. The trees hold the soils of the forest floor together and make a deep litter of fallen leaves, etc. Both these factors encourage infiltration. Once the trees are lost, the litter and the soils are soon eroded resulting in increased runoff of sediment-laden water. The resulting erosion of hillsides is very deleterious and also leads to increased sediment loads in rivers and silting up of reservoirs down-stream. Buildings and roads and other paved areas are effectively waterproof and cause very rapid runoff.

Flash floods are defined in the WMO/UNESCO International Glossary of Hydrology as floods of short duration with a relatively high peak discharge. They generally arise from precipitation of high intensity within the watershed (flash floods could also occur from non-rainfall events such as the breaching of natural dams formed by landslide material). The high concentration of rainfall on a small area can have devastating effects as the river flow can rise to several hundred times the normal flow in the space of a few hours. It is difficult to forecast flash floods in time for action to be taken.

Many floods in coastal areas and in river estuaries are due to storm surges which result from the sea being driven onto the land by meteorological forces. There are two physical forces which act together. A storm with intense low pressure will cause the level of the sea to rise because of barometric effects and the strong winds associated with this storm, if they are directed onshore, will drive the sea on to the land. Storm surges are associated with tropical cyclones.

Storm surges can occur with any intense storm. The storm that produces the surge can also give rise to heavy rainfall inland so that the estuary region can be subject simultaneously to river flooding and to storm surge.

Garbage and debris in rivers can also be a cause of floods. Debris and garbage can stop water from flowing until water pressure breaks the garbage dam flowing down the river along with garbage and debris.

7. Flood Types

From Reference 2, we have:

- Flash Floods

Flash floods are the result of heavy rainfall or cloudbursts over a relatively small drainage area. These types of floods carry highly destructive flood waves and are most common in mountainous areas or in steep places that have streams flowing through narrow canyons. Flash floods are difficult to forecast.

- Riverine Floods

Riverine floods occur when a large amount of rain falls in river systems with tributaries that drain large areas containing many independent river basins. They may last a few hours or many days depending on the intensity, amount, and the distribution of the rainfall.

- Land based flooding

Some states are subject to relatively large amounts of rain in relatively short periods of time. This together with angle of slopes and general terrain, porosity of soil, and the shape and size of the river basin, siltation, deteriorated or insufficient drainage systems and unregulated deforestation of upland areas, and the presence of obstacles in drainage ways may lead to land based flooding.

- Coastal/Tidal Flood

This results when large bodies of water overflow onto bordering lands. They are mainly caused by

- high tides,
- the heavy rains that accompany hurricanes,
- waves created by high wind surges created by storms in which the friction of strong on-shore winds on the sea surface plus the “suction effect” of reduced atmospheric pressure piles water along a coastline, and
- long waves produced by earthquakes or volcanic eruptions out at sea.

Particularly in the absence of fringing barrier reefs, coastal settlements (having no real buffering), may be exposed to aggravated ocean waves and swells.

- Ponding

This is a slow build up of water in depressions, sinks, areas with clay base soil and slow percolation rate. These floods persist for many days because of poor drainage.

8. Flood Frequency.

In analysing the statistics of floods, hydrologists usually study the largest flood in each year, the so-called *annual flood*. From the analysis of these annual floods it is possible to estimate the probability that a certain flood would be exceeded in any year. This flood can be expressed either as water level or as a discharge, the two being related by the properties of the river channel. Hydrologists prefer to use discharge in flood analyses as it is more readily transferable up and down the river and is unaffected by the construction of flood prevention works such as dykes or levees, which increase the level for any given discharge.

The frequency of a flood of a given size is often described by the recurrence interval or return period. For example, if a flood of, say, 2,500 m3/s is said to have a return period of 100 years, then there is a 1 per cent chance that the river discharge will be 2,500 m3/s (or higher) in any year. This definitely does not mean that the flood of a given return period occurs at regular intervals, but is merely a graphic way of describing the rarity of the flood. An important parameter of the flood frequency distribution is the *mean annual flood*, the average of the annual floods. This gives a measure of the magnitude of floods for a particular river basin and is used to scale the floods of different return periods for a catchment. It can be related empirically to the characteristics of the catchment such as area, slope, rainfall statistics, soil types, and land-use. The mean annual flood is a very common flood and has a return period of 2 to 2.5 years. In many rivers it is approximately the flow that river channel can carry when running bankful.

In countries where there are no rivers in which this approach could apply (like Saint Lucia), flood forecasting using flood data requires decades of well-recorded flow data. In Saint Lucia, such data is not available. The approach then, would be to analyse annual rainfall records and then to apply simple catchment models to estimate the flood flows that would occur from the derived rainfall depth-duration-frequency data.

9. Legislation.

Legislation is an effective tool for the implementation of flood management activities.

In some cases specific legislation concerning floods is enacted. In other cases, floodplain management and flood response activities have legal support from several different sources of legislation.

One example is the case of Trinidad and Tobago, whose Flood Plan is supported by different legislation by the Constitution to the Defence Act, the Disaster Measures Act, the Environmental Management Authority Act, the Fire Service act and others such as the Water and Sewage Act and the Water Works and Water Conservation Act. Trinidad and Tobago has, also, a National Physical Development Act that guides development initiatives.

To present one case with specific flood legislation, we will present the case of the USA, where the National Flood Insurance Act and the Flood Disaster Protection Act were enacted in 1968 and 1973 respectively. (Reference 5). The government found that annual losses throughout the Nation from floods and mudslides were increasing at an alarming rate and that property acquired

or constructed with grants or other Federal assistance were exposed to risk of loss through floods, thus frustrating the purpose for which such assistance was extended. In other words, housing, building and other projects were built with governmental money and were lost because of floods, thus losing money and also creating the need for more governmental money to rebuild.

Through that legislation, the government established the National Flood Insurance Programme (NFIP), to enable persons to purchase insurance against loss resulting from physical damage to or loss of real property or personal property related to any flood resulting in the USA. The government established a National Insurance Fund from (NIF) which funds would be used in the case insured areas would be damaged by floods, avoiding, thus, that tax-payers pay for these losses. The legislation stated that flood-prone areas should be identified and that this information should be published. The legislation stated also that no financial assistance should be approved for acquisition or construction purposes for use in any area that has been identified as an area having special flood hazards and in which the sale of flood insurance has been made available. Eligible mitigation measures for flood prone areas were also defined by the legislation.

10. Flood Mapping.

Before the flood can be effectively controlled, it is essential to know the likely extent of flooding so that the area under management can be decided. Flood maps are needed for this purpose. These can be prepared at different levels of sophistication from simple maps of areas flooded in the past to comprehensive maps showing areas that would be flooded with a given probability.

The simple map of areas flooded in the past, or of the area flooded in a particular event are relatively easy to prepare after each flood. If aerial photographs can be taken during the flood, the flooded area can be delineated on a topographic map. Alternatively, surveys can be made after the flood to collect information on the extent of flooding by observing flood debris marks and interviewing local residents. These maps can be used to show the areas at risk in a manner easily understood by the public. Maps of the area flooded should be prepared after major floods, partly as a check on the accuracy of more sophisticated flood plain maps.

The need for accuracy in preparing a flood map has been emphasised because of the importance that the map can assume. The flood map will be used as the basis of floodplain management, which has as its aim the control of development on the flood plain. Any inaccuracies in the map could lead to developments being permitted that will subsequently be at risk of flooding, or preventing developments that run no risk of being flooded.

In the Caribbean, some flood mapping activities are the following:

1. *Jamaica*. The Government of Jamaica (GOJ) has received funding from the United Nations Development Programme to support a three-year Community-Based Disaster Management Project in the parishes of St. James, St. Ann, Clarendon, St. Mary and Portland. The project is designed to help strengthen national and community level capacities to conduct vulnerability reduction programmes in selected areas. It primarily focuses on empowering communities to effectively deal with natural hazards, namely floods and landslides. ODPEM has the overall responsibility for ensuring timely and

successful completion of the project. ODPEM is undertaking floodplain mapping and with the assistance of consultants ODPEM will conduct hydrological analysis for estimating the 10-, 25-, 50- and 100-year peak discharge and a hydraulic analysis to convert these peak-flows to flood elevations.

2. *Trinidad and Tobago*. In Trinidad and Tobago, the National Emergency Management Agency (NEMA) and its partners have begun the flood hazard mapping process for at least four high-risk areas. Maps are produced in AutoCAD and converted to ARCView format. These maps are shared with the communities to help implement community-based flood early warning systems. The maps are also shared with the Drainage Division and Town and Country Planning Division (with recommendations) to help minimize risk in the future. NEMA has identified risk areas by possible type of flood (flash flood, riverine flooding dam break and urban flooding) including information about recurrence intervals and causes of previous events. Finally, the maps and the risk analyses are also used by the NEMA in the disaster management process.

3. *Belize.* A flood hazard assessment was conducted in 1998-9 for the upper Belize River. (CDMP Belize River Flood Hazard Assessment, completed in 1999).

4. *Antigua/Barbuda and St. Kitts/Nevis.* Inland flood hazard assessments were completed in 2001 for Antigua, Barbuda, and St. Kitts and Nevis. Both technical and summary reports on these hazard assessments are available by country in the CDERA web page: http://www.cdera.org, under CHAMP projects.

5. *US Virgin Islands.* In 2000, the USVI developed a Territorial Flood Hazard Mitigation Plan, which among other things called for re-mapping of the Territory's Flood Maps, especially on St. Croix.

6. *CDERA.* With the assistance of the Government of Japan and beginning in 2002, CDERA is undertaking flood hazard mapping pilot projects in Barbados, St. Vincent and the Grenadines, and Trinidad and Tobago.

In the USA, the above-mentioned legislation (Reference 5, Title 42, Chapter 50, subchapter 3, § 4101) mentions, regarding flood-prone areas and mapping, that it is necessary:

1. To identify and publish information with respect to all flood plain areas. Including coastal areas.
2. To establish or update flood risk zone data in all such areas, and make estimates with respect to the rates of probable flood caused for the various flood risk zones for each of these areas.
3. To give the highest practicable priority in the allocation of manpower and other available resources to the identification and mapping of flood hazard areas and flood risk zones.
4. To review flood maps.
5. To update flood maps.
6. To make the flood maps available.
7. To notify when flood maps are changed.

