SECTION FOUR: HAZARD IDENTIFICATION AND RISK ASSESSMENT

SECTION FIVE: MITIGATION STRATEGY

SECTION SIX: PLAN MAINTENANCE

SECTION SEVEN: BIBLIOGRAPHY

APPENDICES

INTRODUCTION

The Federal Emergency Management Agency (FEMA), in implementing the Disaster Mitigation Act of 2000, initiated far-reaching programs and policies that will affect how every level of government approaches emergency management. The legislation reinforces the importance of hazard mitigation planning and assigns certain responsibilities to state governments, which also apply to its territories such as the US Virgin Islands.

PURPOSE OF THE PLAN

The underlying purpose of the United States Virgin Islands Territorial Hazard Mitigation Plan is to identify strategies and actions that can be taken before a disaster strikes that can greatly reduce the human suffering, damage to property, and the long- term economic impact of natural hazards.

OVERVIEW OF PLAN UPDATE

States and territories are required to prepare and submit a mitigation plan and then review and update the plan on a three year planning cycle. The Virgin Islands Territorial Emergency Management Agency (VITEMA) has established a Hazard Mitigation Steering Committee as well as three Island Hazard Mitigation Committees - one each on the islands of St. Thomas, St. Croix and St. John - to provide oversight and assist in the Plan Update process.

Table 1.1 *Summary of the 2014 Plan Update*

Plan Section	Plan Update
Introduction	The introduction has been updated to indicate the purpose of the Plan Update. It also acknowledges key contributors to the Plan Update.
Section One - Adoption	An updated adoption letter has been included for signature and adoption of the Plan Update by the Governor of the Virgin Islands.
Section Two – Planning Process	This section has been updated to reflect the planning process involved in this Plan Update. This included the description and summary of several meetings with the Hazard Mitigation Steering Committee, the island specific Hazard Mitigation Committees, key stakeholders and public.
Section Three – Capability Assessment	This section was updated based on the findings of an assessment to evaluate USVI agency capabilities to implement the various hazard mitigation actions. This consisted of interviews with identified stakeholders to achieve the stated hazard mitigation goals and objectives. New references were included to new planning initiatives including the update of zoning and subdivision legislation. The limited capacity of VITEMA to implement the entire suite of hazard mitigation

	actions in the 2011 Plan was discussed and recommendations made for a more realistic hazard mitigation strategy for the next three year planning cycle.
Section Four – Risk Assessment	This section has been updated to reflect changes in the Risk Assessment. It outlines the hazard identification process which includes description of an evaluation process utilized to identify hazards for further study in this Plan Update. It includes a summary of data that has utilized for this Plan Update. This includes inventory information along with data and maps that were developed in the hazard profile. New profile information was added for coastal erosion, which was integrated into the discussion on coastal flooding. New profiles and maps developed for drought, wildfire and rain-induced landslides. This information was used to update the vulnerability assessment. All the data, with the exception of drought information, was compiled to update loss estimates.
Section Five – Mitigation Strategy	This section of the Plan Update was based on a detailed review of the goals, objectives and actions contained in the 2011 Plan update. The assessment of the mitigation strategy was based on the findings of the hazard identification and risk assessment and the capability assessment. The mitigation strategy and associated mitigation actions reflected a greater emphasis on conducting planning and hydrologic and hydraulic studies to address areas throughout the islands where inadequate stormwater drainage leads to flooding issues for many neighborhoods. Programmatic mitigation actions emphasized the importance of reducing repetitive loss properties throughout the USVI; however, it is particular important for St. Croix where dense clusters of repetitive losses occur in some of the more flood-prone estates. The Island specific mitigation actions were updated and focused on the implementation of hard projects to reduce the risk to hazards identified by the island specific Hazard Mitigation Committees. The repetitive loss strategy was updated and received greater emphasis in the Mitigation Strategy. Many of the mitigation actions for this Plan Update are focused on reducing repetitive flood losses
Section Six – Plan Maintenance	A detailed description of the maintenance process is contained in this section of the Plan Update. This includes information concerning the composition of the hazard mitigation committees and the responsibilities of each in the maintenance of this newly updated Plan.
Section Seven - Bibliography	This section was updated to reflect new references that were utilized in the Plan Update. It provides an inventory of resources, materials and sources of relevant information utilized in this Plan Update.

The Plan Update was completed through an extensive planning process. The Virgin Islands Territorial Emergency Management Agency (VITEMA) was designated as the lead agency for the Plan Update. Various USVI departments and authorities actively participated in its development.

The Plan Update describes processes and methods that were utilized in the revise of each section of the Plan. Of primary importance, was interagency participation in the planning process along with extensive public outreach efforts, which included both meetings and public workshops. These efforts led to the Update of the hazard mitigation strategy that seeks to implement both programmatic as well as island specific actions for the US Virgin Islands.

This Update, like its predecessor, seeks to serve a number of purposes, including:

- Promote interagency coordination of programs, policies and practices regarding hazard mitigation opportunities;
- Enhance public awareness and understanding of hazards that affect communities and actions the public can take to make themselves safer;
- Identify, evaluate and prioritize a range of mitigation actions that are specific to St. Thomas, St. Croix, and St. John;
- Comply with federal program requirements regarding eligibility for disaster recovery and mitigation grant funding.

This Update was prepared to meet all applicable state mitigation plan requirements as outlined in the Interim Final Rule for DMA 2000, published in the Federal Register on February 26, 2002, at 44 CFR Part 201 and 206.

VITEMA gratefully acknowledges the efforts of the departmental representatives for their participation as members of the Hazard Mitigation Committees (HMC) on each major island, along with the numerous private sector and community representatives who gave their time and support to this undertaking. The complete list of Committee members is included in Section 2.0

DEFINITIONS, ACRONYMS AND ABBREVIATIONS

This section provides the definitions of all acronyms and abbreviations used in the document.

ARC	American Red Cross
BCA	Benefit Cost Area
BCR	Benefit Cost Ratio
BEA	Bureau of Economic Analysis
BFE	Base Flood Elevation
CAD	Caribbean Area Division
CDBG	Community Development Block Grant
CFR	Code of Federal Regulations
CLWUP	Comprehensive Land and Water Use Plan
CRBA	Coastal Resource Barrier Act
DOA	Department of Agriculture
DMA 2000	Disaster Mitigation Act of 2000
DPW	Department of Public Works
DHS	Department of Homeland Security
DPNR	Department of Planning and Natural Resources
FEMA	Federal Emergency Management Agency
FHBM	Flood Hazard Boundary Map
DFIRM	Digital Flood Insurance Rate Map
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance Program
FMV	Fair Market Value
GAR	Governor's Authorized Representative for Hazard Mitigation
GIS	Geographic Information System
GDP	Gross Domestic Product
HAZUS	Hazards United States
HMGP	Hazard Mitigation Grant Program
HUD	Housing and Urban Development
HPR	Department of Housing, Parks and Recreation
HMTAP	Hazard Mitigation Technical Assistance Program
HMC	Hazard Mitigation Committee
NEPA	National Environmental Policy Act
NFIA	National Flood Insurance Act
JFLH	Juan F. Luis Hospital
OMB	Office of Management and Budget
NOAA	National Oceanic and Atmospheric Administration
PDM	Pre-Disaster Mitigation Program
SRMC	Schneider Regional Medical Center
SLOSH	Sea, Lake and Overland Surges from Hurricanes

STAPLEE	Social, Technical, Administrative, Political, Legal, Economic and Environmental review criteria
VIFD	Virgin Islands Fire Department
VIPD	Virgin Islands Police Department
WPA	Water and Power Authority

This section describes the plan adoption process utilized in the Update of the US Virgin Islands Territorial Hazard Mitigation Plan.

1.1 IFR REQUIREMENTS FOR PLAN ADOPTION

DMA 2000 compliant Standard State Hazard Mitigation Plans must be formally adopted by the appropriate elected official(s). In the US Virgin Islands, the Governor has the authority to act on behalf of the Territory in this regard.

The IFR contains two specific requirements relative to the adoption of the Plan by the US Virgin Islands:

- **Requirement §201.4(c)(6):** "The plan must be formally adopted by the State prior to submittal to [FEMA] for final review and approval."
- **Requirement §201.4(c)(7):** "The plan must include assurances that the State will comply with all applicable Federal statutes and regulations in effect with respect to the periods for which it receives grant funding, in compliance with 44 CFR 13.11(c). The State will amend its plan whenever necessary to reflect changes in State or Federal laws and statutes as required in 44 CFR 13.11(d)."

1.2 PLAN ADOPTION BY THE GOVERNOR OF UNITED STATES VIRGIN ISLANDS

Adoption of the Virgin Islands Territorial Hazard Mitigation Plan by the Governor of the US Virgin Islands affirms the commitment of the Territory to pursue the activities and actions identified in the Plan.

Following this page is a formal letter of adoption on behalf of the US Virgin Islands, signed by Governor deJongh on July 10, 2014, which incorporates and satisfies both IFR requirements (§201.4(c)(6) and §201.4(c)(7)).

THE UNITED STATES VIRGIN ISLANDS
OFFICE OF THE GOVERNOR
GOVERNMENT HOUSE
Charlotte Amalie, V.I. 00802
340-774-0001

July 10, 2014

Mr. Jerome Hatfield
Regional Administrator
Federal Emergency Management Agency, Region II
FEMA Region II
26 Federal Plaza
New York, NY 10278-0002

RE: Virgin Islands Territorial Hazard Mitigation Plan Update (2014)

Dear Administrator Hatfield:

It is with pleasure that the Government of the United States Virgin Islands submits the Virgin Islands Territorial Hazard Mitigation Plan Update for your review and approval. The Plan Update was prepared in response to the Standard State Hazard Mitigation Plan Update requirements of the Disaster Mitigation Act of 2000 (44 CFR 201.4). Upon the recommendations of the Virgin Islands Territorial Emergency Management Agency (VITEMA), this letter represents my formal adoption of this plan as the blueprint for future actions to reduce the devastating impact of natural disasters on our residents, property owners and commercial enterprises.

The actions included in this Plan Update reflect strategies that we can undertake to reduce the adverse effects of major hazards that impact our Territory. These strategies address hazards such as hurricanes, coastal and inland flooding, earthquakes, drought, wildfire, tsunamis, and ran-induced landslides. The Plan Update follows our previous plan that was submitted in 2011 and outlines recommended actions ranging from programmatic measures that seek to incorporate enhanced mitigation practices within our governmental agencies; to specific actions that focus on implementing meaningful hazard mitigation projects for each island.

I certify that the Territory will comply with all applicable statues and regulations in effect with respect to the periods for which it receives grant funding. We will also amend the plan, whenever necessary, to incorporate changes in state or federal laws and statues as required in 44 CFR 1.11 (d).

Mr. Jerome Hatfield
Regional Administrator, FEMA Region II
July 10, 2014
Page 2

The efforts of your staff within the Caribbean Area Division (CAD) in working with VITEMA to develop this Plan Update are greatly appreciated. It is my desire to continue to work in a close relationship as partners with the Federal Emergency Management Agency (FEMA) as we continue to mitigate the losses associated with the hazards that affect our Territory.

I look forward to receiving approval of our Plan Update by your agency so we may continue to mitigate the potential impact of future losses due to all hazards. If you or your staff have any comments, questions or concerns please contact VITEMA Director Elton Lewis at Elton.lewis@vitema.vi.gov to (340) 773-2244 or Mr. Haldor Farquhar, Territorial Hazard Mitigation Officer, at haldor.farquhar@vitema.vi.gov or (340) 774-2244. Again, thank you for your continued support.

Sincerely,

John P. de Jongh, Jr.
Governor

pc: Alejandro De La Campa, Director, Caribbean Area Division
Elton Lewis, VITEMA Director
Richard T. Evangelista, Esq., Alternate Governor's Authorized Representative

This section is presented in the following four subsections:

- 2.1 IFR Requirement for Planning Process,
- 2.2 Description of the Planning Process,
- 2.3 Coordination among Government Agencies, and
- 2.4 Integration with other Planning Efforts

2.1 IFR REQUIREMENT FOR PLANNING PROCESS

IFR §201.4(b) states that "[a]n effective planning process is essential in developing and maintaining a good plan." The IFR continues to include three specific requirements for the process of developing Standard State Hazard Mitigation Plans:

- **Documentation of the Planning Process** per **Requirement §201.4(c)(1):** "[The State plan must include a] description of the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how other agencies participated."
- **Coordination Among Agencies** per **Requirement §201.4(b): "**The [State] mitigation planning process should include coordination with other State agencies, appropriate Federal agencies, interested groups,…"
- **Program Integration** per **Requirement §201.4(b): "**[The State mitigation planning process should] be integrated to the extent possible with other ongoing State planning efforts as well as other FEMA mitigation programs and initiatives."

2.2 DESCRIPTION OF THE PLANNING PROCESS

2.2.1 ANALYSIS OF PLAN

For the purposes of the Plan Update, the newly established Hazard Mitigation Steering Committee (Refer to Section 2.3.2 below) led the Plan Update effort. The 2011 Plan indicated that the Plan would undergo annual evaluations and that VITEMA, and then established three (3) Hazard Mitigation and Evaluation Committees (HMEC) for each island and would initiate the evaluations by contacting agencies identified as responsible parties for the implementation of Mitigation Action. No annual meetings has taken place between 2011 and 2014 to review and update the Plan as outlined in the Plan Maintenance Section of the 2011 Plan Update.

Justification as to reasons why there were no annual meetings was not made available at the time of this Plan Update; however, new personnel involved VITEMA have been engaged in this process and have hired the consultant team to work with VITEMA on an annual basis (contracted for 2015) to document the status of the implementation of Mitigation Actions. This process has been defined during subsequent meetings of the Hazard Mitigation Steering Committee. The changes that have been made to the 2014 Plan Update are as follows:

Section One – Introduction and Adoption

- Add a table or statement of what has changed in the update of Plan
- Ensure that Territorial assurances are in the adoption letter, particularly related to the Plan maintenance process

Section Two – Planning Process

- Explain Plan Update process, invitations, community meetings (include announcements; specify dates, place, and attendees of meetings).
- Summarize findings of meetings
- Updated listing of participants and key stakeholders that were involved in the planning process, meeting information, coordination among government agencies, and integration with other planning efforts.
- Key change is that the island hazard mitigation committees as referenced in previous plans are now called hazard mitigation and evaluation committees, persons identified for each island, and will play a role in the annual maintenance process.

Section Three - Capability Assessment

- Update Virgin Islands policies, programs and capabilities related to pre- and post-disaster hazard mitigation;
- Update Mitigation Project Status;
- Clarify Administration of Mitigation grant funds;
- Update Federal Funding Sources, particularly new Hazard Mitigation Assistance Unified Guidance;
- Elimination of the Severe and Repetitive Loss Claim grant programs;
- Changes to the cost share provisions of PDM, FMA, and HMGP grant programs;
- Update VI funding and responsibilities matrix, as appropriate;
- Update Regulatory Compliance Table update, as appropriate.