8. To have a compendia of flood maps.

Flood estimation is far from an exact science; not least because the catchments are constantly changing with respect to catchment wetness river alignments, ground cover, channel stability/siltation, etc. It is a dynamic system. Then there are vagaries of the spatial and temporal patterns associated with any particular storm. In any case, it is important to highlight the importance of having flood maps and to use them for disaster management and floodplain management purposes.

11. Structural Countermeasures.

These measures rely on building structures to change the regime of the river in some way to reduce inundation of the flood plain. They include dykes, levees, bunds or stopbanks (the terms are synonymous) to keep the river off the flood plain; upstream storage reservoirs to contain flood waters and to release them slowly: and river training (channel improvement) to evacuate the flood as quickly as possible.

Structural measures can be expensive, largely because they have to be built on a large scale if they are to be at all effective. Many may only be used at long intervals, perhaps decades long. When high floods occur, and without regular maintenance it is easy for the installations to fall into disrepair and fail when required. These structures are most effective when they form part of a well-thought out flood control strategy and are combined with the non-structural measures, such as land-use regulation and flood forecasting.

In Reference 1, some general measures for flood control are mentioned, namely:

1. Dams and reservoirs built on mainstreams or tributaries that store excessive water and release it gradually after the threat has passed.
2. Levees or floodwalls that confine flood waters to a floodway, thereby reducing flood damage.
3. Channel improvements that include:
    a. Straightening to remove undesirable bendways
    b. Deepening and widening to increase size of waterways
    c. Clearing and remove bush, trees and other obstructions
    d. Lining with concrete to increase efficiency.
4. Establishment of basement elevations and first floor elevations consistent with potential flood levels.
5. Structural strength to withstand water pressure or high velocity of flowing water.
6. Prohibition of equipment that might be hazardous to life when submerged.
7. Prevention of flotation of buildings by requiring proper anchorage.

Specific structural countermeasures mentioned in the FEMA legislation (Reference 5) are:

1. Demolition or relocation of any structure located on land that is along the shore of a lake or other body of water and is certified by an appropriate State or local land use authority to be subject to imminent collapse or subsidence as a result of erosion or flooding.

2. Elevation, relocation demolition, or flood proofing of structures (including public structures) located in areas having special flood hazards or other areas of flood risk.
3. Acquisition by States and communities of properties (including public properties) located in areas having special flood hazards or other areas of flood risk and properties substantially damaged by flood, for public use, as the Director (of FEMA) determines is consistent with sound land management and use in such area.
4. Minor physical mitigation efforts that do not duplicate the flood prevention activities of other Federal agencies and that lessen the frequency or severity of flooding and decrease predicted flood damages, which shall not include major flood control projects such as dikes, levees, seawalls, groins and jetties unless the Director specifically determines in approving a mitigation plan that such activities are the most cost-effective mitigation activities for the National Flood Mitigation Fund.
5. Beach nourishment activities
6. The provision of technical assistance by States to communities and individuals to conduct eligible mitigation activities.

Minimum NFIP floodplain requirements from FEMA's National Flood Insurance Programme (Reference 8) are the following:

For all new and substantially improved buildings in inland flood prone areas:

1. All new constructions and substantial improvement of residential buildings must have the lowest floor (including basement) elevated to or above the BFE.
2. All new construction and substantial improvements of non-residential buildings must either have the lowest floor (including basement) elevated to or above the BFE or dry-flood proofed to the BFE. Dry flood proofing means that the building must be designed and constructed to be watertight, substantially impermeable to floodwaters.
3. Buildings can be elevated to or above the BFE using fill or they can be elevated on extended foundation walls or other enclosure walls, on piles, or on columns.
4. Because extended foundation or other enclosure walls will be exposed to flood forces, they must be designed and constructed to withstand hydrostatic pressure otherwise the walls can fail and the building can be damaged. The NFIP regulations require that foundation and enclosure walls that are subject to the 100-year flood be constructed with flood resistant materials and contain openings that will permit the automatic entry and exit of floodwaters. These openings allow floodwaters to reach equal levels on both sides of the walls and thereby lessen the potential damage. Any enclosed area below the BFE can only be used for the parking of vehicles, building access or storage.

In addition, to the above requirements, communities are required to select and adopt a regulatory floodway in riverine inland zones. The area chosen for the regulatory floodway must be designed to carry the waters of the 1-percent-annual-chance flood without increasing the water surface elevation of that flood more than one foot at any point. Once the floodway is designated, the community must prohibit development within that floodway which would cause any increase in flood heights. The floodway generally includes the river channel and adjacent floodplain areas that often contain forests and wetlands. This requirement has the effect of limiting development in the most hazardous and environmentally sensitive part of the floodplain.

For all new and substantially improved buildings in coastal areas:

1. All new construction and substantial improvements of buildings must be elevated on piles and columns so that the bottom of the lowest horizontal structural member of the lowest floor is elevated to or above the BFE. No fill can be used for structural support.
2. All new construction and substantial improvements of buildings must be properly anchored to resist flotation, collapse and lateral movement.
3. In coastal zones, the velocity of water and wave action associated with coastal flooding can exert strong hydrodynamic forces on any obstruction to the flow of water. Standard foundations such as solid masonry walls or wood-frame walls will obstruct flow and be at risk to damage from high-velocity flood forces. In addition, solid foundation walls can direct coastal floodwaters into the elevated portion of the building. For these reasons, the area below the lowest floor of the elevated building in coastal zones must either be free of obstruction, or any enclosure must be constructed with open wood lattice-panels or insect screening or, be constructed with non-supporting/non-load bearing breakaway walls which meet applicable NFIP criteria. Any enclosed area below the BFE can only be used for the parking of vehicles, building access, or storage.
4. In order to further protect structures from damaging wave impacts, structures must be located landward of the reach of mean high tide. Furthermore, man-made alteration of sand dunes and mangrove stands, which would increase potential flood damage, are prohibited within coastal zones.

As we can see, there are several structural measures that can be implemented to reduce vulnerability and reduce risks of flooding; we can also see that their identification and implementation depend on the definition of the flood mapping.

12. Non-structural Countermeasures.

12.1. Control of Floodplain Development.

Flood maps indicate areas that are subject to flooding and thus where development needs to be controlled if flood damage is to be reduced. A variety of methods is available for controlling development and the particular methods adopted will depend on the legal and administrative systems of the country. Usually, control will involve some form of land-use regulations. These need to be set in the appropriate legal context, depending on the planning system of the country.

Regulations establish zones where types of development are prohibited. These zones must be based on an accurate flood plain map drawn to a specific design flood level so that the effect of the regulations is clear to all concerned.

Regulations do not need to prohibit all development on the flood plain. There is a whole range of activities with different vulnerabilities to flooding that can be considered for the flood plain. These include agriculture, particularly the grazing of livestock that can be moved in times of flood, or crops that can be grown outside the flood season; recreational uses such as parks or playing fields; wildlife reserves, including wetlands; and secondary transport routes and car

parks. On the other hand, there are facilities that should never be located in the flood plain because they will be needed in times of a flood emergency. These include hospitals, clinics, telephone exchanges, electricity sub-stations and emergency operation centres.

We will present here some examples of non-structural measures and floodplain development control:

Some non-structural measures mentioned in CDERA web page (Reference 1) are:

1. Designated floodways and encroachment lines are the lateral boundaries of the floodway where no construction or land filling should be permitted.
2. Zoning is a legal tool used by governments to control development
3. Subdivision regulations specify the manner in which land may be divided. Typical provisions show the extent of the floodplain on maps. Floodway limits or encroachment lines prohibit filing in channels and floodways that restrict flow and require that each lot contain a building site with an elevation above the flood level.
4. Building codes are standards for construction of buildings and other structures and if enforced can reduce damages to buildings in flood-prone areas.

Again, we see here the importance of flood mapping and the determination of floodplains, floodways and BFE's.

One example of floodplain development control is Canada's Flood Damage Reduction Programme (Reference 9).

The prime reason for the Programme was the escalation in flood disaster payments by the government in the early 1970's. Payments were generally being made for extensive flood damage to new developments, many of which were actually encouraged by the false sense of security engendered by structural works. It was a classic case of public spending causing further public spending, as well as human hardship.

Provincial governments agreed that the first step was to stop encouraging or assisting flood-prone development within the floodplain. This meant joint federal/provincial co-operation in identifying areas prone to flooding, mapping those with the highest development and therefore damage potential, and making this information available to the public. The government ***designated*** those areas as flood risk areas.

For each designated area, the two levels of government agreed to the following policies:

1. They would not build, approve or finance flood-prone development in the designated flood risk area.

2. They would not provide flood disaster assistance for any development built after an area becomes designated.

3. The provinces would encourage local authorities to zone on the basis of flood risk.

The FDR represented then a new approach to reducing flood damage in flood-prone areas.

12.2. Flood Forecasting.

Hydrological Models can be used to forecast future river flows, giving the population time to take precautions against floods. During a flood the information provided by the forecasts is used for planning the flood-fighting. The forecasts will indicate when and where dykes systems are likely to be overwhelmed, enabling resources to be concentrated in critical areas.

The hydrological models used for forecasting use measurements of the rainfall over the catchment and produce estimates of future river flows. The rainfall data have to be particularly detailed because the rate of rainfall varies greatly from time to time and from place top place.

Flash floods, it has been mentioned, are difficult to forecast. With adequate equipment and adequate procedures, however, there could be some time for warning. It is important, then, to define beforehand the means and conditions for flood forecast, so they can be used in the case of a threat of a flood in order to implement response activities with enough time.

12.3. Public Awareness.

The general population also needs to know how to respond in case of an emergency. The population has the right to know that they live in a hazard-prone area. When a hazard is threatening, the population has to be warned that the hazard is approaching or about to occur/impact so measures of protection, like evacuation, can be taken. However, in several cases the people is not warned in time or, if they are, they do not believe that the hazard is approaching and they do nothing.