- Update Recommendations Table update, as appropriate

Section Four – Hazard Identification and Risk Assessment

- Explain how the HIRA was reviewed, and explain if process has changed
- Update Hazard Identification by explaining how it was reviewed, and explain why hazards were added or removed.
- Note the addition and integration of four recommended hazards: coastal erosion (integrated with coastal flooding), wildfire, drought and rain-induced landslides

Coastal Flooding and Erosion

- No Change, No new events reported or documented

Earthquake

- Update history based on information from the Puerto Rico Seismic Network for earthquakes with a Magnitude of 4.0 or above;
- Update of new seismic hazard map with building code provisions table.

Tsunami

- New Tsunami maps were utilized in hazard profile.
- Update hazard profile accordingly

Wildfire

- Update Hazard Identification and Profile
- Conduct loss estimates for future events based on review of data from NCDC.

Drought

- Update Hazard Identification and Profile
- Conduct loss estimates for future events based on review of data from NCDC

Rain-Induced Landslide

- No Change, No new events reported or documented
- Update Hazard Identification and Profile
- Develop Hazard Susceptibility Map to provide an understanding of spatial extent of hazard
- Describe and/or list historic events to understand frequency of the hazard in the USVI
- Update Vulnerability Assessment
- Conduct loss estimates for future events.

Inventory of Assets

- Describe if the 10 model building types have changed for this Plan Update.
- Update building and Critical Facility values based on rate of inflation, construction price index and compounded inflation factor.
- Update Population figures based on Annual Growth Rate, projected; as to figures derived from the 2010 census information for the USVI is not available.

Vulnerability Assessment

- Based the above, update population data and update social impacts table
- Based on the above, update exposure and vulnerability tables.
- Conduct spatial overlay and queries and update social impacts sections for wildfire, drought and rain-induced landslides
- Conduct spatial overlays and queries and update exposure and vulnerability tables for wildfire, drought and rain-induced landslides

Section Five - Mitigation Strategy

- Review goals / objectives, explain how they were reviewed, and explain any changes to goals or objectives
- Review previous programmatic mitigation strategy and explain progress made on each action, if any
- Review previous island specific mitigation strategy and explain progress made on each action, if any
- Review and reference previous repetitive loss mitigation strategy and explain progress made on each action, if any
- When prioritizing Actions for the Plan Update, explain if STAPLEE review came before or after the actions were put into the mitigation strategy

Section Six - Plan Maintenance

- Describe if any monitoring was actually done since last Plan Update
- Explain if the approach has been successful, and whether, it should be used in this Plan Update.
- Explain why a new approach was chosen
- Explain that there were no annual evaluations of the existing Plan;
- Explain changes to membership of the Hazard Mitigation Steering Committee, and how it differs from the Hazard Mitigation Monitoring and Evaluation Committee; justify or explain changes that occurred
- Explain the Public Notification Process that was used to initiate the plan update; explain when and how notices were issued
- Describe Annual Meetings and Reports
- Explain or describe process for monitoring project closeouts, add to whom quarterly reports are sent
- Describe findings of 3-year evaluations and updates to the plan;
    - In the update, add a schedule for evaluation activities, explain responsible parties
    - In the update, provide a schedule showing how the next update process will be implemented
- Describe the Steering Committee; explain who is on this committee, if it is an effective approach, and if the approach will continue to be used or will be modified

The Hazard Mitigation Steering Committee reviewed all of the above listed comments with the CIPA consultant team. Each section of the Plan was reviewed utilizing a completed FEMA crosswalk.

2.2.2 PLAN UPDATE

As noted, the Disaster Mitigation Act of 2000 (DMA 2000) provides a strong incentive for the development of a Standard State Hazard Mitigation Plan. The planning process began in 2004 and led to adoption of the Virgin Islands Territorial Hazard Mitigation Plan by the Governor and approval by the Federal Emergency Management Agency (FEMA) Region II on April 28, 2005.

The law stipulates that the Plan will be updated and re-submitted to FEMA for re-approval every three (3) years, as required by law. It is the understanding of the planning team, based on (44CFR Part 201).
In April of 2014, FEMA promulgated a Final Rule that changed the frequency of Mitigation Plan Updates (44CRR Part 201). The Final Rule extends the Plan Update requirement for States and Territories from 3 to 5 years.

The process used to update this Plan in accordance with the IFR requirement was formally initiated by VITEMA during a special meeting in April, 2014. The work undertaken consisted of updating all sections of the 2011 Plan Update. This was done by using the best available data and methodologies for a target of June 2014 for FEMA final approval.

The process of planning and review of the Plan Update is detailed in this section. The method utilized includes the appraisal and expansion of the 2011 Plan. In accomplishing the objective of the Plan Update, several areas of importance were addressed. The following summary identifies the process used to revise and update each section of the Plan.

- **Introduction**: The introduction presents a summary of the purpose of the Plan Update. It also acknowledges the primary contributors to the Plan Update. It provides information as to the changes made from the 2011 Plan Update. It also includes a list of acronyms.

- **Section One – Adoption**: This section of the Plan Update includes an adoption letter for signature by the Governor of the US Virgin Islands which includes agreement with the Plan Update and assurances that the Plan Update will be implemented by the various agencies of the government.

- **Section Two – Planning Process**: This section has been updated to reflect the participants involved in this Plan Update. The planning process for the Plan Update was similar to that employed for the 2005, 2008 and 2011 Plan Updates. Meetings of the Hazard Mitigation Steering Committee have been held. The meetings for three Island Hazard Mitigation Monitoring and Evaluation Committees, established for each major island, have been documented as well as other key stakeholders involved in the planning process.

- **Section Three – Capability Assessment**: The assessment of the capability of the US Virgin Islands Government, all programs and policies relating to hazard mitigation were reviewed. Recommendations in regard to an analysis of mitigation actions were updated. Progress since the adoption of the 2011 Plan Update has been noted. Technical and financial capabilities are the most crucial area of concern and have stymied the implementation of actions that were identified in the previous plan. Fiscal uncertainty, adequate staffing and the availability of necessary resources remain as hindrances to the full implementation of hazard mitigation in the Territory, especially in VITEMA. Assistance through federal funding sources and the territorial responsibilities were updated.

- **<u>Section Four – Risk Assessment</u>**: The Plan Update utilizes data furnished by the Office of the Lieutenant Governor to VITEMA in 2014. It has been updated in this Plan Update to determine and the inventory of structures and their present replacement cost. The inventory developed is more reliable than that previously available as it utilized compounded inflation rates, to the most current year 2013. The Plan Update reflects general increase in the number of buildings and increase in overall total value since the 2011 Plan Update. Using this data, an island specific vulnerability assessment was updated for each of the identified hazards. The hazards included in this Plan update include: hurricane winds, riverine flooding, coastal flooding, earthquake and tsunami, wildfire, drought and rain-induced landslide. It is necessary to note that the profile for Tsunami has been updated to include new mapping data developed by NOAA, and the coastal flooding profile has been updated to include the potential impacts that Climate Change, and specifically sea-level rise, so as to understand on coastal flooding and secondary coastal hazards such as coastal erosion.

- **<u>Section Five – Mitigation Strategy</u>**: This section of the Plan Update presents the goals, objectives and mitigation actions necessary to implement the Territorial Hazard Mitigation Strategy. The goals and objectives in the 2014Plan Update have not changed from those highlighted in the 2011 Plan; however, The Island Hazard Mitigation Committees approved postponing any mitigation actions associated with *Goal 2: Integrate Hazard Mitigation and Sustainable Development principles into ongoing Government operations and long term Planning* because of human resources and operational budget constraints at VITEMA, DPNR and DPW. The strategies contained in the 2011 Plan Update were reviewed and mitigation actions undertaken since the 2011 Plan Update was formally approved. Viable strategies were prioritized according to urgency and evaluated according to economic and social impact. This ranking is detailed in Appendix G (STAPLEE). A comparison between the mitigation actions contained in the 2011 Plan and this Plan Update revealed a more actions focused reducing on severe repetitive loss properties and planning projects that provide needed data to address flooding issues, given the lack of data to participate fully in a Benefit Cost Analysis and due to the limited capacity at VITEMA and other agencies. The strategies developed by the various hazard mitigation committees show a congruency with the Risk Assessment.

- **<u>Section Six – Plan Maintenance</u>**: The maintenance process is detailed in this section of the Plan Update. It explains the changes made to maintenance and implementation of mitigation strategies when compared to those in the 2011 Plan. Even though the membership of the committees has changed, the present membership demonstrates a high degree of dedication and commitment to implement and accomplish a more realistic hazard mitigation strategy.

- **<u>Section Seven – Bibliography</u>**: The bibliography of the Plan Update provides an inventory of resource material, sources of pertinent information and new references that were used in the Plan Update.

The Plan Update represents the efforts and contributions of several governmental agencies and other stakeholders. The 2014 Plan Update was reviewed and analyzed resulting in pertinent modifications. With the incorporation of information concerning climate change, which provides an overview of how susceptibility will increase or decrease, the territory's profile and understanding of natural hazards is more complete. Mitigation strategies were developed and prioritized to address present data concerns. The 2011 Plan along with the recent data formed the foundation for this Plan Update. The Hazard Mitigation Steering

Committee and the island specific Hazard Mitigation Committees have been newly formulated and have expressed a commitment to implementing an effective hazard mitigation program in the USVI, particularly those priority mitigation actions included in this Plan Update.

2.2.3 PLANNING TEAM

During the development of the 2014 Plan Update, VITEMA established a Hazard Mitigation Steering Committee with the charge of the Plan Update. However, for this Plan Update, this new committee was comprised only of VITEMA staff members. Similar to the previous plan update, this Committee had oversight of the Plan Update consultancy, and consequently remained intact for the plan maintenance and monitoring process outlined in Section 6.0 of this Plan. This Committee is responsible for the implementation of actions identified in the Plan Update. FEMA, which played an advisory role on the Hazard Mitigation Steering Committee, emphasized the importance of monitoring and evaluation, and the importance of capturing historic information for the approval of hazard mitigation projects, especially flood drainage construction projects.

The Virgin Islands Territorial Hazard Mitigation Officer, Mr. Haldor Farquhar, has organized the Hazard Mitigation Steering Committee, and will chair the Committee. The members of the Hazard Mitigation Steering Committee are noted below in Table 2.1.

TABLE 2.1 ***Hazard Mitigation Steering Committee***

Name	Agency/ Department
Haldor Farquhar***	VITEMA
Austin Callwood	VITEMA
Joanne White	VITEMA
Malinda Vigilant	VITEMA
Renata Christian	VITEMA
Debra Henneman-Smith	VITEMA
Oliver Morton	VITEMA
*** Chairman	

VITEMA feels that the development of an effective state-level Hazard Mitigation Plan requires inclusion in the planning process of representatives from a wide-range of public, private, and non-profit sectors. Clear lines of communication with the active participants and the general public are necessary. For the 2014 Plan Update, VITEMA also re-established three Committees: the St. Thomas Hazard Mitigation Monitoring and Evaluation Committee (covering St. Thomas and Water Island), the St. John Hazard Mitigation Monitoring and Evaluation Committee and the St. Croix Hazard Mitigation Monitoring and Evaluation Committee.

The purpose of the Hazard Mitigation Committees was three-fold:

(1) to provide oversight to the VITEMA contractor during the Plan Update;

(2) to contribute to the development of a revised mitigation strategy; and

(3) to identify and prioritize mitigation actions that were specific to each island.

The members of each Island Hazard Mitigation Committee members are outlined in the tables below:

TABLE 2.2 Hazard Mitigation Monitoring and Evaluation Committee, *St. Thomas*

	Hazard Mitigation Monitoring and Evaluation Committee		
St. Thomas	Tom Mc Coy	Rachael Ackley	Vince Roberts
	Elton George	Alex Bruney	Byron Todman
	Bliss Bully	Daryl George	Stacy George
	Nicole Turner	Vance Pinney	Austin Callwood
	Joanne White	Haldor Farquhar	

TABLE 2.3Hazard Mitigation Monitoring and Evaluation Committee, *St. Croix*

	Hazard Mitigation Monitoring and Evaluation Committee		
St. Croix	Jayson Parrilla	Amos King	Malika Felix
	Dexter Hypolite	Ellerton Maynard	Barbara Walker
	Tawana Nicholas	Akila Toussaint	Eran Flemming
	Marla Matthew	David Sweeney	Raphael Joseph
	Malinda Messer	Haldor Farquhar	Leonard Gumbs
			Joanne White

TABLE 2.4 *Hazard Mitigation Committee, St. John*

	Hazard Mitigation Monitoring and Evaluation Committee		
St. John	David Rosa	Sharon Coldren	Dale Brathwaite
	Derron Jordon	Attlee Connor	Avery Christian
	Linda Williams	Leonard Gumbs	
	Joanne White	Haldor Farquhar	

2.2.4 MEETINGS AND WORKSHOPS

The Hazard Mitigation Steering Committee and Islands Hazard Mitigation Committees met on ten (10) separate occasions for the Plan Update. The purpose and outcomes of the meetings are included in the matrix provided in Sections 2.2.3.1 and 2.2.3.2.

2.2.4.1 Hazard Mitigation Steering Committee Meetings

The Hazard Mitigation Steering Committee met on ten (10) separate occasions while developing the 2014 Plan Update.

TABLE 2.5 ***Hazard Mitigation Steering Committee Meetings***

#	Date/Place	Attendance	Purpose/Outcomes
1	1/11/2014 VITEMA Headquarters	VITEMA Mitigation Staff, FEMA	Plan Organization
2	1/14/2014 VITEMA Headquarters	VITEMA Mitigation Staff, FEMA	Planning Process
3	1/21/2014 St. John EOC	VITEMA EOC St. John	Planning Process
4	3/11/2014, VITEMA Headquarters; St. Croix ECO, St. John EOC,	VITEMA Mitigation and Evaluation Committee. All islands	Planning Process, identification of new projects, discussion for all islands.
5	3/19/2014 VITEMA Headquarters; St. Croix ECO, St. John EOC,	VITEMA Mitigation and Evaluation Committee, All islands	Planning Process, identification of new projects, discussion for all islands.
6	4/22/2014, VITEMA Headquarters	VITEMA Steering Committee	Review of projects and status of plan
7	4/24/2014, VITEMA Headquarters	VITEMA Steering Committee, CIPA	Contractor hired, Contractor provided overview of planning process related to the update of the Territory's Hazard Mitigation Plan according to DMA 2000. Consultant discussed key points: timing for plan update, mitigation strategy simplification based on capabilities of territorial agencies, and hazards of concern. Planning process and scheduled public workshop meetings; mitigation strategy updates needed for goals, objectives and actions
8	May 6, 2014, VITEMA Headquarters	VITEMA Steering Committee, CIPA	New FEMA funding framework discussed, particularly HMA Unified Guidance and the National Disaster recovery Framework. Plan Update discussed with FEMA and VITEMA and insane time schedule established for submittal of plan for simultaneous FEMA, VITEMA and public review on May 23, 2014.
9	5/12/2014/ VITEMA Headquarters	VITEMA Mitigation Staff, Director	Update as to status of the Plan and newly established schedule for Plan Delivery.
10	5/22/2014 VITEMA Headquarters	VITEMA Mitigation Staff, CIPA	Review of hazard mitigation strategy and staple, review status of plan update schedule.

Sign-in sheets from these workshops are available in Appendix A of this Plan.

2.2.4.2 Hazard Mitigation Monitoring and Evaluation Committee Meetings

In this Plan Update, VITEMA utilized its state of the art teleconference facility at the VITEMA headquarters building in St. Thomas. Each of the Island Hazard Mitigation Committees was teleconferenced in to the meeting on six (6) separate occasions to contribute to the current update of the Plan (2014):

TABLE 2.6 ***Hazard Mitigation Monitoring and Evaluation Committee Meetings***

#	Date/Place	Attendance	Purpose/Outcomes
1	3/11/2014 VITEMA Headquarters	Government Officials, VITEMA Mitigation Staff	Planning process orientation
2	3/13/2014 VITEMA Headquarters	Government Officials, VITEMA Mitigation Staff	Planning process orientation
3	4/1/2014 VITEMA Headquarters	Government Officials, VITEMA Mitigation Staff	Mitigation action submittal/ review from government agencies
4	5/13/2014 Emerald Beach	VITEMA Mitigation Staff, Hazard Mitigation Committees (St. Thomas), CIPA and FEMA	Review of preliminary HIRA results, and Review of evaluation of new island specific mitigation actions.
5	5/14/2014 St. John EOC	VITEMA Mitigation Staff, Hazard Mitigation Committees (St. John), CIPA and FEMA	Review of preliminary HIRA results, and Review of evaluation of new island specific mitigation actions.
6	5/15/2014 Gertrude's, St. Croix	VITEMA Mitigation Staff, Hazard Mitigation Committees (St. Croix), CIPA and FEMA	Review of preliminary HIRA results, and Review of evaluation of new island specific mitigation actions.

While sign-in sheets are evidenced in Appendix A for the meetings listed in the tables above, it is necessary to note that several additional meetings took place in the territory for the update of the 2014 Plan most notably teleconferences led by VITEMA for the coordination of the planning process.

2.2.3.3 Public Involvement and Outreach

2.2.4.3.1 Public Notification

For the Plan Update, VITEMA's public notification campaign was led by Ms. Christina Lett, VITEMA Public Relations Officer. The public was notified through the media and press releases. Specific information about the project, including mitigation action descriptions were also disseminated to the public through the three Island Hazard Mitigation Monitoring and Evaluation Committee.

Notification of the VITEMA community meetings were published in the major newspapers (VI Source, St. John Trade Winds). The public meetings were also announced on radio shows. Committee members were emailed and kept posted of project progress, including the completion of major milestones. Draft sections of the plan were mailed to the committee members for review and comment.

Public Notices were also prepared following the preparation of the draft Plan encouraging the public to review and comment on the document which was made available by VITEMA on its website (see VITEMA web site posting on May 23, 2014). See Appendix B for documentation of public notification.

2.2.4.3.2 Public Workshops

For the Plan Update, a total of three (3) public information workshops were held in the Territory. These workshops were held on St. Thomas on May 13, 2014, St. John on May 14, 2014 and St. Croix on May 15, 2014. Sign-in sheets from these workshops are available in Appendix A of this Plan. The public informational workshops were held at 5:30 pm.

For this Plan Update, only one (1) public workshop was held on each island. One (1) public informational meeting was deemed to be sufficient as it provided the public with an overview of the planning process, an overview of the DMA 2000 criteria, HMA Unified Guidance, National Disaster Recovery Framework, the results of the HIRA and a preliminary listing of hazard mitigation actions, both programmatic and island specific. Then each workshop was open to participants to express any and all concerns regarding the planning process, natural hazards and hazard mitigation strategy.

These meetings, as in the previous Plan Update, proved to be valuable and provided insight into the desires and concerns of the community related to hazard mitigation actions. The discussions and recommendations of the community meeting provided insight for the identification of Hazard Mitigation Actions included in this Plan Update. A "Cardstorming" session was held, where participants were encouraged to list three personal concerns related to hazard mitigation. This facilitated an interactive consensus-building exercise that provided important feedback from individuals who have been directly affected by recent disasters.

These public information workshops allowed all participants the opportunity to express their issues, concerns and recommendations with regard to disaster recovery, natural hazards and reoccurring damages in their communities. This met the criteria of providing the public an opportunity to comment during drafting.

During the meeting, VITEMA agreed to make the draft Plan available to the public before final approval. This will be done by email notification and via a global press release which will indicate its location on the World Wide Web via a URL. Again, this process is consistent with planning criteria, which does not require formal hearing and that plan comments can be harvested in numerous ways including website participation. VITEMA received public comments during the period in which that plan was posted on its web site (May 25-June 11, 2014). Public comments received from government agencies and private citizens and organizations have been incorporated into the Final Plan Update for 2014.

St. Thomas Information Workshop/Town Hall Meeting

The St. Thomas Public Information Workshop was held at the Emerald Beach Resort on May 13, 2014. There were ten (14) participants in the workshop, including residents and representatives of community associations/ businesses. Following are specific concerns identified by participants during this community workshop:

- Water Island Ferry Dock at “Philips Landing” experiences periodic flooding in the main turn around area, which can remain flooded for a week or longer with depths around 2 feet near the center.

- Honeymoon Beach at Druif Bay at the western end of Water Island; flooding blocks passage and covers road with as much as 3 feet on the beach road, which takes 3 weeks to drain.
- Flamingo Bay Upper Road – main access to rescue vehicles and fire station. Road is in very bad condition. Very large potholes and washes out in certain areas after heavy rain.

- Honeymoon Beach at Druif Bay. Upper Main Road; roadside guts on North and South roads do not drain properly; drains are blocked with sludge and debris.

- Ivanna Eudora Kean High School. Water seeps through block wall and floods classrooms.

- Hurricane Shutters are needed for Garden Street Career & Tech Center

- Evelyn Williams School - Main structural system of the facility needs to be addressed.

- Pearl & Larsen School. Roof needs to be addressed for hurricane winds (retrofit).

- Dam on Weymouth Ryhmer Highway needs to be cleaned.

- Black Point Road needs a retaining wall to prevent large rocks from rolling in the road during rains.

- Department of Public Works need to improve drainage along Route 3, especially in front of Banco Popular (Main Branch) to Cancryn School to alleviate flooding in main thoroughfare.

- Address flooding on main roadway in front of Tutu Park Mall

- Northside Village Area – severe flooding and landsliding during heavy rains.

- DPW needs to procure appropriate equipment that will facilitate the cleaning of small guts as this seems to be a recurring problem throughout the island.

- Flooding in Estate Nadir by the St. Thomas Abattoir and race track (Bovoni road)

- A thorough inspection of waste water system should be conducted with focus to separate waste water collection system and storm water drainage to reduce and correct infiltration issues.

- Development of satellite sites to handle debris after storm events (Convenience Center).

- Still flooding problems at the St. Thomas Tutu Fire Station, which can be alleviated by a simple culvert.

- Smith Bay needs a drainage study as it is in a basin and easily floods.

- Human Services building on First Street; that area floods and has a shelter there.
- Flooding of VITEMA entrance due to poor drainage in front of building that needs to be improved to prevent intrusion of storm water runoff from parking lot into the building.

- Structural retrofit of critical facilities used for sheltering on St. Thomas, including: Lockhart School, Bertha Bochulte Middle School, and Humans Services Head Start.

- Water Catchment at Hospital Ground, near the Danish Burial Grounds. Following severe storm events, the water in the catchment basin rises, and then drains through a gut within the burial ground. Storm water flows, often at least 2 feet in depth, leads to damage on the road, preventing access and egress and continual road damage that needs to be maintained. Elderly and persons with disabilities live in the area and cannot evacuate following severe storm events.

- Concern about WAPA power plant – what would happen if STT was faced with a tsunami event that took out the power plant.

- Would like to see road repair and guts and drainage improvements by Al Mc Bean Park. Water and rocks settle on the main road from storm water flowing down from the surrounding hill.

- Frenchman Bay Estate. The main road on Frenchman Bay is failing due to a major road slippage. The roadway is cracked and with a 40 feet slab of roadway hanging over a private property. This is a hazard to property owners and those traveling down the road. Emergency vehicles have difficulty traversing the road. Rain causes rock and dirt land slippage onto the road and adjacent private property. Engineering study is needed to develop a cost-effective solution to this problem.

- Wintberg Estate public road is being undermined by erosion. The road is higher than the retaining wall of private homes.

- At the Blue Water Bible College there is a need to retrofit the electrical service so that all 3 main buildings can be connected to the same power back-up generator.

St. John Public Information Workshop/Town Hall Meeting

The St. John community workshop was conducted at the Julius Sprauve School on May 14, 2014. There were nine (9) participants in the workshop, including residents and representatives of community associations/ businesses. Following are specific concerns identified by participants during this community workshop:

- Cruz Bay Fire Station. Flooding from new construction road. Extra drain needs to be put in place at the top of the road.

- Functional replacement of the Fire Station in Coral Bay due to flooding and building sinking because it is too close to the ocean.
- St John local roads need to be inspected so as to identify areas for culvert replacement/improvement, especially enlarging existing rusted galvanized steel at least one diameter size.

- Slope stabilization on both the high and low sides of watershed in coral bay is required to identify Best Management Practices (BMPs) to reduce erosion and sedimentation of culverts and guts.

- Seek agency in territory to conduct a Hydrologic and hydraulic (H&H) study of Coral Bay drainage basins and determine engineering solutions for current and projected residential development so as to address outlet locations, natural guts, and the need to adjust storm water flows.

- Expand repetitive loss strategy by developing phased approach to resolving clusters repetitive loss properties on St. John and throughout the territory.

St. Croix Public Information Workshop/Town Hall Meeting

The St. Croix Public Workshop was conducted at Gertrude's on May 15, 2014. There were eight (8) participants in the workshop, including residents and representatives of community associations/ businesses. Following are specific concerns identified by participants during this community workshop:

- Pursue a shutter project for windows for Lew Muckle School (St. Croix) as the windows are quite old.

- Address the corroded light poles at Complex High School (St. Croix).

- Southern Coast at Container Port represents a Tsunami hazard and the Tsunami warning siren not heard in this portion of St. Croix.

- Coastal Interceptor should be relocated in the Little Princess area, approximately 2000 feet of a submerged sewer line needs to be replaced to reduce sewage spillage and health hazards.

- Clean out and increase the capacity of the Frederiksted Gut, to alleviate flooding near the Ball Park.

- Separation of storm and sanitary sewers in the Christiansted Collection System.

- Flood prevention upgrades for all pumping stations on the island; including elevating and grading access road, and drainage improvements to nearby gut to reduce flooding of stations.

- Initiate a project to have St Croix become eligible for reduced flood insurance costs by developing a strategy and action plan for improving the flood management program on the Island so that we can participate in the community rating system. This effort would include an outreach strategy and series of community meetings on the NFIP program, First living floor and base flood elevation determinations, LOMARs, and other flood insurance questions and concerns.

- Installation of a culvert and other drainage improvements in Estate Rust-up-Twist. A hydrological study of the drainage basin will be required to provide factual basis for upgrades.

- La Grange Gut still remains to be a problem area where there was a recent fatality from flooding. A retention pond needs to be constructed upstream to lessen the velocity of storm waters.

- Old Castle Coakley, south of the Red Cross keeps flooding due to storm water runoff coming from Zion farm community which require swales to be constituted to curb the excess runoff to the gut leading to Hovensa.

- North of Williams Delights ponds need to be developed to retain the excess storm water coming from Blue Mountain. This will reduce storm water runoff reaching the community of Williams Delight. In addition, small-diameter culverts need to be installed on the local roads of Williams Delight to reduce the localized flooding. The culverts can be connected to the major box culvert that was constructed a number of years ago at Williams Delight.

- Hannah's Rest where there is flooding of localized roads. A comprehensive drainage plan needs to be done for Hannah's Rest to address the many valleys in the roadways where water often seems to pond.

- Structural retrofit of the critical facilities used for sheltering should be considered such as Claude O. Markoe School and St. Croix Educational Complex.

- A generator is needed for the Red Cross Chapter Building for Saint Croix.

- Land erosion protection and vegetative cover plantings at the Red Cross Chapter Building for St. Croix.

- Retrofit existing and ensure new utility/infrastructure meet current earthquake standards for the USVI, such as pump stations, waste water treatment facilities, water treatment facilities, and power generation facilities.

- Provide additional drainage features along roadways with excessive sheet flow during rain events, roadside swales, and provide additional drainage inlets and culverts

- Provide seawall to protect Tsunami prone-infrastructure in main towns.
- Retrofit portions of Juan F. Luis Hospital roof for hurricane hazards.
- Clear drainage system in front of JFL Hospital to alleviate local flooding.

2.3 COORDINATION AMONG GOVERNMENT AGENCIES

For a State Hazard Mitigation Plan to become an effective tool in implementing hazard mitigation it cannot remain the sole province of VITEMA. Coordination among government agencies that have a role in implementing hazard mitigation is essential. For this plan update, coordination with government agencies was very similar to the process utilized during the 2011 Plan development. There were some changes in this process during this Plan Update; these include:

- Establishment of the Hazard Mitigation Steering Committee. This committee was formed for the specific intent of not only the Plan Update, but also its implementation. Unlike the Hazard Mitigation Monitoring and Evaluation Committee (HMMEC), established for each island, which included multi-agency participation, the HM Steering Committee included members only from VITEMA. It is necessary to note that initially the same government agencies were invited to participate in the steering committee, but it was decided that only VITEMA members would have a role in the steering committee. It also should be noted that FEMA played an advisory role in the Steering Committee meetings in that it emphasized the importance of addressing certain items in the Plan Update, particularly the importance of reviewing and integrating the HMA Unified Guidance, emphasizing the importance of updating severe repetitive loss strategy by integrating recommendations into the Territory's Mitigation Strategy and emphasizing the need to integrate climate change into the Hazard Identification and Risk Assessment, specifically sea level rise.

- Different Participants from Government Agencies. There was a marked reduction of Federal and Territory agencies that played a role in this Plan Update. During this Plan Update, many participants that were included on committees were familiar with the Hazard mitigation planning process. However, there were new members that required more information in order to arrive at a basic understanding of emergency management and hazard mitigation. As these persons gain a better understanding of FEMA programs, processes and terminology, the Plan Update process in the future will become more efficient.

- Identification of Key Stakeholders. Key stakeholders such as the Virgin Islands Territorial Emergency Management Agency (VITEMA), Department of Planning and Natural Resources (DPNR), and Department of Public Works (DPW) were identified during the planning process. These key agencies participated in the Hazard Mitigation Monitoring and Evaluation Committee Meetings and/or Public Informational Workshops. These agencies also made staff available for the Plan update, namely DPW and DPNR.