This is due to (Reference 10):

1. The authorities think that the population ‘will panic’
2. The population does not believe the authorities.
3. The population believes the authorities but is reluctant to take action because they do not want to evacuate and leave their property behind.

With a good and adequate permanent public awareness campaign and good warning messages this problems can be sorted out.

In general, the public must know:

1. That there is a flood risk.
2. That there is a high probability that a flood will occur.
3. The effects of a flood if it occurs. How can the people be affected?
4. The response measures governmental agencies would execute if there is a threat of a flood and/or if it has occurred.

5. The measures the people have to take to protect themselves and their belongings, particularly regarding evacuation.
6. How can the people participate in the planning process and in preparation activities for an evacuation such as simulation exercises.

In general, public awareness campaigns, particularly regarding disaster preparedness, must be permanent, since hazards do not impact every day and disasters do not occur every year, the population must be sensitised all year long.

12.4. Simulation Exercises.

Simulation exercises are supposed to test the response and level of preparedness of response personnel and the status of plans and equipment. Simulation exercises are normally executed to test governmental, private and social organisations involved in the response. This is very good for most of emergency procedures that involve only response organisations; but what about emergency functions that involve the population, such as evacuation, for instance? In these cases, the population has to be involved as well, both in the planning and in the testing of planning (simulation exercises): evacuation exercises must involve the population at risk that lives in an area that would be evacuated under a specific threat of a specific hazard; in our case, although these statements are valid also for hurricanes, we refer to evacuation in the case of a floods. Not involving the population in simulation exercises, together with a deficient public awareness campaign, has, in several countries, caused problems with evacuation of the population at risk once the flood threat is present.

So, disaster management organisations must first determine vulnerable areas at risk and then estimate their population and determine the resources needed to conduct an adequate evacuation once a flood threat is present. The population must be informed about these activities and must be involved in the planning, organisation, execution and evaluation of evacuation simulation exercises. Yearly simulation exercises or, at least, one every two years will educate the population and make them accustomed to participate not only in simulations but also during a real event.

12.5. Flood insurance.

The primary purpose of flood insurance is, of course, to pay for the damage caused by the flooding, but it is also often recommended as a means to promoting good use of the flood plain. Insurance premiums that correctly reflect the risk of flooding, by being based on long-term annual average damages, should provide an indication of the risk of developing in the flood plain and would deter unsuitable developments there. In practice, this rarely happens. Flood insurance premiums are usually very high as only those likely to make frequent claims consider insuring themselves against floods. This leads to one of two possibilities: the customer decides that the insurance is too expensive and does not insure his or her property or, the insurance companies decide that there will be no profit in underwriting flood damage at a premium that customers are willing to pay and decline to offer the business.

When flood insurance is not available commercially, governments may intervene to ensure that people can insure themselves against flood losses. The United States National Flood Insurance Programme (NFIP) was set up, in part, because of the difficulty of obtaining flood insurance. The NFIP is managed by FEMA and uses flood insurance to promote well-managed flood plains. The basic principle is that flood insurance should only be available in areas where certain minimum floodplain management policies have been adopted.

The National Flood Insurance Programme (NFIP) was established in the USA by the National Flood Insurance Act of 1968 and further defined by the Flood Disaster Protection Act of 1973. The 1968 Act provided for the availability of flood insurance within communities that were willing to adopt floodplain management programmes to mitigate future flood loses. The act also required the identification of all floodplain areas within the USA and the establishment of flood-risk zones within those areas.

A vital step toward meeting those goals is the conduct of Flood Insurance Studies (FISs) for flood prone communities (See references 11 and 12). A FIS provides a community with sufficient technical information to enable it to adopt and amend the floodplain management measures required for participation in the NFIP. A FIS also develops the flood risk information necessary to establish and maintain accurate actuarial flood insurance premiums.

General guidance is provided for work involving standard professional practice for flood hazard evaluation and revision, whereas specific instructions are provided for work unique to FISs and subsequent updates. The result of these studies are set forth in a final FIS report which contains a written section, flood profiles, figures and tables. In addition, an essential product of the study is the Flood Insurance Rate Map (FIRM), which is distributed to the private insurance industry, the community, Federal and State agencies and others. This map provides 100-year flood elevations and divides the area studied into flood hazard zones that are used to establish actuarial insurance rates. The FIRM may also depict areas determined to be within the FEMA-designated floodway and 500-year floodplain (which might not be applicable to other countries like Saint Lucia; 100 year event being a considerable limit). In addition, certain landmark features in the community may be shown on the FIRM to assist in locating individual properties. The NFIP provides $623 billion in flood insurance coverage for the country's homeowners (2002).

In the UK, flood insurance is paid by all, regardless of the level of risk. Following many recent large flood events, this may be changing with those in flood plains now having to pay higher premiums.

13. Flood Response.

13.1. Warning

The purpose of warning (valid and existent only in the case of predictable hazards), is to notify the authorities and the population that a hazard is about to impact so proper action can be taken with enough time to protect the population and to respond to the effect of the hazard if it impacts.

In the case of a flood warning, the purpose is to warn of a possible flood and to take action before the flood occurs, mainly by evacuation and shelter management activities; this is, taking away the population from the areas that would be flooded to a safer place.

Warning must be, then, one of the most important tools for emergency response and it is the response activity that triggers all the rest of the activities responsibility of all governmental, private and social agencies and organisations.

Warning depends on the capacity to forecast the event (equipment and capabilities), but also based on a good warning system that must determine very clearly:

1. The conditions that determine the need for warning.
2. When the warning has to be issued.
3. Who has to issue the warning and to whom.
4. By what means.
5. Within what timeframe.

The conditions that determine the issue of the warning must be monitored to determine how they change and how they affect the response of the disaster management organisations. The conditions that determine the end of the warning have to be defined and notified as well.

13.2. Evacuation.

Evacuation is the emergency response activity by which emergency response organisations take out vulnerable elements from the scope of impact of a specific hazard until the duration of the impact finishes and there is no longer any danger to return to the area where the vulnerable elements originally were.

Evacuation in the case of predictable hazards must be done before the hazard impacts the vulnerable area in order to protect the population therein and their property.

Evacuation must start after the agencies responsible for evacuation are notified by the National Disaster Organisations. Notification is made immediately after warning is received and the decision to evacuate has been made based on the possible effects of the hazard's impact.

Perhaps the most important response activity during a flood threat is evacuation. Therefore; if asked to by the governmental authorities, all the population in a specific area at risk must evacuate. This can only be achieved by involving the population in the planning process and by increasing and improving public awareness campaigns. Otherwise, any evacuation plan or procedure is useless. Disaster managers should not assume that the population will evacuate immediately when they tell them to do so. On the contrary, they should start from the assumption that the first reactions of the population when told that a hazard will strike would be disbelief and refusal to evacuate.

So, the best way to achieve an evacuation is to involve the people that live in areas at risk in the planning process. Here we suggest two main activities: public awareness and education campaigns and simulation exercises.

Evacuation should be planned for all the areas susceptible to flooding. Information about number of inhabitants, roads, and exact delimitation of the zones must be determined by the governmental authorities.

Another important point regarding evacuation is the need to include it in the legislation and the need to establish specific limits of the areas to be evacuated through vulnerability studies and disaster scenarios. This has to be done by disaster management organisations if they want evacuation to be successful.

Returning the population to evacuated areas must be a decision based on the conditions of the evacuated area as they were at least before the threat or impact of the hazard: safety, no-more risk-present, services operating (electricity, water supply, etc.). The decision must be taken by the national disaster management organisations with the advice of organisations responsible for damage assessment, public utilities, and security/evacuation.

13.3. Public Information

Once the threat is present and the warning and notification given, the public must be informed of the possibility and likelihood of having a flood. This, in order for them to take the adequate measures to protect themselves and their property as practiced in simulation exercises.

In order to have an effective and timely response from the general population and besides permanent activities (public awareness campaigns, simulation exercise), governmental officers in charge of public information and the media must understand and follow the following points (reference 10)

1. Initial response to disaster warnings is disbelief.
2. People will not panic when warned of a hazard impact.
3. Warning messages must come from reliable sources/individuals.
4. Warning messages must be frequent.
5. Warning messages must be clear about the threat and its real consequences.
6. Warning messages must not use euphemisms. Flood must be called flood, danger, danger, evacuation, evacuation, damage, damage and death, death.
7. Warning messages must mention very clearly the activities the population has to do to protect themselves: protect their personal and important documents and valuables, disconnect appliances, go to meeting points, etc.
8. If there is the need for evacuation in an area at risk, this has to be mentioned in the messages very clearly: " the area X must be EVACUATED…".
9. If a hazard threatening to impact does not impact, messages must be broadcast explaining what happened and why there was not an impact.
10. If a hazard impacts, post impact messages must be broadcast explaining what were the effects of the impact.

11. If a hazard impacts, post-impact people will not panic.
12. If a hazard impacts, people will not starve immediately.
13. If a hazard impacts, there is no immediate need of foreign assistance in terms of medical and rescue teams or field hospitals.
14. If a hazard impacts, the most important resource is the response at the local level.
15. Warning messages (as well as public awareness campaigns) must be also broadcast and carried out in all the languages and dialects that the population speaks.

Once the threat of the flood is present, the public must be informed regularly (every hour) about what they have to do until the emergency or the disaster finishes. If the hazard did not impacted. The people must be informed why this happened.

13.4. Clean-up

In the case of a flood, if it occurs, it might carry a lot of damage. Immediate rehabilitation must include cleaning up activities to retire and dispose of mud, silt and debris from affected areas and to dispose of flood-damaged objects as well. This will speed up the process of taking the population evacuated back to their homes.

Cleaning up is important not just after the flood, but before it occurs. Once the warning is issued, the authorities must clean up all garbage and debris from rivers where they can obstruct the free flow of water.

Cleaning up must be a permanent activity in rivers and floodable areas. Garbage and debris must me collected so they would not be part of the cause of floods. Sometimes the time between the warning and the impact of a hazard is not enough to clean up. This must be done before, permanently.

Part III. Floods and Floodplain Management in Saint Lucia.

14. Floods.

Floods in Saint Lucia were in general not very well documented for events prior to the late 70's. NEMO has a list of hazards that have occurred in Saint Lucia, although this list does not includes floods per se; it mentions mostly hurricanes and their effects in some cases, but in general, floods have been disregarded as main hazards; they have just regarded as a consequence of hurricanes. (See reference 12)

Regarding floods and its characteristics in the Saint Lucia context, The meteorological service provided the following information (reference 14):

1. Floods can be caused by a variety of weather systems apart from tropical cyclones. Tropical waves, Upper and Mid-Level Troughs and The Inter Tropical Convergence Zone are a few examples.

2. On October 26th, 1996, a tropical wave caused widespread flooding and serious damage to infrastructure in Saint Lucia. Another instance of non-Tropical Cyclone flooding occurred on February 22nd, 1999, during the *dry season*. This was caused by a mid to low level trough.

3. A flood occurs when the existing drainage system in a specific watershed is overwhelmed by rainfall. This can occur over a short period of very intense rainfall (flash flood) or over a longer period of more moderate rainfall. How fast the flood occurs will depend on a number of factors:

    a. How efficient the drainage is. (The extent of urbanisation within the watershed).
    b. The terrain and topography of the watershed. (The ground cover and topography of the watershed).
    c. Rainfall preceding the flood event. (Antecedent rainfall [catchment wetness]).
    d. Rainfall intensity. (Storm direction relative to the direction of the river flow).

4. Floods in Saint Lucia are of the 'flash flood type'. A typical flood within the Saint Lucian context lasts less than six hours and would very seldom last more than twelve hours. The flood which accompanied Tropical Storm Debby in 1994 and the one in 1996 most likely lasted more than twelve hours but these are extreme events.

5. Storm surges during tropical cyclones can also produce floods in the coastal areas and can be an important factor contributing to increase the magnitude of floods produced by heavy rainfall in those areas.

Very little information, however, can be found about flood events and its characteristics in Saint Lucia. Reports only mention 'floods' without being very specific about information about the area affected, how long they lasted, water level, damage occasioned by the flood itself, etc.

Reports focus mainly in the characteristics of the tropical cyclone and on the damage, forgetting floods. This should change.

The only flood mentioned by the Disaster Matrix (Reference 10) is the one had in February 7, 1911 as a consequence of a rainstorm: " 10 killed in flash flood in Mabouya valley…".

The recommendation here is that we have to start taking floods, disregarding their cause, as main hazards and keep records with information about their causes, characteristics and consequences.

The most important flood in the recent times is the one caused by Tropical Storm 'Debby'.

15. Tropical Storm 'Debby'.

In 1994 Tropical Storm 'Debbie' hit Saint Lucia causing, besides other damages, great loss due to a high precipitation and floods.

A description of 'Debby', focusing on the floods it caused and its effects, is the following taken from post-event Debby reports (See references 15, 16 and 17 at the end of this Plan):

On the evening of Friday, September 9th, 1994 at 11:00 PM, a strong Tropical Wave developed into a Tropical Cyclone, Depression # 6, during its passage over Saint Lucia.

From 6: 30 AM. That Friday, the Met Office had, through it's daily bulletin on radio, announced that a Tropical Wave would cause flash flooding and that persons living in lowing areas should take precautions against flooding. The same bulletin was repeated at 1: 30 and 6:30 PM on radio and at 7:30 PM on television.

As the system hit the island with torrential rains and thunder storms, it intensified and at 5:00 AM the following day, Saturday 10th, it was named "Tropical Storm Debby" leaving widespread destruction to the tune of $ 230 million EC dollars. Three (or four according to others) lives were lost as a direct result of the storm.

Some small patches of clouds ahead of the system moved over the island causing occasional showers during Friday. The main cloud mass associated with the system began affecting the island at about 11:30 PM soon after it was classified as a Tropical Depression. The system continued to affect the island until late Saturday, September 10th. Most of the rainfall occurs between the hours of 2:00 AM and 9:00 AM as indicated by the rainfall recorder at Union with the most intense period being from 5:00 AM to 8:00 AM when 215 mm (8.5 in.) were recorded in that 3-hour period or a rainfall of 2.83 in. per hour.
TS Debby at 5 AM Saturday 10th was :

- Location of centre: 14.3 deg. N., 62.1 deg. W. of Saint Lucia .
- Maximum sustained wind: 40 mph.
- Movement: West North West at 17 mph.

Rainfall from the system was as follows:

Vigie Airport: 240.8 mm from 8 PM on the 9th to 3 PM on the 10th.
Union: 305.2 mm from 9 AM on the 9th to 3 PM on the 10th.
Hewanorra Airport: 212.0 mm over 48 hours from 9 AM on the 9th to 9 AM on the 11th.

Written records and reports only mention general information about the floods. Floods in Anse La Raye and Dennery are mentioned, the one in Anse La Raye being by far the worst. No written record or report could be found about the specific characteristics of the floods. Verbal information given by Anse la Raye District Disaster Committee members mentions all the village flooded, particularly the area where the playing field is located and the houses west and south the playing field with up to 5 feet of water. This was a product of heavy rainfall in the morning of the 10th of September. The flood, they mentioned, lasted for just a few hours with the water receding from the morning of the same day finishing the flood in the afternoon.

Regarding Dennery, another of the most important flood prone areas, some reports mention damage by torrents to roads and to supports of timber houses. In a 2003 Study by Smith Warner International (reference 18) mention is made of levels of +5.8 m downstream of the Dennery bridge on the north bank and of a level of +3.2m. in the 'Resting Place' restaurant on Mole Road opposite the cemetery. In this same study, an analysis of runoff flows from various storm conditions was simulated using HydroCAD, a computer aided design programme for modelling the hydrology and hydraulics of runoff. The results are shown in the following table:

Table River Estimated Flood Flows and Flood Levels. (From reference 18)

Return periods and 24 hr. rainfall	*> 100 Yr 300 mm*	*1:100 Yr 250mm*	*1:50 Yr 225 mm*	*1:25 Yr 200 mm*
Upstream of Dennery Bridge				
Flow (m3/sec)	462	362	312	263
Top water level (m)	+5.45	+4.83	+4.52	+4.22
Downstream of Dennery Bridge				
Flow (m3/sec)	363	289	255	223
Top water level (m)	+3.1	+2.74	+2.56	+2.4

The return period for an event such as the one caused by Debby, is deemed by the Saint Lucia Meteorological Service to be in the 50-100 year region.

Damage caused by Debby is estimated in 230 million EC Dollars (references 15, 16 and 17): Bridges and roads were damaged, 55 % of the banana acreage was destroyed by the flood waters; 33 of 34 water supplies were affected; three schools suffered damage; numerous landslips occurred in central Saint Lucia; damage to all major river banks and the villages of Dennery and Anse La Raye were the most affected by the floods, also in the settlement of Joyeux in the

quarter of Vieux Fort, eight houses were swept away by the Grande Riviere du Vieux Fort: in All, it is estimated that 200 homes and 1000 persons were affected.

16. Legislation.

Saint Lucia has the Disaster Preparedness and Response Act, No. 13 of 2000 (Reference 19). In this act, it is of particular interest, from the flood management point of view, that it considers what the Act calls Specially Vulnerable Areas.

In Part VI, 15 'Delimitation of vulnerable areas', the Act says:

(1) "The Prime Minister may on the recommendation of the Director designate specially vulnerable areas for the purposes of the mitigation of, preparedness for, response to and recovery from emergencies and disasters by delimiting such areas under this section."

(2) The Director shall prepare for the approval of the Prime Minister, a draft Order delimiting
any especially vulnerable area that the Director recommends for designation under Sub section (1).

(3) Before approving the draft Order delimiting a especially vulnerable area, the Prime Minister shall arrange for a public enquiry to be held in conformity with the First Schedule, at which the Director shall present the draft Order for discussion and comments.

(4) The Prime Minister may combine e public enquiry under this section with any other enquiry under other Act under section 18 (1) or both.

(5) After the public enquiry has been held, the Prime Minister shall, if he decides to accept the Director's recommendation for the designation of the area, consider what revisions ought to be made of the draft Order and shall settle the delimitation of the specially vulnerable area by making the Order and publishing it in the *Gazzette*."

The Act also considers, after identifying the especially vulnerable areas, the need for designing special precautionary plans for each of the vulnerable areas identified: Thus, we can read in the act in Section 16 the following:

(1) "The Director may prepare for the Prime Minister's approval a draft special area precautionary plan for a special vulnerable area.

(2) A special area precautionary plan may include:

a. Strategies, policies and standards for development and for maintenance of structures in the specially vulnerable area or any proposed specially vulnerable area;

b. Standards for environmental impact assessment for contemplated development in the specially vulnerable area;
c. Provision designating any part of the specially vulnerable area as a prohibited area for navigation or for the purpose of removing vegetation, sand, stones, shingle or gravel.

(3) A special area precautionary plan may communicate strategies, policies, standards or designations by means of maps and diagrams."

Also, according to Section 17, 18, 19 and 20 of the Act, the special area precautionary plans would be discussed in public enquiries and, after approval, published in the *Gazzette.*

Although these especially vulnerable areas and special area precautionary plan can be prepared for any town or village vulnerable to any hazard, they are of high importance regarding floods, flood mapping and floodplain management. So the Act would definitely be of great importance in the legal support for delimiting floodable areas (especially vulnerable areas) in Saint Lucia and the subsequent floodplain management plans (special area precautionary plans). Saint Lucia has the Legal framework to do this.

Besides the importance of knowing, delimiting and managing floodable areas, the fact of knowing the limits of a floodable area are needed for evacuation purposes. Evacuation from a floodable area is based on the previous knowledge of what area is likely to be flooded and how. Also, when the evacuation order is given, it has to be mentioned exactly what area has to be evacuated and not just the name of the town or village. Of course this has to be done previously through hydrological and hydraulics studies to determine the frequency of floods, its extent and the expected depth of water in specific point.

The fact that Saint Lucia has in its disaster management legislation the articles needed to declare a floodable area a especially vulnerable area is a very important fact that will allow the NEMO to implement vulnerability and risk reduction activities through multi-sectoral plans.