2.3.1 FACILITATING INTERAGENCY COORDINATION

There were numerous ways in which VITEMA encouraged coordination among US Virgin Island governmental departments, agencies and authorities. The most important way that VITEMA encouraged coordination was to invite representatives of the relevant agencies to participate in the Hazard Mitigation

Monitoring and Evaluation Committees. The list of Public Sector participation in the Committees, presented in Section 2.3.2, reflects the success that VITEMA had in involving a broad range of Territorial and Federal agencies in the mitigation planning process from the very beginning.

Public Sector participants were encouraged to discuss the planning process with other staff in their respective departments. This brought their collective insight and enabled identification of potential mitigation projects that could be brought back to subsequent Committee meetings. By interfacing with representatives of other VI departments within the setting of the Hazard Mitigation Committee meetings, participants gained an understanding of the respective roles of many agencies and departments. All of the agencies that participated in the Hazard Mitigation Committees meetings had a stake and a vote in identifying and prioritizing new hazard mitigation actions at the Territorial-level as well as for each major Island.

2.3.2 PARTICIPANTS

These workshops and meetings were facilitated by VITEMA and its consultants. A number of individuals from private and public sector played key roles in preparing the Plan Update. On a territory-wide basis, the three Committees reflected the participation from the following Federal and Territorial agencies, businesses, institutions, associations, and organizations:

Public Sector

- Virgin Islands Territorial Emergency Management Agency (VITEMA)
- Department of Planning and Natural Resources (DPNR),
- VI Housing Authority
- VI Port Authority
- VI Property and Procurement
- VI Fire Service
- VI Police Department
- VI Department of Education
- Emergency Management Services (EMS)
- VI Department of Human Services
- VI Water and Power Authority

Private Sector

- Tropical Shipping
- Caneel Bay Hotel
- Coral Bay Community Council
- Enfield Green Owner's Association

Organizations

- University of the Virgin Islands
- The American Red Cross

Federal Emergency Management Agency, Region II

FEMA Region II, through its Caribbean Area Division (CAD), San Juan, Puerto Rico participated in the Plan Update planning process. FEMA CAD's representative provided the territory training in Hazard Mitigation and the FEMA territory representative in the Virgin Islands, Mr. Leonard Gumbs, participated in an advisory capacity in the Hazard Mitigation Steering Committee, and in all public meetings.

Consultants

The consultant for the Hazard Mitigation Plan Update was the Council for Information and Planning Alternatives, Inc. (CIPA). The consultant assisted in the following ways:

- Developing an appropriate planning process for the Plan Update;
- Providing technical support in performing the risk assessments for the Plan Update;
- Developing written materials for meetings and web postings;
- Facilitating VITEMA meetings and workshops and addressed Plan elements;
- Assembling information for inclusion in the Plan Update.

2.3.3 STAKEHOLDERS

VITEMA has undertaken a number of steps to encourage the widest range of stakeholder involvement from the onset of the Plan Update process. The Update of the US Virgin Islands Territorial Hazard Mitigation Plan was a collaborative effort resulting from dedicated efforts of a number US Virgin Islands agencies, departments, and authorities, in addition to the vital involvement of the public and private sectors.

1) Public notices were provided to the print and voice media, encouraging the general public and special interest groups to participate in the Plan Update process (Appendix B).

2) Representatives of government agencies were identified as key stakeholders and were invited to be members of the three Island Hazard Mitigation Monitoring and Evaluation Committees and/or participate in public workshops. The term "Stakeholders" as used in the rest of this Plan Update includes the following:

- Virgin Islands Territorial Emergency Management Agency (VITEMA)
- Department of Planning and Natural Resources (DPNR),
- Department of Public Works (DPW)
- VI Water and Power ((WAPA)
- VI Department of Education

2.3.3.1 Outreach to Virgin Island Agencies

In addition to involvement on the hazard mitigation committees, contacts were made with the important government agencies for the Plan Update in order to solicit their involvement in the review of key elements of the Plan. The meetings were held with the following agencies:

The Department of Public Works (DPW)

DPW has lead responsibility for the design, construction and maintenance of drainage infrastructure and public roads throughout the Islands;

The Department of Planning and Natural Resources (DPNR)
DPNR is responsible for administration of the Natural Flood Insurance Program (NFIP). It is also responsible for the following activities that have the potential to reduce the future vulnerability of the US Virgin Islands:

- Reviewing subdivision plans and development proposals
- Developing long-range land use plans and policies for the US Virgin Islands
- Approving building permits
- Conducting building inspections
- Protecting natural resources

VI Housing Authority
The Virgin Islands Housing Authority is empowered with the responsibility for planning, financing, constructing, maintaining and managing Public Housing Developments in the Territory, and in the future should play an important role in recovery efforts given the importance of the role given to the US Housing and Urban Development (HUD) under the new National Disaster Recovery Framework.

Meetings were held with each of the above referenced agencies to review existing plans, program and policies. Discussions focused around the development of appropriate hazard mitigation actions that should be included in this Plan Update.

Further to these discussions, a series of one-on-one interviews were held with mid-level representatives of key US Virgin Islands agencies. Their goal was twofold: to obtain legislation, regulations, plans, and policies relevant to hazard mitigation; and, to jointly discuss opportunities to encourage hazard mitigation in the agencies day-to-day, and strategic, long-term planning activities.

These meetings and discussions proved beneficial for improving coordination among these key agencies with a major role in implementing hazard mitigation.

2.3.3.2 Contributions from Interagency Coordination

First and foremost, the contributions to Plan's development from interagency coordination were reflected in the broad-based composition of the Hazard Mitigation Planning Committees. Representatives of Federal and Territorial agencies, departments and authorities actively participated in the Committee meetings. They provided oversight to VITEMA, contributed to the development of goals and objectives, and by voting to prioritize programmatic and island-specific mitigation actions. However, it is also important in the Plan Update to acknowledge the specific contributions made by key government agencies. They include:

- **Tax Assessor's Office**. The Tax Assessor's Office did not provide a copy of the Territory's tax database for this Plan Update. Instead, through its consultant, the CIPA consultant team was provided a summary of real property values so as to validate and calibrate its estimates. This data was used to develop damage estimates for specific natural hazards.

- **Department of Public Works.** DPW representatives participated as active members of the Hazard Mitigation Committees. In addition, the Department provided a list of projects that require Federal funding to be constructed. Most of the projects listed were included in the Plan Update and address repetitive flooding problems. DPW representatives provided project descriptions for the Plan's mitigation actions.

- **Department of Planning and Natural Resources.** The Department contributed to the Plan development in many ways. They provided representatives to the numerous Committee meetings, in addition to facilitating numerous interviews between the VITEMA planning team and major DPNR divisions.

2.4 INTEGRATION WITH OTHER PLANNING EFFORTS

All relevant and completed plans and/or on-going planning efforts were reviewed for this Plan Update. The 2011 Plan provides a good departure point to identify new opportunities where hazard mitigation can be better integrated into US Virgin Islands long-range planning initiatives.

2.4.1 VIRGIN ISLANDS GOVERNMENT PROGRAMS

During the capability assessment for this Plan update, several DPNR planning initiatives are worth mentioning. They are USVI Zoning and Subdivision Code Update and several other NOAA watershed-based planning initiatives. The specific documents, highlighted below, were reviewed and specific comments about these plans related to hazard mitigation can be found in Section 4, Capability Assessment.

- *Coral Bay Watershed Management Plan: A Pilot Project for Watershed Planning in the USVI,* Center for Watershed Protection, (2008)
- *St. Croix East End Marine Park Management Plan*, VI Nature Conservancy and UVI for DPNR, Division of Coastal Zone Management (2002)
- *St. Croix East End Marine Watersheds Management Plan, USVI DPNR, NOAA, USDA NRCS (2011)*
- *USVI Zoning and Subdivision Code Revisions,* currently under development by Rutgers University and Duncan Associates, in conjunction with the Community Foundation of the Virgin Islands

The *USVI Zoning and Subdivision Code Update,* currently under development, should be ready for public and legislative review and comment in mid-2014, and is intended to create a more streamlined, enforceable zoning process. This revision will consider and identify areas where DPNR can expand its managerial, administrative, technical and human capacity and will have a positive impact on mitigating adverse impacts of residential and commercial development in hazard prone areas.

2.4.2 FEMA MITIGATION PROGRAMS

There are been significant changes to FEMA's national disaster management organizational structure and a consolidation of a number of hazard mitigation grant programs that have occurred since the last USVI Plan Update in April of 2011.

Soon after the last Plan Update was completed, FEMA rolled out the National Disaster Recovery Framework (NRDF) which realigned the roles of a number of Federal agencies regarding disaster recovery.

Six groupings of core recovery capabilities, called Recovery Support Functions (RSFs) were delineated and primary and secondary Federal agencies associated with each RSF. The six RSFs are:

- *Community Planning and Capacity Building*
- *Infrastructure System*
- *Housing*
- *Economic Development*
- *Natural and Cultural Resources*
- Health and Social Services

Although FEMA retains the central planning and coordination role in post-disaster situations, several Federal agencies will have a more defined role in recovery, particularly for the housing and economic development RSFs. VITEMA will establish relationships in the steady-state (pre-disaster) timeframe with US Housing and Urban Development (HUD) and US Department of Commerce (DOC) representatives that could facilitate recovery in the future post-disaster conditions.

The most obvious programs and initiatives for VITEMA to integrate with are FEMA mitigation grant programs. VITEMA serves as the lead agency for the Territory in FEMA related grant administration and will be the "Applicant" in most, if not all, of FEMA hazard mitigation grant applications. VITEMA is responsible for soliciting sub-applications from eligible sub-applicants; assist them in preparing them and submitting eligible, complete applications to FEMA in a prioritized order. Upon award, VITEMA becomes the "Grantee", monitoring and managing grant administration on behalf of the "Sub-Grantees".

FEMA has consolidated its hazard mitigation grant programs under the Hazard Mitigation Assistance (HMA) Unified Guidance, first issued in July of 2013. The Territory should take advantage of HMA funding programs in both the pre- and post-disaster timelines. The three consolidated hazard mitigation programs include:

- Hazard Mitigation Grant program
- Pre-Disaster Mitigation Grant program
- Flood Mitigation Assistance Program

The National Mitigation Framework, finalized in May 2013, describes the following seven core capabilities:

- Threats and hazard identification;
- Risk and disaster resilience assessment;
- Planning;
- Community resilience
- Public information and warning;
- Long-term vulnerability reduction; and,
- Operational coordination.

HMA programs reduce community vulnerability to disasters, promoting individual and community resilience, and enabling a more efficient and more rapid recovery following natural disasters. For both the Territory and the Nation, taking advantage of HMA programs will reduce response and recovery resource requirements. From the perspective of the National Mitigation Framework, the HMA programs will lead to safer, more sustainable communities that are less reliant on external financial assistance.

A more detailed description of key changes to FEMA mitigation programs since the last Plan Update is provided in Section 3 – Capability Assessment, in addition to Appendix H which lists all hazard mitigation program changes that are reflected in the July 2013 HMA Unified Guidance.

The Biggert-Waters Flood Insurance Reform Act of 2012 eliminated the Repetitive Flood Claims and Severe Repetitive Loss grant programs. Cost share requirements have been changed to allow more Federal funds for properties with repetitive flood claims and severe loss properties.

This Plan Update includes a repetitive loss strategy that is consistent with the 2004 amendments to the National Flood Insurance Act (42 U.S.C 4001 et seq). The National Flood Insurance Act was amended to "introduce a mitigation plan requirement as a condition of receiving a reduced local cost share for the activities that mitigate severe repetitive loss properties under the Flood Mitigation Assistance and Severe Repetitive Loss grant programs". The October 31, 2007, interim final rule established this requirement under the 44 CFR § 201.4 (c)(3)(v) to allow a state to request the reduced costs share under the FMA and SRL programs if it has an approved State Mitigation Plan that also includes an approved Severe Repetitive Loss Strategy" (FEMA, Multi-Hazard Planning Guidance, 2008).

The most recent guidance (HMA Unified Guidance 2013) on crafting an effective repetitive loss strategy is that States and Territories need to describe specific actions that the Territory has taken to reduce the number of repetitive loss properties and clearly outline the steps planned to reduce the number of repetitive properties over time.

This Plan Update incorporates the goals and objectives of the repetitive loss strategy in Section 5 Mitigation Strategy and then provides additional detail on how the Territory plans to achieve those reductions is outlined in Appendix C. The Territory's approach is primarily focused on public education, data collection, and direct mitigation actions focused on minimizing repetitive losses. The actions are reflected in both the discussion on programmatic and island specific hazard mitigation actions.

This section includes the following five subsections:

- 3.1 The IFR Requirements for Capability Assessments
- 3.2 US Virgin Islands Policies, Programs and Capabilities
- 3.3 Funding
- 3.4 Analysis and Evaluation of US Virgin Islands Departments, Agencies and Authorities
- 3.5 Summary and Recommendations

3.1 THE IFR REQUIREMENT FOR CAPABILITY ASSESSMENTS

The Interim Final Rule (IFR) includes two specific requirements for conducting capability assessments as part of Standard State Hazard Mitigation Plans:

- **State Capability Assessment** per **Requirement §201.4(c)(3)(ii): "[***The State mitigation strategy shall include a] discussion of the State's pre-and post-disaster hazard management policies, programs, and capabilities to mitigate the hazards in the area, including: an evaluation of State laws, regulations, policies, and programs related to hazard mitigation as well as to development in hazard-prone areas [and] a discussion of State funding capabilities for hazard mitigation projects*"
- **Local Capability Assessment** per **Requirement §201.4(c)(3)(ii): "[**T*he State mitigation strategy shall include] a general description and analysis of the effectiveness of local mitigation policies, programs, and capabilities…"*

The Disaster Mitigation Act of 2000 (DMA 2000) requires that the territories of the United States, including the US Virgin Islands, meet the IFR requirements for States. However, the US Virgin Islands differs from the 50 States in one important way. Although the islands of St. Croix, St. John and St. Thomas could be considered as distinct "communities" in many regards, there are no incorporated units of local government. Since there are no incorporated counties, municipalities or subunits below the Territorial government that can promulgate or enforce "local" policies, programs or regulations, the requirement for a "Local Capability Assessment" does not apply and is not addressed in this Plan.

3.2 US VIRGIN ISLANDS POLICIES, PROGRAMS AND CAPABILITIES

An important purpose of this assessment is to identify the capabilities that need to be strengthened to assure successful implementation of programs, and the rules and regulations intended to support the hazard mitigation related policies of the US Virgin Islands.

The remaining portions of this subsection of the Plan address:

- Policies
- Programs, Rules and Regulations

3.2.1 KEY WORD DEFINITIONS

The IFR does not provide definitions for key words in its requirements, i.e., "*policies, programs and capabilities*". For the purposes of this assessment, the following definitions will be used:

- *Policies* – are statements included in the Territory's plans or enabling legislation that express the vision or intent of the US Virgin Islands government. In the specific context of this plan, policies are identified that already do, or feasibly can, support hazard mitigation in the US Virgin Islands.
- *Programs* – are related, coordinated activities by one or more agency that have a distinct focus or purpose. Often, programs are developed as a direct response to policies and are enabled by the corresponding legislation or executive order. In the context of this assessment, relevant programs are often directly linked to rules and regulations.
- *Capabilities* – as used in this document, describe the past performance and future potential of agencies to carry out programs. As a simple example, if you want to build a house (the "program"), you need to assess your capability to do so. You should look at the materials and tools you have or need to buy; the skills you have or can hire (carpenters, electricians, plumbers, etc.); and whether the money you have saved for the project will be enough.
- Under this definition and for this particular planning exercise, capabilities refer to the strength and weaknesses of rules and regulations ("tools and materials"), the adequacy of human resources to carry out administrative procedures and enforcement activities (the "skills" to implement the program) and the funds available to maintain operations and provide capital improvements (the "project budget").

3.2.2 CAPABILITY ASSESSMENT INTERVIEWS

For the Plan Update, the majority of capability assessment interviews involved representatives from VITEMA, DPNR, DPW and VI Housing Authority. The following list identifies the name, title and affiliation of US Virgin Islands officials interviewed during the capability assessment:

Department of Planning and Natural Resources:

- T. Stuart Smith, DPNR, Director of Planning
- Phillip Smith, DPNR STT, Director, Director of Permits

Virgin Islands Territory Emergency Management Agency
- Austin Callwood, Deputy Director
- Haldor Farquhar, Mitigation Chief,
- Joanne White, Grants Specialist

Virgin Islands Housing Authority
- Robert Graham, Executive Director,
- Lydia Hughes, Director of Modernization & Development
- Mrs. Monique Farrell, Construction Manager

Department of Public Works:
- Nicole Turner, P.E., , DPW STT, District Engineer

Other Agency Representatives Interviewed:
- Leonard Gumbs, Structural Engineer, FEMA CAO

3.2.3 POLICIES

This section provides a summary of plans, policies and legislation that lay out specific goals, objectives and policy statements that already do, or potentially could, support pre- and post-disaster hazard mitigation. The plans reviewed for the Plan Update include land use and environmental planning documents, specific hazard mitigation plans, and other emergency management plans. They are listed below:

Land Use and Environmental Planning Documents

- *Coastal Land and Water Use Plan* (see "Coastal Zone Management" under Section 2.3.1)
- *St. Croix East End Marine Park Management Plan*, VI Nature Conservancy and UVI for DPNR, Division of Coastal Zone Management (2002)
- *Coral Bay Watershed Management Plan: A Pilot Project for Watershed Planning in the USVI,* Center for Watershed Protection, (2008)
- *St. Croix East End Marine Watersheds Management Plan, USVI DPNR, NOAA, USDA NRCS (2011)*
- *USVI Zoning and Subdivision Code Update,* currently under development by Rutgers University and Duncan Associates, in conjunction with the Community Foundation of the Virgin Islands

Activities related to other areas or phases of emergency management were not evaluated for this Plan Update.

All Hazard or Hazard Specific Mitigation Plans

- Natural Hazard Mitigation Plan for the US Virgin Islands, David Brower, Esq. and Timothy Beatley, Ph.D., for VITEMA (1988)
- Mitigating the Impacts of Natural Hazards in the US Virgin Islands, Island Resources Foundation, for VITEMA (1995)
- Mitigating the Impacts of Natural Hazards in the US Virgin Islands, Island Resources Foundation, for OMB (1999)
- Virgin Islands Flood Hazard Mitigation Plan, Island Resources Foundation for VITEMA, funded by FEMA FMA grant (2000)
- Phase 4 Report, Earthquake Hazards Reduction Plan, Geoscience Associates, for VITEMA, funded by FEMA grant EMA-K-86-0055 (1987)

Emergency Management Plans

- US Virgin Islands Territorial Recovery Operations, Part II, Territorial Disaster Recovery Assistance Handbook on Federal Programs, VITEMA (1992)
- Disaster Management Guide for the US Virgin Islands. FEMA Region II CAO (2004)
- Hurricane Evacuation Study for the US Virgin Islands, Technical Summary, US Army Corps of Engineers for VITEMA (1994)
- WAPA Emergency Operations Plan, WAPA (2003)

These plans provide a solid base for the maintenance, development and pursuit of coordinated programs that can reduce the risk of damage and loss from natural disasters in the US Virgin Islands.

Comprehensive Planning

As highlighted in the 2005, 2008 and 2011 Plans, the *Comprehensive Land and Water Use Plan (CLWUP)* adhered to goals and objectives laid out in the "*Guidelines for the Development of a Long-Range Comprehensive Plan for the United States Virgin Islands*" adopted by Executive Order No. 333-1991 on May 17, 1991.

The *Comprehensive Land and Water Use Plan* (CLWUP) proposed to incorporate territorial-wide land and water use guidelines developed by the V.I. Department of Planning and Natural Resources (DPNR) into the Virgin Islands Code (V.I. Code). In 2005, a formal bill was proposed by V.I. Senator Richards (Bill No. 25-0209) which sought to amend title 29, chapter 3, Virgin Islands Code, to enact the "Virgin Islands Development Law of 2003". Bill No 25-0209, which sought to provide for a comprehensive land and water use plan for the U.S. Virgin Islands and also called for the revision of zoning districts on all islands of the US Virgin Islands.

The CLWUP was perceived by the Legislature and stakeholders as too restrictive to the economic development of the US Virgin Islands and the draft bill was held in abeyance in legislative committee. There are currently no long-range comprehensive or master plans in process for the US Virgin Islands. However, DPNR is in the process of developing zoning and subdivision code revisions, which will be in compliance with all existing legislation, and will hopefully provide a basis for the eventual development and adoption of a comprehensive land-use plan, as required by Territorial law.

The zoning and subdivision code revisions are being developed with the assistance of Rutgers University. This project includes the following components:

- Comprehensive update and modernization of existing zoning and subdivision codes
- Organization, layout, ease-of-use/administration
- Internal/external consistency
- Administration/procedural clarity & efficiency
- Strategic amendments to address identified issues and opportunities
- Introduction of form-based floating zone
- Urban design plan for areas in Charlotte Amalie

These revisions are anticipated to support the process of moving towards the development of long-range comprehensive plan. A number of sections of the draft zoning and subdivision sections have been presented to a review committee and interested stakeholders. As of May 8, 2014, DPNR anticipates that the revisions will be finalized over the next several months, at which time they will be presented to both the Territorial Legislature and the public.

These code revisions will address significant, current issues related to hazard mitigation, including erosion control and management of storm water runoff. The major elements of the code revision are anticipated to encompass both technical standards and performance standards. It is anticipated that the code revisions will be complete and adopted in time for future Plan Updates, and that more information regarding the specifics of the code revisions will be available at that time.

Other plans include policy-related statements that are more focused on specific hazard mitigation issues. Although outdated by the consolidation of hazard mitigation programs in the HMA Unified Guidance, the *US Virgin Islands Flood Mitigation Plan*, adopted in 2003, is still relevant today. The goals and objectives highlighted in the 2003 plan were reflected in this Plan Update and clearly support both pre- and post-disaster hazard mitigation activities for flooding, one of the key hazards for the US Virgin Islands.

As such, the foundations of these plans continue to provide a solid base for the maintenance, development and pursuit of coordinated programs that can reduce the risk of damage and loss from natural disasters in the US Virgin Islands. The extent to which the Territory has been successful in building on this base is discussed in the following subsections. After the descriptions of these programs, Section 3.5– Summary and Recommendations relates each plan's "policies", as well as the related programs, rules and regulations to the elements of the IFR requirements.

3.2.4 PROGRAMS, RULES AND REGULATIONS

This subsection describes relevant programs, rules and regulations of the US Virgin Islands. The discussion is organized by four main headings:

- Pre-disaster hazard mitigation;
- Post-disaster hazard mitigation;
- Other related programs; and
- Proposed programs.

3.2.4.1 Pre-Disaster Hazard Mitigation

Programs, rules and regulations that are focused primarily or substantially on pre-disaster hazard mitigation in the US Virgin Islands include:

- Floodplain Management;
- Coastal Zone Management; and
- Land Development Regulations (e.g., zoning; subdivision regulations; building codes).

3.2.4.1.1 Floodplain Management

Current pre-disaster floodplain management efforts in the US Virgin Islands are pursued through four interrelated programs:

- National Floodplain Insurance Program;
- US Virgin Islands Flood Map Modernization Program;
- US Virgin Islands Flood Hazard Mitigation Plan; and
- Flood Damage Prevention Rules.

National Floodplain Insurance Program

Through the National Floodplain Insurance Program (NFIP), FEMA provides Federal insurance for structures and their contents located in participating communities. The NFIP was enacted by the Federal government in 1968 to help reduce flood damage by regulating new development in flood prone areas and to provide flood insurance to the general public at reasonable rates to cover damages to buildings and their contents caused by flooding.

In order to participate and qualify their residents for flood insurance, communities must adopt minimum regulations governing floodplain development. For example, participating communities must prohibit new development in designated floodways that raises flood levels. In addition, the lowest floor of all new buildings in Special Flood Hazard Areas must be elevated to or above the height of the base flood elevation or “100-year flood”. A third significant requirement is that subdivisions must be designed to minimize exposure to flood hazards. Added standards are imposed on communities where the flood hazard is compounded by coastal wave action or “V” zones as described in Section 4.2 – Hazard Identification and Profiles.

In June 2004, the National Flood Insurance Act (42 U.S.C. 4001 et seq.) was amended to introduce a mitigation plan requirement as a condition of receiving a reduced local cost share for activities that mitigate severe repetitive loss properties under the Flood Mitigation Assistance (FMA) and Severe Repetitive Loss (SRL) grant programs. The October 2007, Interim Final Rule established this requirement under 44 CFR §201.4(c) 93) (v) to allow a State to request the reduced cost share under the FMA and SRL programs if it has an approved State Mitigation Plan that also included an approved Severe Repetitive Loss Strategy (contained in Appendix C).

The US Virgin Islands has been a member of the NFIP since 1980. The Territory adopted NFIP-compliant floodplain management provisions in 1993. See discussion under “Flood Damage Prevention Rules” below for a description and evaluation of the rules and regulations enacted by the US Virgin Islands that help satisfy the statutory requirements associated with their NFIP participation. The program is administered by DPNR, Division of Permits. The Director of Permits is the designated NFIP Coordinator for the US Virgin Islands.

Evaluation / Assessment

The NFIP was an important impetus for the enactment of the US Virgin Islands Flood Damage Prevention Rules. In addition, the program has provided loss coverage for a significant number of properties. It is important to note that of the 2,061 policies that are currently in force (2/28/2014 policy data FEMA R2), approximately 225 cover “repetitive loss properties”, properties that are currently insured for which two or more NFIP losses (occurring more than ten days apart) of at least $1,000 damage each have been paid within any 10-year period since 1978 (FMA, 2000). As of November 2010, following Hurricane Earl (FEMA Disaster Declaration DR-1939-VI), there were 250 repetitive loss properties in the NFIP database. Removing duplicate and other entry errors, along with three structures removed from the list through implementation of a FMA-funded hazard mitigation project (Note: these are the most current years for which NFIP and SRL data that was made available to VITEMA.)

The prioritization of mitigation activities to reduce the number of repetitive loss properties (through acquisition, elevation, etc.) is consistent with actions outlined in Section 5 of this Plan.

Also, in evaluating the impact of the current floodplain management program in the US Virgin Islands, three other issues are important to examine:

- NFIP policy coverage assessment – Using October 2007 data from the Flood Hazard Mitigation Plan, there were 2,535 policies with insurance coverage totaling $350,594,700 in the US Virgin Islands. This represents an addition of approximately 535 policies since the 2000 FMA Plan. The 2000 FMA Plan also reported that the results of reviewing aerial photographs of the islands indicated that as much as 10 percent of the Territorial housing units are located in the Special Flood Hazard Area. Given that there are at least 50,500 housing units in the islands, 10 percent would yield approximately 5,050 units within the SFHA. If that is the case, NFIP policies cover approximately one half of the total eligible properties. When you realize that this calculation does not include commercial properties and that a higher proportion of them are probably located in or near the SFHA, then the resulting coverage rate is most likely even less.
- Insurance claims -- Data compiled for the 2004 Map Modernization Business Plan indicate that, as of March 2004, there were over 2,400 policies in force and over 2,500 insurance claims in the US Virgin Islands, resulting in an average 1.05 claims per policy. As of October 2007, there were over 2,535 policies in force and over 2,783 insurance claims filed in the Territory, resulting in an average 1.11 claims per policy.
- Repetitive Loss Insurance claims – Since the inception of the Virgin Islands qualification for NFIP in 1980 through November 2010, two-hundred and twenty five (225) properties have been identified and validated as repetitive flood loss properties. The total number of properties identified and validated as severe repetitive losses is three (3), making it a very small subset of the whole. The distribution of these properties is as follows:
  - St. Croix: 133 Repetitive Loss; 3 Severe Repetitive Loss
  - St. John: 2 Repetitive Loss
  - St. Thomas: 112 Repetitive Loss

  The figures above represent two hundred and fifty (250) total properties initially identified as repetitive loss or severe repetitive loss. Of these two hundred and fifty (250) identified properties, two hundred and twenty five (225) were later validated by FEMA. The twenty-five (25) that were removed from the list consisted primarily of duplicate entries, with others being mitigated properties or vacant lots.

  These repetitive loss and severe repetitive loss properties have filed six hundred and seventy (670) claims in the previous thirty (30) years, and have received payments of $33,417,083.88. This produces an average claim of $49,876.24 per property, or an average of $1,662.54 per property each year for the previous thirty (30) years.

The relationship of the number of policies versus claims is overly simplistic, and likely does not accurately depict the flood risk to properties in the Territory. Nevertheless, the increasing number of claims is disconcerting and may indicate the need for more careful development review and long-range comprehensive planning. The Territory has a substantial opportunity to address and take positive action relative to reducing the number of Repetitive Flood Loss properties. This Plan Update outlines specific actions (See Appendix G) to target these properties and the surrounding environ that perpetuates these losses.

Simple measures in the development review process have potential to pay dividends in reducing future flood-related disaster damages. Care should also be taken to make sure that well intentioned programs like the NFIP are focused on providing coverage for properties that are already at risk, not to support the development of new sources of risk and loss for the community.

Flood Insurance Rate Maps (FIRMs)

The NFIP issues Flood Insurance Rate Maps (FIRMs), which delineate the Special Flood Hazard Areas (SFHA) as either A-zones (riverine flooding) or V-zones (coastal flood hazard areas). The FIRMs, which have been utilized in the Virgin Islands since their initial issuance in August 1980, have served a useful purpose for establishing insurance rates.