Nevertheless, since this process seems to be a very long one, the NEMO must evaluate if we have to go through it, or if the Legislation should change in order to find a faster legal procedure for the declaration of flood-risk areas.

17. Flood Mapping.

Currently in Saint Lucia the Ministry of Physical Development is conducting projects regarding vulnerability mapping, including the identification on maps of vulnerable elements and key response facilities.

However, since floods are our concern within this plan, we must highlight the need to know the limits of different-period floods and their elevations (depths at different points within the floodplain).

The flood mapping process has not been finished in Saint Lucia. This has precluded organisations to design and implement adequate multi-sectoral plans and programmes for floodplain management including both structural and non-structural measures. It is imperative to design floodplain maps for the villages that are at risk such as Anse la Raye, Dennery and Soufriere. Of course, having flood maps is not enough to reduce flood risk; the information from the flood maps has to be used by decision makers from disaster management ad floodplain management organisations through specific risk/vulnerability reduction and mitigation programmes.

18. Structural Countermeasures

Mitigation has been an important task undertaken by the Government of Saint Lucia, particularly to mitigate the effects of hydro-meteorological hazards.

In recent years mitigation projects have been done through funding from CDB and the World Bank.

18.1.- CDB Funded.

Recently and with funds from the CDB, the following projects have been conducted:

Improvement of the Drainage Systems in Castries and Anse La Raye.

This project includes:

- Preparation of detailed designs and tender documents for the execution of the works
- Assisting the Programme Co-ordinator in the pre-qualification of contractors and the evaluation of tenders, including preparation of tender reports, and
- Assisting the Programme-Co-ordinator in negotiation of the contracts for the construction works and preparation of contract documents.

The works will start January-February 2004.

Castries River Wall

This project considers extensions to the river wall to fill gap particularly in the areas of Marchand and La Cou Dou.

18.2.- World Bank Funded.

Within the World Bank/OECS Emergency Recovery and Disaster Management Project, the following projects have been/are being conducted:

Hewanorra Airport Flood Protection Works.

Flood protection works carried out, consisting of the embankment of the Vieux Fort river to prevent the river from going through the old bed. The Engineering Study includes hydrological assessment of river, and detailed engineering to prepare a sea defence project to protect both the airport landing strip and the ring road.

Bridges and Rivers Training.

Bridges and River Training works carried out at: (i) Marc Floissac, and (ii) Caico including the launching of a Bailey-type bridge, a new abutment and wing walls, and river training. Additional studies carried out to assess the frequency of floods and complete the design for the bridges. The project is aimed also to strengthen the capacity of the Ministry of Works to carry out bridge works through the procurement of about 60 meters of Bailey-type components and the replenishment of the gabions stock which will enable the Ministry to respond quickly to emergency flood situations.

Cul de Sac Prevention Works.

The project would finance bridge construction, drainage and embankment for Cul de Sac Valley and raise the West Coast Road.

Supplementary Reservoir for Victoria Hospital.

A supplementary water reservoir at La Toc will be constructed to ensure water supply to Victoria Hospital.

Disaster Management Programme for Schools and libraries.

This project includes retrofitting of schools used as shelters and the installation of sanitary facilities. The following schools that would function as emergency shelters were retrofitted in the period of April 2002 and March 2003: Bogius Combined, Bexon Infant, Monchy Combined, Micoud Secondary, Richfond Infant, Plainview Combined, Ave Maria, Clendon Mason, George Charles, Odsan Combined and Mangouge Combined.

Study and Design of Coastal Protection for Dennery Village.

This project will assess protection options and develop appropriate recommendations and designs for coastal protection to Dennery Village.

The Ministry of Works besides co-ordination most of previous projects mentioned, conduct permanent activities such as desilting, construction of culverts, roads repair, clearing of drainage, etc.

18.3. Building Code.

Regarding the requirements from the Building Code (reference 20) for floods we found that in Section 5 Public Health and Safety, subsection 503, Fire and Safety Requirements under point 503.3 Requirements for Building sites:

(a) No building shall be erected on a site which:

(b) Cannot be put into such condition as to prevent any harmful effect to the building or to its occupants by storm or flood waters.

(c) Has an average site elevation of less than 4' 0" above mean sea level.

So the Building code, when enacted, would also provide legal support to reduce the vulnerability of buildings by keeping them above possible levels of flooding; however, the limit of 4' 0" can be revised and increased/changed for specific areas (special vulnerable areas) if it is necessary and according to the result of hydrological and hydraulic studies and of the design and approval process of special area precautionary plans.

18.4.- The Caribbean Hazard Mitigation Capacity Building Project (CHAMP).

The Caribbean Hazard Mitigation Capacity Building Project (CHAMP) is a three-year project funded by the Canadian International Development Agency (CIDA), implemented by the Caribbean Disaster Emergency Response Agency (CDERA) and executed by the Organisation of American States (OAS). The project is seeking to enhance regional capacity to reduce vulnerability to the effects of natural hazards. This is being done through the development of national hazard mitigation policies and implementation programmes, the promotion of the wider use of hazard information in development decisions and the strengthening of safe building practices, building training and certification. CHAMP activities will be carried out in the four pilot states of Belize, British Virgin Islands and Saint Lucia.

The expected results of the Programme include:

- A model hazard mitigation policy for use throughout the region;
- Refined models and guidance documents for hazard mitigation policy development and implementation in the region;
- Viable natural hazard vulnerability reduction programs in pilot countries;
- A cadre of builders and artisans trained in safer building techniques;
- A training and certification program for safe building developed and incorporated into appropriate organizations in the region;
- The initiation of gender mainstreaming activities in hazard vulnerability reduction in the region, with particular focus on data collection, hazard mapping and vulnerability assessment; and
- Strengthened capacity at CDERA for guiding comprehensive hazard vulnerability reduction policy development and implementation.

In Saint Lucia, the process of adapting the model Policy to create a National Mitigation Policy is being conducted. A workshop was held in May 2003 and the Policy will be finished and approved by December 2003.

18.5. Saint Lucia National Hazard Mitigation Plan.

Saint Lucia has a National Hazard Mitigation Plan. The initial version of the Hazard Mitigation Plan was drafted in the immediate aftermath of the Tropical Wave of October 26, 1996 that caused serious damage in the village of Anse la Raye and the town of Soufriére. The plan therefore reflected immediately the hard lessons of the Wave, which together with Tropical Storm Debby (September 1994) proved to be a stern teacher.

The plan has been revised three times: in January 2001, in December 2002 (by the NHMC) and in June 2003 by the NEMO. In this last revision the plan has been distributed to all the sectors of society involved for comments and input. A national consultation is being held to revise and approve a 2003 version of the plan.

The plan establishes goals and priorities and considers several structural and non-structural mitigation measures. The Hazard Mitigation plan mentions floodplain mapping as one of the most important priorities

Once the plan is approved it will be the most important tool for the planning, implementation, monitoring and evaluation of structural (and non-structural) mitigation measures, including those related to floodplain management.

19. Non-Structural Countermeasures.

19.1. Control of Floodplain Development.

Since the floodplains have not been determined in terms of their limits, frequency of floods and elevations, it is difficult to determine what activities have to be implemented and where in terms of relocation, change/increase of elevation, restricted or prohibited construction and development, etc.

Hence, again, the need for vulnerability mapping and flood studies; they are the foundation of floodplain management.

19.2. Flood Forecasting.

Saint Lucia is a small island with very small watersheds; so, in general, there is very little time between a rainfall event and the associated flooding. This poses a huge problem in issuing evacuation orders. There are no existent foolproof rules or methodologies to determine when evacuation should take place. Presently evacuation orders from NEMO are generally issued when the island is threatened by a tropical cyclone or strong tropical wave. This is usually done when the system is some distance from the island (beyond Martinique radar coverage) and the rainfall patterns within the system are not yet clearly determined. This is clearly not the most

efficient approach but some improvement is expected with the establishment of the Local Flood Warning System (in progress) and the Caribbean Radar Project (in development stage).

Again, from reference 14, we have:

1. Flood prediction in the Saint Lucian context is not an exact science and there is no way of being sure that a flood event will take place within X hours. With sufficient Radar coverage and rainfall data one can determine with a reasonable degree of accuracy the time and magnitude of a flood event. The problem is always how much time is left to act after that determination is made.

2. The time can vary from a few minutes to hours. This depends on the type of weather system one is dealing with and the level/quality of Radar and Satellite coverage available. This means that an excellent response mechanism is needed if evacuation is to work on short timeframes.

3. Saint Lucia is now in the process of setting up a Flood Warning System for the island and there are two automatic rainfall stations to be installed in the Anse la Raye area. This would provide the right data set to start to design an accurate forecasting mechanism in the future.

19.3. Public Awareness.

Although people may be aware of the need for hurricane preparedness, Tropical Storm 'Lili' in September 2002 demonstrated that, at least in Anse la Raye, they are not prepared to evacuate even under the request of the authorities on site.

Very few people accepted to evacuate, mainly elderly and only to the SDA church. People, in general, mentioned that the other shelter (Sir Arthur Lewis Community College) was too far away. People (it is understandable) did not want to leave their property behind.

Although the memory of TS Debby is still recent for some people, they still refused to evacuate.

Work must be done with the communities as mentioned in Section 12 from this Plan.

The population must know:

1. That there is a flood risk.
2. That a flood can and will occur.
3. The effects of a flood if it occurs. How can they be affected?
4. The response measures governmental agencies would execute if there is a threat of a flood and/or if it has occurred.
5. The measures they have to take to protect themselves and their belongings, particularly regarding evacuation.
6. How can they participate in the planning process and in preparation activities for an evacuation such as simulation exercises.

19.4. Simulation Exercises.

Simulation exercises have been conducted but only involving governmental agencies:

In February 2002, the Humanitarian Allied Forces 2002 (FAHUM 2002) Command Post Exercise was held in Tegucigalpa Honduras with the participation of 16 governmental officers of the highest level from Saint Lucia. The EOC was activated in the simulation and for 5 days the Saint Lucian EOC responded to several situations considered in the simulation inserts.

In February 2003 a flood simulation exercise (table top) was held in the NEMO office with the participation of several governmental agencies. The simulation was organised by the NEMO and the consulting company that designed the model plan for CDERA. The scenario was that one of a hurricane approaching and causing floods.

In both simulations the scenario demanded the evacuation of the village of Anse la Raye; however, they were executed only to test the response of governmental agencies not to test the general population.

Again, the urgent need to involve the population of floodable areas id highlighted. Simulation exercises must be planned, organised, executed and evaluated at least yearly in Anse la Raye and in Dennery to get the people used to evacuation. Specific evacuation plans have to be designed for each area and tested through simulation exercises.

19.5. Flood insurance.

Insurance companies provide insurance against floods, but not separately, only as part of a comprehensive policy that would include several perils: Hurricane, earthquake, floods, riots, fire, strike, lightning and others. The cost of the insurance would depend on the materials of the construction and on the property value; other factors would be taken into consideration such as the location of the property (flood-prone area, near a river, etc) and the occurrence and damage of previous events. Based on these conditions, the insurance company, then, could set a high cost of the insurance or even refuse to insure a specific property.

Regarding the emergency housing policy of the government of Saint Lucia, it would apply only to hazard impacts that would make impossible for the displaced persons to go back to their original properties; for instance in the case of landslides or volcanic eruptions, but in the case of flash floods where the population leaves before the impact of the hazard and comes back one day or two later, the government would not provide emergency housing.

There is no specific insurance programme involving the government, the insurance companies and the communities, such as the NFIP.

20. Flood Response.

20.1. Warning.

In December 2001, within the World Bank/OECS emergency Recovery and Disaster Management project, a study for the Design of Local Flood Warning System was conducted by NEXRAIN Corporation (See reference 21). The study affirms:

"Since there is limited real-time rain data available to forecasters and no river data, hydrologic forecasts are general in nature."

And continues: "Without specific data about conditions throughout the island and in the general vicinity of Saint Lucia. It is nearly impossible for forecasters to provide forecasts with enough specificity for residents to take meaningful action. Residents in low lying areas are frequently subject to flooding…There is no information available to forecasters to create messages that distinguish events that might produce nothing than nuisance flooding from a potential disaster."

If we also consider the fact that floods in Saint Lucia are of the 'flash flood type' there's no time to trigger a warning based on information taken directly from the water levels: "Unfortunately, by the time stream levels rise sufficiently to trigger a warning, it is already too late."

So the study gives an alternative: "From a flood forecast perspective, the only way to substantially increase warning time is to forecast and/or monitor the rainfall before the rain reaches the island." The easiest way to monitor rainfall before it reaches Saint Lucia is to establish real-time access to the weather radar images from Martinique and Dominica. This would allow forecasters to monitor approaching rain systems up to 100-150 km from Saint Lucia, providing from one to 6 hours of additional warning time instead of just minutes."

So, the Meteorological office would have to trigger a warning before the rain reaches the island; i.e. the warning, and, consequently, the order for evacuation, would be given hours before the rainfall. The Meteorological office would assess the situation and recommend, based on the possible amount of rainfall and on the risk of flooding, recommend to the NEMO to evacuate specific villages at risk. NEMO would make the final decision and activate the response mechanism including evacuation.

During tropical storm 'Lili' in September 2002, the warning was issued by the meteorological office at 5 PM September 22. A Pre-Strike meeting (24 hours before impact) was held and there the meteorological office recommended the evacuation of Anse la Raye. The decision was made by the NEMO to evacuate the area the day after, Monday morning. However, the population refused to evacuate. Luckily, there was no flooding. Unluckily, this situation reinforced the perception of some people that 'nothing will happen'.

One important question to rise is: why the decision of evacuation only involved Anse La Raye and not Dennery as well? This question has to be answered in future events; if only one or both have to be evacuated.

20.2. Evacuation.

So far, no example of evacuation has occurred in Saint Lucia with the exception of the one in September 2002 in which only very few persons (mostly elderly people) evacuated.

Emergency planning has involved, so far, governmental agencies and, sometimes, the private sector: the population has not been involved in emergency preparedness and response for specific emergency response plans. It is a mistake for the authorities to believe that the population will evacuate immediately when told to do so: the initial response of the population to a warning is disbelief and the initial response to an evacuation order is refusal. In fact, so, far, only the governmental and some private and social agencies know the emergency plans Saint Lucia has; the population does not know the plans; therefore they do not know that they have to evacuate and when; they do not know what is going to happen to their property, etc.

Therefore, efforts must be made by the government to:

1. Involve the people of communities at risk in the emergency planning process.
    i. Inform them about the risks they live with.
    ii. Inform them about the possible disaster scenarios including damage to life and property.
    iii. Inform them about the emergency activities that would be carried out by the authorities to protect them and their property.
    iv. Involve them in simulation exercises so they will get used to evacuating the area.

2.-Establish a new public information approach during emergencies and disasters.

These activities will ensure that the population knows the risks, what to do and that they will participate willingly in evacuation activities during the threat of the impact of a hazard. (See next Section).

20.3. Public Information.

During tropical storm 'Lili', after the Pre-Strike meeting held on Sunday 22nd September, an address to the Nation was prepared for the Prime Minister (reference 22). It was read and broadcasted on Monday 23rd when 'Lili' was still tropical depression #13.

From this address we have that the paragraphs related to flood risk are the following:

"…, the following measures have been put in place:
…
- Residents in coastal and marine areas, as well as marine interests are asked to exercise caution.
- Residents in areas prone to flooding and landslides are asked to exercise extreme caution."

The document continues: “The system is expected to produce substantial rain and there could be flooding in some areas. All of Saint Lucia must be on full alert, but I am concerned about Anse La Raye, Dennery and Vieux Fort-particularly the Bruceville and Bacadere areas. Therefore, additional measures have to be put in place specifically for those areas. I have also directed the Commissioner of Police to station more officers in Anse La Raye and Dennery to assist citizens should it become necessary…I know that in the past we have been warned, we have taken measures and we were spared. Therefore, some of us will probably take this current warning lightly. However, I appeal to you: please do not treat this as just another warning. Take this and every other warning very, very seriously. That’s because, as we very well know, nothing can be as unpredictable as the weather.”

Although the address stresses out very well the need to be extremely cautious and to take seriously the warning, it never mentions the need for evacuation or the fact that it was already decided to evacuate Anse La Raye. Since it was already decided, it should have been mentioned in the address. It is then understandable that the people, besides being reluctant to evacuate, were confused by being told to evacuate by authorities in the village without hearing anything about it in the Prime Minister’s Address to the Nation or in any other message broadcast through the media. Therefore, it is recommended that if it is decided to evacuate specific areas, it is imperative to mention it in the address that will be read by the Prime Minister and in the rest of messages broadcast through the media. It is recommendable also that the address and/or messages regarding the need for evacuation are broadcast repeatedly (every one or two hours) through the media.

20.4. Clean-up

After flooding, and depending of the damage, clean-up activities have to be conducted: removal and disposal of mud, silt, debris and flood-damaged objects. Flood waters contain large quantities of sediment that settle out wherever the flow is slow, on roads, open spaces, houses and buildings. The depth of sediments can range from a few centimetres up. Floods also can leave behind a mass of rotting vegetation and, if any, carcasses of dead animals. Therefore, clean-up activities have to be considered for they are vital to recovery and, if a town or village have been evacuated, will allow the displaced population to go back to their homes.

After ‘Debbie’ there were problems with siltation (references15, 16 and 17) that caused damage to all water intakes “hampering the Water and Sewage Authority (today WASCO) from using water catchment facilities for distribution during the emergency…Urgent attention, therefore, needs to be paid to issues such as waste management…”. Special attention, then, must be paid to this matter by governmental agencies.

Currently, and according to the Hurricane Plan and its Emergency Procedure 850- Protection and Rehabilitation of the Environment, the Ministry of Physical Development is responsible to ensure that all rivers and riverbanks are cleaned up from garbage once the hurricane (flood) warning has been issued; this is 24 hours before the impact of the tropical cyclone.

Clean up, of course, should not be and activity done just after the threat and/or impact of a meteorological hazard. It has to be a permanent activity.

Part IV. Floodplain Management and Flood Response Plan.

21. Organisations involved in Floodplain Management and Flood Response.

21.1. National Emergency Management Organisation.

The National Emergency Management Organisation (NEMO) in Saint Lucia is responsible for having the Nation in a state of preparedness for the case of an emergency. NEMO is also responsible for responding to the needs of the Nation after a disaster and co-ordinating the response at local, regional and international levels.

During an event NEMO is part of a larger network that comes into existence to respond to a disaster.

The NEMO comprises several Governmental Organisations responsible for response and recovery activities that do not necessarily chair any Disaster Committee; we will mention here: The Royal Saint Lucia Police Force, the Fire Service and the Saint Lucia Air and Seaports Authority.

In further sections of this plan and in the emergency procedures we will detail the role of all agencies according to the functions they are responsible for within this plan.

21.1.1. National Disaster Committees.

There are 10 National Disaster Committees in Saint Lucia that belong to NEMO; they are all involved in the planning and response against earthquakes. Their composition is as follows.