The 2000 Flood Hazard Mitigation Plan provided a detailed analysis that documents extensive coastal and riverine flood damages outside of the regulatory SFHA boundaries. These maps have been updated and reissued in April 2007 and provide the Territory with a more useful resource for planning and site specific decision making.

The 2007 *US Virgin Islands Digital Flood Insurance Rate Maps (DFIRMs)* are consistent with the proposed five-year strategy for modernizing FEMA FIRMs and Flood Insurance Studies (FISs) in the Territory. The March 2004 strategy stated: "*Because of the steep terrain on all three islands, there is also a need to update riverine studies in US Virgin Islands. Many of the riverine flood hazards are currently shown on the FIRM as approximate floodplains, which do not provide enough detail to properly mitigate risk and provide sound floodplain management. To better manage development in these areas, US Virgin Islands requests that all the riverine flood hazards be studied in detail".*

Evaluation / Assessment

Metadata accompanying the USVI DFIRM database indicates that: *"The published effective FIRM and DFIRM maps are issued as the official designation of the SFHAs. As such they are adopted by local communities and form the basis for administration of the NFIP. For these purposes they are authoritative..."* (FEMA MSC, 2007). The data for the development of these maps is consistent with the "Guidelines and Specifications for Flood Hazard Mapping Partners" (FEMA, 2003). The DFIRMS are used as reference and to obtain more detailed information in areas where Base Flood Elevations (BFEs) and/or floodways have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the FIS report (FEMA,2007).

The DFIRM data has been provided to the US Virgin Islands in both hardcopy and as a GIS-enabled product, which is consistent with FEMA's goals of distributing DFIRMs as GIS data online for the population of US Virgin Islands.

Flood Hazard Mitigation Plan

In July 2000, the US Virgin Islands Territorial Emergency Management Agency (VITEMA) completed the *US Virgin Islands Flood Hazard Mitigation Plan,* which was subsequently adopted in

2003. This plan was developed to preserve the eligibility of the US Virgin Islands for project grants from FEMA's Flood Mitigation Assistance (FMA) Program.

The plan is based on goals and objectives that were detailed earlier in Section 3.2. The plan also outlines an extensive series of recommended mitigation measures, some of which have been implemented. These include:

- Traditional property protection (e.g., elevation of flood prone structures, flood proofing, etc.);
- structural mitigation measures (e.g., retention basins, levees or flood walls, etc.) for specific areas of concern; and
- Recommendations to improve emergency response and recovery actions (see more detailed discussion of this part of the plan under Section 2.3.2 – Post-Disaster Hazard Mitigation).

The *US Virgin Islands Flood Hazard Mitigation Plan* also recommended the updating US Virgin Islands FIRMs. This action has finally been implemented and the results are highlighted in the subsection above.

<u>Evaluation / Assessment</u>

The *US Virgin Islands Flood Hazard Mitigation Plan* (2000) plan has not been updated; in fact, there is no need to update this Plan, given FEMA's Unified Guidance for the Hazard Mitigation Assistance programs, final version dated February 14, 2014. By bringing all of the major hazard mitigation grant programs (HMGP, PDM, and FMA) under one combined and simplified grant process, there is no need for a separate Flood Hazard Mitigation Plan. In essence, this update of USVI Territorial Hazard Mitigation Plan, and all future updates, integrates flood hazard mitigation as one important component of an all-hazard perspective. The 2000 FMA plan included recommendations in two important areas.

- Regulation and Permitting - recognizing that existing rules and regulations governing flood hazard mitigation are of little value without adequate enforcement, the plan identified six different recommendations under this heading including:

    1. Adequately staff, train and equip regulatory agencies charged with issuing permits;
    2. Provide training and education for government officials, developers and residents;
    3. Add flood hazard mitigation criteria to Coastal Zone Management (CZM) permitting (see discussion below regarding the CZM Program);
    4. Designate the SFHAs as an Area of Particular Concern (see CZM);
    5. Strengthen implementation and enforcement aspects of zoning and subdivision regulations (see discussion below under Land Development Regulations); and
    6. Ensure strict enforcement of the US Virgin Islands Building Code (see Land Development Regulations).

- Watershed Management Approach – recognizing that "*the success of the Flood Hazard Mitigation Plan relies on its implementation*" and building on an established principal strategy for controlling pollutant discharges in the US Virgin Islands under the §6217 Coastal Non-Point Pollution Control Program (see discussion below under Section 2.3.3 – Other Related Programs), the plan highlighted the benefits of implementation based on hydrologic units (watersheds or drainage basins). This approach would also be consistent with related efforts under the Unified Watershed Assessment and Restoration Priorities Program (see Section 2.3.3) and could increase the effectiveness and efficiency of all three programs.

The recommendations highlighted above are reflected in the programmatic actions of this Plan Update (see Section 5.3.2). Specific flood mitigation actions such as structural mitigation measures (e.g., retention basins, levees or flood walls, etc.) for specific areas of concerns are highlighted in Sections 5.3.3; 5.3.4 and 5.3.5. Also addressed are several proposed actions to develop hydrological and hydraulic analyses and watershed-based studies to address repetitive losses.

Flood Damage Prevention

The Territory adopted NFIP-compliant floodplain management provisions under Rules and Regulations on Flood Damage Prevention, Title 3. Executive Chapter 22, Department of Planning and Natural Resources, Subchapter 401(b)(15), VIRR on July 8, 1993. The Rules and Regulations apply only to the areas defined on the most recent FIRMs as the Special Flood Hazard Areas (SFHA). In these areas, a permit is required for any type of development procedure or change to the floodplain including excavation, dredging, filling, drilling, modification to existing structures and construction of new structures. The Rules and Regulations reference the appropriate provisions of Section 44 of the Code of Federal Regulations (44 CFR) as General Standards, but add a number of general and specific standards.

The Commissioner of DPNR is appointed to administer and implement the provisions of these regulations, and may request the assistance of other departments and agencies to provide technical assistance. Administration of the rules and regulations includes a number of responsibilities, which can be grouped according to the following categories:

- Permit application and plan reviews – to determine whether development can occur in proposed locations and if so, if the proposed development complies with the regulations and any established criteria,
- Field verifications and determinations – for flood elevations and to resolve ambiguities or disagreements regarding the locations of flood zone boundaries or determination of BFEs, and
- Monitoring compliance with approved permits and plans.

<u>Evaluation / Assessment</u>

Aspects of these standards that should be considered for revision or refinement in the context of this Plan are as follows:

- The basis for determining whether or not the Rules and Regulations are applicable to any particular permit application is based on information in the FIRMs, i.e., "*is the proposed activity in or out of the SFHA?*" It has been noted above that the FIRMs have been updated. The intention of the update is to provide the Territory with "more useful resource for planning and site specific decision making";
- Residential and non-residential construction in the SFHA must be built so that the lowest floor (including basement) is set at the base flood elevation [401(b)(15)(b)(1-2)]. Requiring additional freeboard (as little as one (1) foot above the base flood elevation) would significantly reduce the potential for damages from common storms without significantly increasing construction costs.
- In Coastal High Hazard SFHAs (i.e., V-zones), buildings must be constructed such that the lowest supporting horizontal members are located at the BFE [401(b)(15)(b)(5)(B)]. As noted in the preceding item, reductions in losses can be realized by increasing the "freeboard" requirements of this part of the Rules and Regulations.
- Demonstrations that flood elevations will not be increased by fill within the SFHA or encroachments on streams or guts without established base flood elevations or floodways are required but no specific procedures or evaluation criteria for these determinations are provided [401(b)(15)(c)].
- Subdivision provisions contain vague language such as "minimize flood damage" and "reduce exposure to flood hazards," but do not require (or even suggest) actual avoidance of construction in these areas other than excluding the floodway from subdivisions. The regulations could require avoidance with a provision where developers can attempt to demonstrate (with appropriate procedures and evaluation criteria) that avoidance is not reasonable or feasible. This would put the "burden" on the developers, not on the DPNR reviewers. Revisions to the subdivision regulations, currently in process, should help to clarify requirements to address storm water runoff and amounts of impervious coverage allowed.
- Subdivision provisions do not require that each lot include an area outside of the SFHA with adequate area to site buildings per zoning designation. As in the previous item, this could be a requirement with a provision for developers to demonstrate (with appropriate procedures and evaluation criteria) that such provisions are not reasonable or feasible.

In addition, relative to the Territorial Hazard Mitigation Plan, one of the key responsibilities of DPNR is to review and evaluate development permit applications, including making a determination as to whether or not development will take place in a flood prone area. Procedures for preparing permit applications for development in the floodplain are well defined in the regulations. In fact, most of the document is concerned with how to make development that is "destined" to occur in the flood hazard areas as flood proof or resistant as possible. Unfortunately, for the most part, the Flood Damage Prevention Rules and Regulations do not provide a strong basis for excluding development from high risk areas within the floodplain altogether.

3.2.4.1.2 Coastal Zone Management

The Federal Coastal Zone Management Act of 1972 included requirements for the States and Territories of the United States to develop a coastal zone management program. The US Virgin Islands Coastal Zone Management Act of 1978 became effective in 1979. The resulting US Virgin Islands Coastal Zone Management Program was prepared by the US Virgin Islands Planning Office (which has since been reorganized as DPNR) and submitted by the Governor to the US Department of Commerce.

The Program, as articulated in Title 12 VIRR, Chapter 21, §901-14, is based on a fundamental desire to preserve a significant environmental resource that benefits the economy and quality of life for the Territory's residents. Included with the Program's "findings and goals" (§903) are statements that directly relate to hazard mitigation including:

- "*there has been uncontrolled and uncoordinated development of the shorelines*…" [Title 12 VIRR, Chapter 21, §903 (a)(6)]; and
- "*improper development of the coastal zone and its resources has resulted in … erosion, sediment deposition, increased flooding, gut and drainage fillings*…" [Title 12 VIRR, Chapter 21, §903 (a)(6)]

In addition, §906 identifies a wide range of policies "applicable to the first tier of the coastal zone" that specifically reference hazard mitigation issues including development policy:

- "*to the extent feasible, discourage further growth and development in flood-prone areas and assure that development in these areas is so designed as to minimize risks to life and property*;" [Title 12 VIRR, Chapter 21 §906 (a)(9)],

and environmental policy:

- "*to … assure that activities in or adjacent to [complexes of marine resource systems … including reefs, marine meadows, salt ponds, mangroves and other natural systems] are designed and carried out so as to minimize adverse effects on … storm buffering capabilities*," [Title 12 VIRR, Chapter 21, §906 (b)(2)].

DPNR is the central territorial agency for administration of the Coastal Zone Management program in the US Virgin Islands. Other principal entities include the Office of the Governor, Legislature, the Department of Public Works and the Board of Land Use Appeals. The Coastal Zone Management Act created a Coastal Zone Management Commission within DPNR. A Division of Coastal Zone Management was also created within DPNR to assist the Commission and the Commissioner in administration and enforcement of the Act. There are three committees within the Commission, one for each major island. Each committee has authority over the administration of the Program within its "jurisdiction" including:

- issuance of Coastal Zone Management (CZM) permits;
- compliance with requirements related to Areas of Particular Concern (APC); and
- compliance with requirements related to the Coastal Barrier Resources Act (CBRA).

Coastal Zone Management Permits

The Coastal Land and Water Use Plan was approved and implemented as part of Title 12 VIRR, Chapter 21, §910. The Plan provides comprehensive guidelines for development of Tier 1 of the Coastal Zone.

Tier 1 is defined as the area extending from the outer limit of the territorial sea (including offshore islands) to distances inland as indicated on a set of maps. The Tier 1 area does not necessarily correspond to consistent physiographic characteristics or other regulatory boundaries such as the SFHAs, DPNR regulatory buffers (to wetlands, guts, and salt ponds).Tier 2 includes all other interior portions of the three major islands.

CZM permits are only required for development proposed in Tier 1. The appropriate committee of the Coastal Zone Management Commission or the Commissioner must find that "*the development as finally proposed incorporates to the maximum extent feasible mitigation measures to substantially lessen or eliminate any and all adverse environmental impacts of the development; otherwise the permit application shall be denied*." [Title 12 VIRR, Chapter 21, §910 (a)(2)]. It is also worth noting an important exclusion from the requirements for a CZM permit for existing structures as "*no coastal zone permit shall be required pursuant to this chapter for activities related to the repair or maintenance of an object or facility located in the coastal zone, where such activities shall not result in an addition to, or enlargement, or expansion of such object or facility.*" [Title 12 VIRR, Chapter 21§903 (b)(1)]

In addition, the Coastal Zone Management Act made provisions for two different levels of permits; major and minor, which are administered with slight differences for land and water based projects. Major permits incorporate the requirements of the zoning use permit; the earth change permit, shoreline alteration and submerged lands permit (see discussion of Land Development Requirements below). In addition, Environmental Assessment Reports (EARs) are required for major and minor water projects and for all major land projects in Tier 1. The EARs include requirements for submittal of information regarding:

- Climate and weather conditions including potential impacts resulting from wind, wave and flooding;
- Landforms, geology and soils;
- Drainage, flooding and erosion control;
- Oceanography;
- Marine resources;
- Terrestrial resources;
- Wetlands;
- Rare and endangered species; and
- Air quality.

As detailed in Title 12 VIRR, Chapter 21, §910 (c), major permits are required for all development except:

- "*a development which is to be conducted completely or substantially seaward of the line of mean high tide*" but meeting definitions of permissible activities established by the appropriate committee of the Commission (e.g., navigation buoys, moorings for vessels, etc.);
- construction of one or two single-family residences;

- construction of a duplex;
- improvements to an existing structure below an established cost threshold (currently set at $94,000);
- the development of one or more structures valued in their entirety below a threshold (currently set at $136,000);
- any other development, except the extraction of minerals, valued below a threshold ($120,000); and
- the extraction of minerals valued below the current threshold ($31,000).

In addition, a major permit is not required for subdivisions. For all these activities excluded from the major permit, a minor permit is required but the requirements for submittal and approval are correspondingly weaker. In particular, as noted above, EAR's are not required for minor permits. However, there is a provision in Title 12 VIRR, Chapter 21, §910 (c)(2)(E), that "*if the Commissioner, upon reviewing any minor permit application …, determines that the proposed activity is likely to have significant adverse environmental consequences he shall, upon giving notice to the applicant, forward such application to the appropriate Committee of the Commission for review as a major coastal zone permit*."