Transportation Disaster Committee

1. Chair
2. Deputy Chairperson - Air Transport
3. Representative - Ground Transport
4. Representative - Shipping
5. Representative - Tourism Sector
6. Coast Guard Commander
7. Chief Pilot, Air and Sea Port Authority
8. Officer in Charge - Police Force/Traffic Department
9. Chief Officer - Transport Board
10. Transportation Officer – Ministry of Works
11. Transportation Officer – Ministry of Health
12. Transportation Officer – Ministry of Education
13. Transportation Officer – Ministry of External Affairs
14. Transportation Officer – Ministry of Agriculture
15. Transportation Officer – Department of Fisheries
16. Transportation Officer – Department of Forestry
17. Transportation Officer – Police Depot
18. Transportation Officer – SLASPA

19. President - National Mini Bus Association
20. President – National Taxi Union
21. President – Saint Lucia Marine Association
22. General Manager – Shell Antilles
23. General Manager – Texaco
24. Rep – Saint Lucia Cadet Corps
25. Eighteen Transportation Team Leaders from District Disaster Committees

Supply Management Disaster Committee

1. Cadet Corps – Chair
2. Saint Lucia Red Cross
3. Ministry of Health: Pharmacy Department
4. St. John Ambulance Brigade
5. Saint Lucia National Council of Women's Voluntary Organizations
6. National Organization of Women
7. Rotary Club [All Clubs]
8. Rotaract Club [All Clubs]
9. Lions Club [All Clubs]
10. Leo Club [All Clubs]
11. Kiwanis Club [All Clubs]
12. The Salvation Army
13. Adventist Development and Relief Agency [ADRA]
14. CARITAS Antilles
15. Boy Scouts
16. Girl Guides
17. Boys Brigade
18. Path Finders
19. Poverty Reduction Fund
20. National Community Foundation
21. Chamber of Commerce
22. Council of and for Disabled
23. Council of and for Older Persons
24. Blind Welfare Association
25. LUSAVE
26. Saint Lucia Postal Service
27. Association for the Improvement of Rastafarianism
28. Education International
29. Community Services of the SDA
30. Saint Lucia Crisis Center
31. Consolidated Foods
32. Eighteen Supply Management Team Leaders from District Disaster Committees

Telecommunications Disaster Committee

1. Chairman
2. Deputy Chairman - The Telecommunications Officer of the Ministry of Works
3. Rep – Utility Companies

4. Rep - Amateur Radio Clubs
5. Rep – HAM Radio Clubs
6. Rep - Citizens' Band
7. Rep - Tourism Sector
8. Rep – National Telecom Regulatory Commission [NTRC]
9. Government Departments with Telecom capacity.
10. Emergency Amateur Radio Support Service (EARSS)
11. Ministry of Home Affairs and Internal Security
12. Telecommunications Network Service Providers
13. Eighteen Telecoms Team Leaders from District Disaster Committees

Damage Assessment and Needs Analysis Disaster Committee

1. CHAIR
2. Engineers, Valuators, QS, Architects
3. WINCROP
4. Banana Companies/WIBDECO
5. Culture: FRC, A&H, SLNT, SLNA
6. Saint Lucia Red Cross
7. Meteorological Services
8. Utility Companies
9. Ministry of Works
10. Ministry of Tourism
11. Ministry of Physical Development
12. Ministry of Housing
13. Ministry of Health
14. Ministry of Agriculture
15. Ministry of Education
16. Department of Statistics
17. Department of Forestry
18. Department of Fisheries
19. Department of Sports
20. Department of Environmental Health
21. Chamber of Commerce
22. Agricultural Services
23. Saint Lucia Air and Seaports Authority
24. Saint Lucia Hotel and Tourism Association
25. Churches
26. Eighteen IDA Team Leaders of District Disaster Committees
27. Fifteen Liaison Officers from Government Ministries
28. Rep – Saint Lucia Cadet Corps
29. Churches
30. AT&T
31. Digicel

Information Disaster Committee

1. Director – Information Services [Chair]
2. Government Information Service
3. Min of Agriculture Information Unit
4. Ministry of Education Information Unit
5. Ministry of Health Education Bureau
6. Cable and Wireless Cable TV
7. Cox Cable TV
8. Voice Newspaper
9. Mirror Newspaper
10. Star Newspaper
11. One Caribbean Newspaper
12. Crusader Newspaper
13. Radio Saint Lucia [RSL]
14. Radio Caribbean International [RCI]
15. The Wave
16. Hot FM
17. Helen FM
18. Praise FM
19. Joy FM
20. National Television Network [NTN]
21. Daher Broadcasting System [DBS]
22. Helen Television System [HTS]
23. Think Caribbean Television [TCT]
24. Choice Television
25. PROs for Eighteen District Disaster Committees

Welfare Disaster Committee

1. Saint Lucia Red Cross - CHAIR
2. St. John Ambulance Brigade
3. Saint Lucia National Council of Women's Voluntary Organizations
4. National Organization of Women
5. Rotary Club [All Clubs]
6. Rotract Club [All Clubs]
7. Lions Club [All Clubs]
8. Leo Club [All Clubs]
9. Kiwanis Club [All Clubs]
10. Saint Lucia Christian Council
11. The Salvation Army
12. Adventist Development and Relief Agency [ADRA]
13. CARITAS Antilles
14. Boy Scouts
15. Cadet Corps
16. Girl Guides

17. Poverty Reduction Fund
18. National Community Foundation
19. Chamber of Commerce
20. Ministry of Social Transformation
21. Ministry of Education
22. Town/Village Councils
23. Rep - Supply Management Committee
24. Basic Needs Trust Fund
25. Saint Lucia Crisis Centre
26. Human Services [Ministry of Health]
27. Mental Health [Ministry of Health]
28. Agency for Indigenous Affairs [ALDEC]
29. Community Services of the SDA
30. Eighteen Welfare Team Leaders from the District Disaster Committees

Stress Response Team

1. Rep. of the Ministry of Health (CMO or nominee)
2. Rep. of NEMO/Chairman Welfare Committee
3. Rep. of NEMO/Chairman Shelter Management Committee
4. Members of NEMO trained in Stress Management debriefing
5. Rep. of the Christian Council
6. CARITAS Antilles.
7. Rep. of the Adventist Disaster Response Agency
8. Rep. of the Saint Lucia Counselling Association
9. Rep. Saint Lucia Mental Health Association
10. Mental Health Professionals
11. Rep. Saint Lucia Red Cross
12. School Counselling Network [Ministry of Education]
13. Any other counselling organisation
14. Any other appropriately trained person
15. Other members as co-opted from time to time.

Note: The Health and Welfare Committee went through changes in its structure and functions: Health matters (medical attention, environmental health, etc.) will be the responsibility of the Ministry of Health or a Health Committee. Since shelter management is no longer (as they used to be) the responsibility of the Health and Welfare Committee ,but of the Shelter Management Committee, only the welfare activities will be taken by a Welfare Committee; it will also have the responsibility of the Stress Management Response Team (stress management of emergency responders) and mental health (stress management of the population after disasters).

<u>Emergency Works/Rehabilitation/Reconstruction Disaster Committee</u>

1. Chief Engineer/Ministry of Works - CHAIR
2. National Transportation Committee
3. NEMO - Secretariat
4. Saint Lucia Fire Services
5. Saint Lucia Police Services

6. Cable and Wireless
7. LUCELEC
8. District Committees
9. Clerks of Councils.
10. LUCELEC.
11. WASCO.
12. Telecom Companies (Cable & Wireless, Digitel, AT & T).
13. Planning Officer Ministry of Health.
14. Director of Community Services and Local Government.
15. Executive Director-Saint Lucia Hotel and Tourism Association.
16. The Saint Lucia Solid Waste Management Authority.

Shelter Management Disaster Committee.

1. Chief Education Officer – CHAIR
2. Ministry of Education/Shelter Team
3. ALL Schools
4. ALL Churches
5. ALL Community Centres / Human Resource Centres
6. Saint Lucia Red Cross
7. Ministry of Works/Inspectors
8. Eighteen Shelter Team Leaders from District Committees

Oil Pollution Action Committee [OPAC]

1. Saint Lucia Air and Sea Ports Authority (Chairperson)
2. Ministry for Physical Development (Deputy Chairperson)
3. Royal Saint Lucia Police Force
4. Saint Lucia Marine Police Unit (OSC-Sea)
5. Fire Service (OSC-Land)
6. Fisheries Department
7. Solid Waste Management Authority
8. Shell Antilles & Guiana's LTD Bulk Station
9. Texaco Bulk Station
10. HESS Oil (Saint Lucia LTD)
11. Ministry for External Affairs, International Trade and Civil Aviation.
12. Caribbean Environmental Health Institute (CEHI)
13. National Conservation Authority

Hospitality Crisis Management Unit

1. Ministry of Tourism – Coordinator [Head of Product Development]
2. Rep – Saint Lucia Tourist Board
3. Rep – SLHTA
4. Rep – Saint Lucia Cadet Corps
5. Rep – NEMO Secretariat

21.1.2.- District Disaster Committees

There are 18 District Disaster Committees as follows:

1. Gros Islet
2. Castries North
3. Castries North East/Barbonneau
4. Castries South East
5. Castries East
6. Castries Central
7. Castries South
8. Anse La Raye
9. Canaries
10. Soufriere
11. Choiseul
12. Laborie
13. Vieux Fort North
14. Vieux Fort South
15. Micoud North
16. Micoud South
17. Dennery North
18. Dennery South

All Committees, its functions and its members can go through changes depending of the needs determined in the permanent planning process. Chairpersons of committees must establish permanent contact with all the members of their Committees in order to define and assign responsibilities, before, during and after disasters.

21.2- National Hazard Mitigation Council and Technical Working Group.

21.2.1.- National Hazard Mitigation Council.

Of great importance is the fact that Saint Lucia has established the National Hazard Mitigation Council (NHMC), who will be key in the planning, implementation, monitoring and evaluation of floodplain management activities.

The National Hazard has the following composition:

1. Chairman: Minister of Works
2. Deputy Chair: Permanent Secretary, Ministry of Physical Development.
3. Permanent Secretary, Ministry of Education
4. Permanent Secretary, Ministry of Health.
5. Permanent Secretary, Ministry of Agriculture.
6. Representative of NEMO: the Chairperson of the Emergency Works Committee (Chief Engineer).
7. Representative of the Chamber of Commerce and Industry.
8. Co-ordinator Crisis Management Unit (Permanent Secretary, Ministry of Tourism).

The objectives of the NHMC are:

1. To co-ordinate government programmes for vulnerability reduction.
2. To foster scientific and engineering endeavours aimed at closing gaps inn knowledge in order to reduce loss of life and property.
3. To develop measures for the assessment, prediction, prevention and mitigation of natural disasters through programmes of technical assistance and technology transfer, demonstration projects and education and training, tailored to specific hazards and locations and to evaluate the effectiveness of those programmes.
4. To prepare a National Mitigation Plan for Saint Lucia.

Additionally, at a meeting of governmental agencies held in November 19th, 1999, the following additional objectives were recommended:

1. That the disaster legislation be reviewed to include mitigation.
2. That the existing initiatives for the preparation of mitigation plans formulated by the FAO/CDERA and the Caribbean Hotel Association should be reviewed with a view to informing the requirements for carrying forward and co-ordinating work in hazard mapping and vulnerability assessments.
3. That a harmonized template be developed for data collection for mitigation.
4. That the technical requirements for the production of hazard maps need to be comprehensively developed.

21.2.2.- Technical Working Group.

The NHMC set up a Technical Working Group (TWG), which comprises representatives from the following:

Chair: NEMO
Deputy Chair: Ministry of Physical Development/Physical Planning Section.
Ministry of Agriculture
Fisheries Department
Forestry Department
Ministry of Works

In the period of 24 months the TWG has to liaise with the staff of the NEMO to:

1. Review the draft disaster legislation to include mitigation.
2. Review the existing initiatives for the preparation of mitigation plans formulated by the FAO/CDERA and the Caribbean Hotel Association (CHA) with a view to informing the requirements for carrying forward and co-ordinating work in hazard mapping and vulnerability assessments.
3. Develop a harmonised template for data collection for mitigation
4. Develop the technical requirements for the production of hazard maps
5. On a quarterly basis to provide regular maintenance of the equipment.

6. In the month of May, on an annual basis, provide a review of the Hazard Mitigation Plan as developed by the NHMC.
7. Collaborate with the relevant agencies such as the Ministry of Public Utilities, Telecommunication Companies, OECS Telecom Unit, et., and departments to identify, formulate and institute appropriate systems for defining, reviewing, and revising medium and training institution for staff development.
8. Identify additional training requirements and recommend appropriate training programmes and training institution for staff development.
9. For a five period to be reviewed at the end design appropriate systems for the continuous monitoring of the system.

All activities related to the conduct of the work of the TWG shall be completed within twenty four (24) calendar months.

The TWG shall report to the NHMC on a quarterly basis. The NHMC in turn shall forward all reports with comments to the Chairperson of the NEMAC or his designated agent. The following reports are required:

1. An initial report within four weeks of commencement of work by the TWG setting out the preliminary findings with a revised work programme.
2. Quarterly reports on the progress of the work programme
3. A training programme to enhance the capacity of personnel in Geographic Information Systems.

22- Floodplain Management and Flood Response Activities.

The floodplain management and flood response activities that have to be done in Saint Lucia, then, are the following:

<u>Floodplain Management Activities:</u>

1 Flood mapping.
2. Legislation
3. Structural countermeasures
4. Non-Structural countermeasures.
    i. Control of flood plain development.
    ii Flood Forecasting.
    iii. Public Awareness.
    iv. Simulation Exercises.
    v. Flood insurance.

<u>Flood Response Activities:</u>

5. Warning.
6. Evacuation.
7. Public Information.
8. Clean-up

The specific activities that Saint Lucia has to implement under each of the categories are described in the following sections.

23. Floodplain Management Activities.

We present here the floodplain management activities that have to be done in Saint Lucia to reduce damage in flood prone areas.

23.1.- Flood Mapping.

1. Floodplain studies for Anse La Raye, Dennery, Soufriere and Vieux Fort. The studies must have maps showing the limits of the floodplains and elevations for 10, 25, 50 and 100-year floods and may include information about the vulnerable elements in the floodplain: population, housing, infrastructure, etc.

Responsible: National Hazard Mitigation Council

23.2.- Legislation.

1- To declare the floodplain areas result of the flood mapping as Specially Vulnerable Areas according to the DPRA (Part VI, 15).

Responsible: NEMO.

2- To prepare a special area precautionary plan for each of the four areas mentioned determine in point 23.2.1. above.

Responsible National Hazard Mitigation Council.

23.3.- Structural countermeasures

1. To identify structural countermeasures to mitigate the effects of floods in the floodplains result from the flood mapping.

Responsible: National Hazard Mitigation Council.

23.4.- Non-structural countermeasures.

23.4.1 Control of Floodplain Development

1. Within the areas identified in the flood mapping, establish a controlled land development based on the likelihood of flooding, floodplains and elevations.

Responsible: National Hazard Mitigation Council.

23.4.2.-Flood Forecasting

1. ***To improve the forecasting capacity through new equipment and the development of specific quantitative mechanisms for warning.***

2. ***To define the quantitative conditions that determines the need for of evacuation specific areas in Saint Lucia.***

Responsible: Meteorological Office.

23.4.3.- Public Awareness

1. ***Establish a permanent public awareness campaign in the areas found in the flood mapping activity regarding flood risks and need for evacuation. (See points in section12.3 of this plan).***

Responsible: Government Information Services.

23.4.4.- Simulation Exercises

1. ***Plan, organise, execute and evaluate, involving the population at risk, a yearly evacuation exercise in at least two of the four areas determined in the flood mapping activity.***

Responsible: Royal Saint Lucia Police Force

23.4.5.- Flood Insurance

1- To design, jointly with insurance companies, an insurance programme for housing in floodplain areas accessible to the population and based on the implementation of mitigation measures by the population and the communities.

Responsible: NEMO.

24. Flood Response Activities

24.1. Warning

1- Continue the warning activities for the case of flood according to Emergency Procedure HP –001 Warning (see attachment 1 to this plan)

Responsible: Meteorological Office.

24.2.- Evacuation

1. Write specific evacuation plans for each of the floodplains identified in the hazard mapping.

Responsible: NEMO Secretariat

3. Conduct evacuation after the recommendation of the Met office when decided to do so by the NEMO and as stated in Emergency Procedure HP- 250.

Responsible: Royal Saint Lucia Police Force.

24.3.-Public Information

1.- In the case of flood threat or impact, inform the public regularly (every 1 or 2 hours) about the hazard threat and effects and about the measures that the population has to take to protect their lives and property as stated in section 13.3 and as stated in Emergency Procedure HP- 750 Public Information. (Attachment 3 to this plan).

2. Prepare a Prime Minister's Address to the Nation considering the points mentioned in section of this plan and as stated in the Emergency Procedure HP – 750 Public Information..

3.- After the warning and after the emergency or the disaster, prepare another Prime Minister's Address to the Nation according to points stated in Section 13.3.of this Plan.

Responsible: Government Information Systems (SLU-GIS)

24.4.- Clean – up

1- To establish and implement a permanent strategy for cleaning up rivers from garbage and debris and eliminate the risk of creating floods

2.- 24 hours before the possible impact of tropical cyclones/ heavy rains/ floods and after the Pre-strike meeting if hold, ensure that all rivers and riverbanks are cleaned up from garbage as stated in Emergency Procedure HP- 850 –Environmental Protection and Rehabilitation. (Attachment 4 to this plan).

3. If the flood occurs, clean-up all flooded areas after the water has receded. Collect and dispose adequately of silt garbage and debris.

Responsible: The Saint Lucia Solid Waste Management Authority (SLAWMA) with the assistance of the Ministry of Planning (Environmental Unit), the National Conservation Trust and the Town and Village Councils.

25. Activities versus Responsibilities

The responsibilities, primary and secondary, for the implementation of floodplain management and flood response activities are shown in the following table:

Activities	Primary Responsible	Secondary Responsible
FLOODPLAIN MANGEMENT.		
1. Flood mapping.	**NHMC**	**NEMO.**
2.- Legislation	**NEMO**	**NHMC.**
3.- Structural Countermeasures.	**NHMC**	**NEMO.**
Non-Structural countermeasures.		
4.- Control of Floodplain Development.	**NHMC**	**NEMO.**
5. Flood Forecasting.	**Met Office, MOW.**	**NEMO.**
6.-Public Awareness Campaign	**SLU-GIS.**	**NEMO. District Committees**
7. Simulation Exercises.	**Royal Saint Lucia Police Force.**	**NEMO. Transportation Committee. Shelter Management Committee. District Committees.**
8. Flood Insurance.	**NEMO**	**NHMC. Ministry of Physical Development, Ministry of Finance, Insurance Companies.**
FLOOD RESPONSE.		
9. Warning.	**Met Office, MOW.**	**NEMO.**
10. Evacuation.	**Royal Saint Lucia Police Force.**	**Fire Service. NEMO. Transportation, Shelter Management and District Committees.**
11.Public Information.	**SLU-GIS.**	**NEMO.**
12. Clean-up.	**Ministry of Physical Development.**	**SLSWMA.**

Table 25.1. Floodplain management and flood response responsibilities.

26. Conclusions and Recommendations.

1. Floods have nor been considered as specific hazards; they have been regarded only as a consequence of tropical cyclones. This has to change. The NEMO and the NHMC must start and maintain a permanent process for flood control.

2. Floods and their characteristics have nor been properly recorded in the past. NEMO, with the assistance of the Met Office, must record every flood occurring in Saint Lucia whether it is caused by a tropical cyclone or not. A database must be kept at NEMO.

3. Normally, the idea we have of floods is one of a slow-growing riverine flood that lasts for weeks or months: we think of the Nile or the Mississippi river. In Saint Lucia floods are totally different: they are flash floods, they have a rapid onset and they last for one day. We have to keep this scenario in mind while we plan and implement flood reduction measures.

4. Floods will never cease to occur; what we can do is reduce the damage they can cause through the activities mentioned in this Plan.

5. A comprehensive and multi-sectoral approach must be taken in floodplain management and flood response if we want to be successful. All governmental agencies, private organisations, communities and population affected must to be involved in the management process.

6. Floodplain management is a long-term process. It starts with flood mapping. Therefore, flood mapping must be a priority in Saint Lucia; otherwise the floodplain management process cannot start. We have to give the first step and we have to give it as soon as possible.

7. A better understanding of the hydrological processes in typical Saint Lucia catchments is needed. This would involve instrumentation (rain gauges, ultrasonic flow gauges, etc.) to measure response characteristics and to improve modelling of flood events simulations and hence the accuracy of flood mapping.

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28.- ATTACHMENTS
Standard Operating Procedures

The SOPs for the Response Phase in a Flood Response are similar to that of the Hurricane Response Plan.

Complete SOPs may be accessed in the

- Hurricane Response Plan,
- the SOPs for the Agencies of the National Emergency Management Organisation [Approved 1149/96] and
- the SOPs for the National Emergency Operations Centre [Approved 1149/96] all of which are stand alone documents of the National Response Plan