Evaluation / Assessment

The CZM permit can be an important part of the process of protecting coastal resources and reducing the impacts of natural hazards on people and property. However, there are inherent weaknesses in the systems that need to be addressed to provide consistent and meaningful hazard mitigation results in the Territory, including:

- The Virgin Island Coastal Zone Management program faces increasing pressure to make decisions regarding competing demands for tourist development, protection of existing threatened properties and the rights of private property owners. The relative small size of the islands, the essential connection between the coastal resources and the watersheds that lie above them and the magnitude of the natural hazards that the islands are subjected to, all make a strong argument that the Coastal Zone and Coastal Zone permits should be extended. At a minimum, all development throughout the Territory should be reviewed at the same level of scrutiny as those permit applications in Tier 1. If the CZM permit system were consistently and aggressively administered, it could provide the appropriate information regarding potential impacts of proposed development on the built and natural elements of the islands and in turn, the impacts of natural hazards on the proposed development.
- In addition, excluding subdivision from review as a major permit activity (in essence, bypassing the requirements for EARs) substantially weakens the system. By not requiring an environmental assessment and an accounting of the impacts of natural hazards on the proposed development, the potential for inappropriate development in the floodplain is greatly increased. By the time permit applications come along for construction of improvements to deeded lots, they only cover pieces of the overall land development project and may not, in and of themselves, be deniable. It is hoped that the revisions to the subdivision and zoning codes that are currently underway may serve to at least

partially remedy this deficiency, though that remains uncertain as of the development of this Plan Update.

- It is important to reiterate that the focus of the EAR's is the impact of the proposed development on the site and adjacent features with only passing emphasis placed on the potential impact of the site and its conditions on the proposed development. To be most effective, the existing EAR requirements need to be revised to include specific references (and threshold criteria of benefits and costs) to assessing vulnerability and estimating potential losses to property from natural hazards as well as the cost of emergency response and recovery operations attributable to the proposed development.

The NOAA *Final 312 Evaluation Findings of the Virgin Islands Coastal Zone Management Program* reiterated concerns about development and earth change in Tier 2 in which erosion and sedimentation is *"one of the major impacts to coastal water quality and to the long term health of the Territory's coral reefs*" (NOAA, 2003). The report goes on to indicate that situation is a very complex issue to resolve, especially on St Thomas and St. John, where a majority of land occur on slopes greater than 25%.

One of the positive aspects of the VICZMP is that a mechanism already exists for initiating the changes to the CZM process. Title 12 VIRR, Chapter 21, §912 (b) identifies a requirement for "continued planning", which states: *"[t]o ensure that the provisions of this Chapter are regularly reviewed and the recommendations for revisions of, or amendments to, the Virgin Islands Coastal Zone Management Program will be … developed, …and to provide for continued territorial coastal planning and management, the Virgin Islands Planning Office [now DPNR] shall undertake on a continuing basis such activity and research as is necessary to maintain a continued involvement in the coastal zone management process…*". This provides DPNR with the ability to make recommendations for amendments that could accommodate the recommended changes in the requirements and process.

It is necessary to note that the VICZMP has initiated changes to rules and regulations in 2006. The 2006 revisions, which are currently under review, do not refine or expand the extent of the coastal zone and/or redefine permit review or CZM commission procedures. The 2006 revisions to the rules and regulations introduce changes to administrative processes and introduce new permit fees.

Areas of Particular Concern

The Coastal Zone Management Act defined Areas of Particular Concern (APC) and established criteria for selection in 15 CFR Part 923. The process should include the development of a management plan for each designated area. In part, the management plans are intended to make provisions for acceptable levels of future land development that in turn can be used to revise the zoning designations in these areas. As a result, a formidable tool is available through the APC management plans to set direction for development in these areas in advance of permit applications – i.e., taking a proactive versus reactive approach to land use and hazard mitigation. To date, eighteen areas have been designated as APCs in the US Virgin Islands. At this time of this Plan Update, draft management plans have been developed for three areas.

Evaluation / Assessment

While there is legislation in place for review of development activities in the APCs, the process will still depend on having approved management plans in place. Only a few management plans, such as the *St. Croix East End Marine Park Management Plan* (approved in 2002), have been implemented. In recent years, efforts to develop new APC plans have faded away from being a priority at DPNR agenda. The NOAA *Final 312 Evaluation Findings of the Virgin Islands Coastal Zone Management Program* have found many problems in the existing APC program and indicated that many of the APC "goals are so broad that a focusing and prioritization of goals and objectives may be necessary for the Territory to move forward with meaningful implementation". It also cited that the implementation of many of the goals rely on various territorial agencies and called for the development of a clear strategy that prioritizes APC plan development and seeks to identify partners within Territorial agencies for the implementation.

Coastal Barrier Resource System

The Coastal Barrier Resources Act (16 U.S.C. 3509) (CBRA) was enacted in 1982 and established the Coastal Barrier Resources System (CBRS). The Act states that in the resulting designated areas along the Atlantic and Gulf of Mexico coastlines, *"most federal expenditures are no longer available to promote economic growth or development".* 35 different coastal areas in the US Virgin Islands, covering a total of 130 miles of the coastline and hundreds of acres of sensitive landscapes, are included in the designations.

Protection of significant areas of the coastal system have been realized although development activity in some of the watersheds have contributed to (and will continue to do so if unchecked) degradation of the resources.

Evaluation / Assessment

Protection only extends to the actual coastal barrier resource in question and not to the watershed that can adversely affect the resource. This could be addressed through more aggressive implementation of a watershed approach to land use planning, and both the quality and quantity aspects of storm water and floodplain management.

3.2.4.1.3 Land Development Regulations

Land development regulations play an essential role in an integrated coordinated program of hazard mitigation. By controlling where and how development occurs, major problems can be lessened or avoided. Also, as properties are redeveloped or rebuilt, strong regulations can ensure that the replacement or repaired structures are better able to resist damage from future events.

In the US Virgin Islands, there are three main elements to the land development regulations including:

- Zoning;
- Subdivision Regulations;
- Building Codes; and

- Building Permits.

Zoning

US Virgin Islands zoning law is based on VIC Title 29, Chapter 3, Subchapter 1. The code divides all the islands into various land and water based districts as tabulated below:

TABLE 3.1 ***Zoning Designations***

Zoning Category	Percent of Total Area
St Croix	
Low Density Residential	54
Agricultural	25
Medium Density Residential	7
Industrial	5
Waterfront - Pleasure	2
Business / Commercial	1
Public and Other	6
St. John	
Low Density Residential	42
Medium Density Residential	3
Industrial	<1
Waterfront - Pleasure	2.5
Public (National Park) and Other	52
St Thomas	
Low Density Residential	70
Agricultural	<5
Industrial	<5
Waterfront - Pleasure	4
Public and Other	15

Evaluation / Assessment

By prohibiting or regulating development and redevelopment in hazard prone areas, zoning can be an effective means to eliminate or reduce the risk of loss of life and property damage. This is most relevant to hazards that have defined geographic extents such as flooding. Comparing the results of the hazard profiling and risk assessment from this study with the existing zoning map would help identify areas where potential development may be in harm's way. This could lead to revisions in the map that provide a better match between the suitability of the land for development and the type and intensity of use proposed.

Creating and implementing a revised zoning map that includes substantial reductions in development capacities in hazard prone areas will have immediate results in limiting future losses. Zoning can also be used to reduce density in existing developed areas. By down-zoning (i.e., reducing allowable development densities and intensities), non-conforming uses will be established. Like the current system, these uses will persist until such time as the property owners request permits for substantial changes to the property or the property is substantially improved or damaged (i.e., at a level greater than 50 percent of its value). In these cases, provisions can take effect that reduces hazard vulnerability and / or the property cannot be redeveloped.

DPNR is in the process of revising the US Virgin Islands zoning regulations. The current revisions do not change the zoning map or zoning designations, but will serve to bring the zoning code up to current standards and provide more flexibility in development review procedures by reducing the need for extensive use of variances. The revisions should be ready for public and legislative review and comment by early summer 2014, and is intended to create a more streamlined, enforceable zoning process. It is DPNR's intent, based on the recommendations of the Rutgers and Duncan Associates study (discussed earlier in this section), to draft and adopt new land use and zoning legislation that defines a set of prescriptive rules and regulations to support the existing land uses and to promote the desired future development patterns in order to maintain the health, safety and welfare of the community over time.

Subdivision Regulations

The main issues related to the subdivision regulations in the US Virgin Islands (as contained in Title 29, Chapter 3, Subchapter 231 of the VIC) are as follows:

- Minor division of land (i.e., development proposals with less than 4 lots) is not considered a subdivision under the US Virgin Island Code and is reviewed by the Chief Surveyor, working under the Lt. Governor's Office. While there are some requirements addressing flood prevention, there are no clearly enforceable complimentary storm water management provisions for these minor subdivisions. However, in the aggregate, all development on a relatively small and closed system like the US Virgin Islands will have some level of impact on storm water runoff and, therefore can detrimentally influence the effectiveness of programs intended to reduce non-point source pollution, protect coastal resources, and mitigate flooding.

- Subdivisions with 4 lots and greater are reviewed by a representative of the DPNR, Division of Comprehensive and Coastal Zone Planning (CCZP). However, for subdivisions in Tier 1, the applicant only needs to address the requirements for a minor CZM permit. The problems with this approach have been discussed previously under the CZM Program section. With no set review criteria, no substantial storm water management regulations, and no formal process for bringing in environmental expertise from other relevant DPNR divisions, it is difficult to influence the way development is planned and implemented in the US Virgin Islands to reduce exposure and risk.
- Basic engineering practices related to land development need to be better incorporated into the subdivision regulations. For example, under the current regulations, it is possible to build roads in the Special Flood Hazard Area with elevations up to two (2') feet below the regulatory flood elevation. In practice, what this can and does result in is the road becomes a conveyance for storm water, promoting unsafe conditions and promoting damage to the roadway that must be repaired by the Territory after major storm events.
- DPNR can take greater advantage of innovative subdivision design and siting techniques than currently allowed under the existing subdivision regulations or proposed revisions by requiring or providing better incentives for cluster development, open space preservation, density-bonuses, setbacks, overlay zoning techniques (described earlier), and special considerations for developments in coastal high hazard areas (for more information on these innovative techniques the interested reader is referred to the FEMA/APA Planning Advisory Service Report # 473 entitled, Subdivision Design in Flood Hazard Areas, 1997).

It is necessary to note that DPNR and the Division of Environmental Protection has implemented a regulation requiring all applicants submitting documents and plans for construction or earth change permits, for developments one acre or greater, to submit a storm water prevention plan. The storm water prevention plan must take into account pre-existing hydrology as well as postulate on post construction run-off. The storm water prevention plan must also clearly indicate how mitigation measures will be introduced in the site design. This action has potential to be an effective strategy to ensure that surface run-off does not exceed pre-existing conditions and may assure that future development does not exacerbate flooding in downstream areas.

At the time of this Plan Update, the subdivision regulations were in the same revision process as the zoning codes. These revisions should also be completed by mid-2014, and are also expected to produce subdivision regulations that are easier to understand, interpret and enforce, that incorporate new technology and new ways of thinking about subdivision zoning, and that create a path for the development of a comprehensive land use plan, which does not currently exist in the US Virgin Islands.

Building Codes

An effectively administered and enforced building code can literally save lives. For current use the US Virgin Islands has adopted and enacted the International Construction Standards. These include:

- International Building Code (IBC) - Pertains to the construction of commercial and multi dwelling buildings.
- International Residential Code (IRC) – Regulates the construction of single and two family dwellings.
- International Mechanical Code (IMC) – Establishes standards for electrical, plumbing and air quality systems.
- International Energy Conservation Code (IECC) – Pertains to the standards for energy efficient structure construction

These codes established by the International Code Council contain specific references to hazard mitigation. A consistent enforcement of these construction codes should result in a significant reduction of property loss especially from the hazards of windstorm, earthquake and fire.

Evaluation / Assessment

The implementation of the IBC, while a good step for the Territory, has met mixed results. In the evaluation for the Plan Update, DPNR has indicated that the local developers and architects have adopted and followed the IBC guidelines fairly well. The implementation of the IBC has fallen short; however, due to staff limitations and lack of resources. This area needing improvement is discussed further in the following sub-section.

Building Permits

A measure of the enforcement of building codes is the number and type of building permits issued. The following tables illustrate the number and type of building permits issued and inspections performed throughout the USVI from FY2008 – FY2010, as well as the estimated value of new construction resulting from these permits and inspections.

TABLE 3.2 ***Building Permit, Inspection and New Construction Data - FY2008***

Permit Applications	St. Thomas Received	St. John Received	St. Croix Received	Total Received	STT/STJ Approved	STX Approved	Total Approved
Flood Plain	1	0	35	36	1	40	41
Plan Review	299	105	528	932	262	315	577
Demolition	8	1	22	31	5	23	28
Building	475	84	410	969	226	312	538
Plumbing	211	63	300	574	206	285	491
Electrical	422	68	487	977	422	445	867
Use and Occupancy	156	69	252	477	263	237	500
Sign	2	0	0	2	1	0	1

Site Inspections	St. Thomas Requested	St. John Requested	St. Croix Requested	Total Requested	STT/STJ Approved	STX Approved	Total Approved
Flood Plain	1	0	26	27	1	14	15
Plan Review	106	41	55	202	108	59	167
Building	1035	558	1105	2698	1496	1089	2585
Plumbing	339	237	712	1288	519	749	1268
Electrical	615	243	830	1688	858	1125	1983
Violation	84	2	46	132	82	46	128
Site Visit	1003	84	73	1160	1182	113	1295

Estimated Construction Cost	St. Thomas	St. John	St. Croix	Total
New Construction	$137,567,534	$18,460,796	$92,301,398	$248,329,728

TABLE 3.3 ***Building Permit, Inspection and New Construction Data – FY2009***

Permit Applications	St. Thomas Received	St. Thomas Approved	St. Thomas Issued	St. John Received	St. John Approved	St. John Issued	St. Croix Received	St. Croix Approved	St. Croix Issued
Flood Plain	0	0	0	0	0	0	27	33	26
Plan Review	158	118	91	55	40	38	509	432	388
Demolition	11	6	5	0	0	0	29	28	24
Building	418	256	180	75	22	18	485	457	391
Plumbing	215	167	220	50	29	20	335	225	221
Electrical	401	317	171	56	43	29	409	424	411
Use and Occupancy	153	147	135	46	39	39	247	210	188
Restoration (Hurricane)	0	0	0	0	0	0	10	10	0
Total	1356	1011	802	282	173	144	2041	1809	1649

Inspections	St. Thomas		St. John		St. Croix	
	Received	Performed	Received	Performed	Received	Performed
Flood Plain	0	0	0	0	3	0
Plan Review	119	131	45	32	39	39
Building	842	1112	445	419	1099	782
Plumbing	313	280	220	229	676	695
Electrical	545	746	316	299	970	1411
Violation	153	172	8	7	22	80
Site Visit	1213	1507	31	40	44	44
Restoration	0	0	0	0	21	20
Total	3185	3948	1065	1026	2874	3071

Estimated Construction Cost	St. Thomas	St. John	St. Croix	Total
New Construction	$63,989,406	$6,358,632	$124,472,981	$194,821,018

TABLE 3.4 *Building Permit, Inspection and New Construction Data – FY2010*

Permit Applications	St. Thomas Received	St. Thomas Approved	St. Thomas Issued	St. John Received	St. John Approved	St. John Issued	St. Croix Received	St. Croix Approved	St. Croix Issued
Flood Plain	0	0	0	0	0	0	11	16	15
Demolition	14	5	4	3	3	3	35	39	33
Building	355	251	213	54	44	30	469	432	418
Plumbing	152	158	93	23	22	12	262	256	240
Electrical	315	275	181	54	46	31	490	449	437
Use and Occupancy	148	151	142	30	34	32	273	262	226
Total	984	840	633	164	149	108	1540	1454	1369

Inspections	St. Thomas		St. John		St. Croix	
	Received	Performed	Received	Performed	Received	Performed
Flood Plain	0	0	0	0	0	0
Building	807	883	633	587	1175	996
Plumbing	307	315	192	181	667	632
Electrical	601	599	202	202	987	1204
Violation	77	77	16	16	20	19
Site Visit	693	693	55	55	39	39
Total	2485	2567	1098	1041	2888	2890

Estimated Construction Cost	St. Thomas	St. John	St. Croix	Total
New Construction	$63,328,779	$8,426,109	$92,917,843	$164,672,730

Evaluation / Assessment

As evidenced in the tables above, the total value of new construction in the USVI declined significantly from FY 2008 through FY 2010. Approved building permits also declined significantly during this three year period; dropping by 120 from 538 approved permits for FY 2009 (22% decline). Although similar data is not readily available for the past three years, it is assumed that a similar pattern of decline occurred due to recent economic conditions on the islands.

DPNR lacks the appropriate staff and resources to resolve technical challenges, particularly in areas of development plan review and enforcement. Adequate staffing is a serious impediment to the effective implementation of the program. In addition, the department could benefit greatly from an investment in GIS technology and staffing, dedicated to facilitating the permitting and review process. Such an investment could also serve to monitor hazard mitigation concerns related to permitting, including permit location within the SFHA and identification of steep grade or seismic concerns.

3.2.4.2 Post-Disaster Hazard Mitigation

Programs, rules and regulations that are focused primarily or substantially on post-disaster hazard mitigation in the US Virgin Islands include:

Emergency Management Council

The Emergency Management Council was established by Executive Order Number 304-1987 under the US Virgin Islands Code (Title 23, Chapter 12, Section 1126a). The order established the Council which sets the basic framework for the Territory's participation in the Federal Disaster Assistance Program.

Flood Hazard Mitigation Plan

The Flood Hazard Mitigation Plan (completed in 2000 and adopted in 2003) was discussed previously as part of the pre-disaster hazard mitigation programs in the US Virgin Islands. The Plan also includes a number of recommendations that are intended to improve the post-disaster hazard mitigation related capabilities in the Territory including improved flood forecasting / disaster warning systems, disaster preparedness and post-flood recovery activities.

FEMA Disaster Management Guide

The FEMA Disaster Management Guide for the US Virgin Islands, FEMA Region II CAO (2004) provides the broad comprehensive disaster management guidance that is still pertinent today.

3.2.4.3 Other Related Programs

Programs, rules and regulations that have provisions or aspects that could support hazard mitigation in the US Virgin Islands include:

Unified Watershed Assessment and Restoration Priorities Program

The DPNR, in cooperation with the US Department of Agriculture and its Natural Resources Conservation Service has developed the Unified Watershed Assessment Report pursuant to the Territory's Clean Water Action Plan. An important element of the Action Plan is to undertake a cooperative process for restoring and protecting water quality on a watershed basis. DPNR identified problem watersheds that were not meeting, or were in danger of not meeting, clean water or other natural resource goals. The assessments were prepared using existing information and were a collaborative effort between local government, federal land management agencies, conservation districts and land conservation departments, non-governmental and private organizations and other stakeholders.

The watershed approach and the collaborative model for public and private partnerships would be conducive to much of the work that needs to be done to implement a comprehensive hazard mitigation strategy. However, the implementation of these programs has been stymied by lack of adequate staffing and resources. Enforcement of erosion and sediment control should become priorities for DPNR, particularly as it relates to reducing surface run-off and flood hazard reduction along with water quality protection.

Environmental Programs

In a similar manner, various efforts of the Territory, including:

- Non-Point Pollution Control Program;
- Sediment Reduction Program; and
- Protection of Endangered Species,

All have aspects that can and should be coordinated with an overall effort to promote hazard mitigation. As more and more elements of the Territory's planning efforts become integrated, the result will be increased effectiveness and efficiency of the programs, as well as, increased sustainability for the Territory.

3.2.4.4 Proposed Programs

No major new proposed programs were identified that are currently underway during the development of this Plan Update that has direct relevance to VITEMA hazard mitigation program elements.

3.3 FUNDING

3.3.1 FEDERAL FUNDING

Section 2.4 of this Plan Update identified some of the key programmatic changes to FEMA's hazard mitigation programs over the past three years; this section provides additional details on how these changes would affect future funding of hazard mitigation in the Territory. Clearly, the Territory should take maximum advantage of HMA grant programs in both pre- and post-disaster settings.

For the purposes of the Plan Update, the following description of federal funding sources is limited to programs with direct or indirect relationship to hazard mitigation. Through the Federal Emergency Management Agency (FEMA), the Federal government has several programs to support hazard mitigation. These programs are federally-funded and are administered by the Virgin Islands Territorial Emergency Management Agency (VITEMA).

- <u>FEMA Pre-Disaster Mitigation Program</u>: The Pre-Disaster Mitigation (PDM) program is designed to implement cost-effective hazard mitigation activities that complement a comprehensive mitigation program. These include planning, acquisition, retrofitting, flood control projects, generators, and other projects. All applicants must participate in the National Flood Insurance Program (NFIP) if they have been identified through the NFIP as having a Special Flood Hazard Area. Only governments are eligible. PDM covers up to 75% of costs.
- <u>FEMA Hazard Mitigation Grant Program</u>: Authorized under Section 404 of the Stafford Act, the Hazard Mitigation Grant Program (HMGP) is funded by FEMA and administered by VITEMA, and provides grants to States and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the program is to reduce the loss of life and property due to natural disasters and to enable mitigation

measures to be implemented during the immediate recovery from a disaster. Eligible projects include drainage systems, structure elevation, landscape alteration, floodwalls, road elevation, property acquisition, development of mitigation plans, development of land-use regulations, and more. Governments and selected non-profits are eligible. HMGP covers up to 75% of costs. Note that there are 10 projects that have been funded by this source following DR-1807 and are included in the 2011 Hazard Mitigation Strategy.

- FEMA Flood Mitigation Assistance Program: The Flood Mitigation Assistance (FMA) program's goal is to reduce or eliminate claims under the NFIP. FMA provides funding to assist States and NFIP-participating communities in implementing plans, projects, and programs to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insurable under the NFIP. This includes acquisition, elevation, flood mitigation, and more. FMA covers up to 75% of costs. For those States and Territories with an approved SRL strategy in the SHMP, the Federal cost share may be increased.
- FEMA Public Assistance: The PA Program provides supplemental Federal disaster grant assistance under Section 406 of the Stafford Act for the mitigation of disaster-damaged, publicly owned facilities and the facilities of certain private, non-profit organizations. Eligible projects include: elevation, flood proofing or relocation of damaged elements during the repair process, and more. PA covers up to 75% of costs, though an increased Federal share can be requested.
- FEMA Unmet Needs: FEMA's Unmet Needs program is authorized by Congress for specific major disaster related events where the needs of the citizens are not met through existing services. The Unmet Needs program is implemented only when deemed appropriate by Congress. Project eligibility is also determined by Congress, but will usually conform to the existing criteria under the HMGP unless specifically waived.

As noted in Section 2.4, the Biggert-Waters Flood Insurance Reform Act of 2012 eliminated the Repetitive Flood Claims and Severe Repetitive loss grant programs. To encourage efforts by states and local jurisdictions, FEMA has changed the cost-share requirements to allow more Federal funds for properties with repetitive flood claims and severe loss properties. Implementing flood mitigation measures for severe repetitive loss properties would be funded by FEMA at 100 percent; and, funding for implementation of flood mitigation measures for repetitive loss properties would be funded at 90 percent. Given the stark economic reality in the USVI over the past six years, focusing the mitigation strategy on addressing repetitive losses is the best option for the USVI Territory.

Several other aspects of the HMA Unified Guidance that are relevant to Federal funding of hazard mitigation in the USVI include:

- Advance Assistance: This funding option applies only to HMGP. Up to 25 percent of the HMGP Ceiling with a cap of $10 million can be used to obtain data to prioritize, select, and develop complete HMGP applications. This is not automatic and the Territory would have to request this option by submitting a brief request for Advance Assistance. This option will be very important for the Territory, as there will be limitations on the amount of pre-disaster planning for long-term recovery that the USVI can undertake under the current economic climate.

- Planning Grants: There is no longer the restriction that a planning grant can only be awarded not more than once every 5 years to a State or Territory.
- Five Percent Initiative: Up to 5 percent of the total HMGP funds may be set aside by the Grantee to pay for a range of activities that are difficult to evaluate against traditional cost effectiveness criteria. There would have to be a reasonable expectation that future damages or loss of life would be reduced or prevented should the 5 percent Initiative be undertaken. VITEMA intends to take full advantage of the 5 Percent Initiative because of the problems associated with a sufficient historical database of disaster-related damages needed to conduct benefit/cost analysis.

Part II of the HMA Unified Guidance discusses "frontloading" HMA program requirements by States or Territories. This new guidance encourages Applicants to conduct adequate scoping and project development prior to submitting HMGP, PDM or FMA grant applications. Scoping would involve conceptualizing project alternatives that would also meet the purpose and need of the proposed project. By evaluating technical feasibility, cost effectiveness and environmental or cultural resource considerations early in project formalization, it will facilitate, expedite and lead to more successful implementation of hazard mitigation projects.

3.3.2 GOVERNMENT OF THE VIRGIN ISLANDS FUNDING

Although the US economy has seen slow but sustained growth from 2011 through 2014, the USVI suffered a major economic impact when the HOVENSA LLC petroleum refinery on St. Croix closed in January of 2012. Over 2,000 well-paid, full-time positions were lost; 1,200 refinery positions, more than half of the manufacturing sector, along with 950 full-time jobs associated with subcontractors. For the years when the refinery was in operation, the USVI economy was somewhat immune to the oscillations of the US economy; however with its closure, the USVI will be more subject to the mainland economic cycles. Future economic growth in the USVI is quite uncertain and the financial challenges are expected continue to persist for the next three year phase.

From FY2008 to FY2010, the Government of the Virgin Islands has experienced asymmetrical oscillations in its fiscal sector. In the 2011 State of the Territory Address, the Territorial Governor discussed the 30% decrease in General Funds revenues each year in 2009 and 2010, which was only partially offset by the $288 million in Recovery Act spending that the Territory received during the same time period. During a three-year period from 2008 through 2010, the General Fund experienced a $660 million budget shortfall, which is the equivalent of almost 60% of the government salaries in the Territory during the same time period. Governor deJongh went on to discuss his belief that the Territory is at a "tipping point," and that serious reductions in government spending must occur; he indicated his position that a 30% reduction was the bare bones reduction to begin to address this deficiency.

The precarious financial position portends that, in all likelihood, the US Virgin Islands government would face a difficult challenge in implementing mitigation actions with Territorial cost share requirements of greater than 10 percent (many FEMA grant programs are 75% Federal / 25% State or Local; USACE programs for structural flood control projects are often set at 50% Federal / 50% State or Local).

Under these present and anticipated near term financial conditions for the Government of the Virgin Islands, adequate operating budgets to implement hazard mitigation actions will be severely constrained. In the case of retrofitting critical facilities or undertaking structural mitigation projects, the financial reality over the next three to five years, implies a heavy reliance on Federal funding sources, and pursuing hazard mitigation program opportunities where a lower cost share for the USVI Government are available . However, many of the programmatic mitigation actions (Territory-wide) recommended in the 2011 Plan and again in this Plan Update, can be implemented at low cost to the US Virgin Islands government and could achieve substantial returns in a more sustainable and resilient future for the islands.

Many of the refinements to development regulations and improved administrative procedures proposed can be implemented through existing or augmented annual departmental operating budgets. These revisions and refinements are expected to significantly increase the ability of the Territory to effectively mitigate known hazards.

3.3.3 OTHER FUNDING SOURCES

Given the current and anticipated financial position of the US Virgin Islands, departments charged with implementing "soft or hard" mitigation actions will need to be creative and innovative in seeking adequate funding. Some innovative approaches that have proved fruitful elsewhere include:

- Encouraging the active participation of the private sector, pursuing non-profit funding opportunities (such as private foundations),
- Seeking other Federal grants not related to comprehensive emergency management (CDBG, Economic Development Administration, USDA rural development grants, etc.),
- Strengthening partnerships with UVI, the Chamber of Commerce, voluntary relief and other civic organizations, and
- Continued outreach to construction, tourism and insurance sectors of the economy.

3.4 ANALYSIS AND EVALUATION OF THE EFFECTIVENESS OF MITIGATION PROGRAMS AND ACTIVITIES

Many of the general observations of this Plan Update are consistent with those of the previous plan development. The findings of the capability assessment interviews fall into three broad categories: (1) funding – local fiscal constraints; (2) inadequate staffing; and, (3) need to enhance technical capabilities. The issue of having an adequate annual operating budget to implement specific department mandates, let alone mitigation actions or programs, was raised as a critical concern by many departmental representatives interviewed.

The section below outlines mitigation program or project activities, Virgin Islands Department, Agency and Authority responsibilities for implementation of hazard mitigation and staffing and technical capability concerns.

3.4.1 ADMINISTRATIVE CAPABILITIES TO IMPLEMENT HAZARD MITIGATION

To fully assess the Virgin Islands capabilities to support hazard mitigation, VITEMA completed a history of the last ten years. The data is broken out to document mitigation activity since the 2005 Plan. All Mitigation Activities funded by HMGP, FMA and PDM were reviewed.

3.4.1.1 Pre-Disaster Grant Administration

The process for identify the history of FMA and PDM mitigation projects in the USVI over the past ten years.

TABLE 3.2 ***Flood Mitigation Assistance and Pre-Disaster Mitigation Grant Projects in the US Virgin Islands***

FISCAL YEAR	Grant Number	Grantee/ Sub-Grantee	Project Title	Federal	Non-Federal	Total Project
Flood Mitigation Assistance Program						
FY 2004	FMA-PJ-02-VI-2004 (0)	VITEMA/DOE	**Central High Flood Mitigation Project** The project consist of the construction and installation of new 3'0"x3'0" concrete manholes, cut and remove sections of the existing drain pipes to accommodate for the new inlet manholes.	$115,000.00	$0.00	$115,000.00
FY 2004	FMA-TA-02-VI-2004 (0)	VITEMA	**St. Croix Central High School Flood Mitigation Project** Technical Assistance to manage the FMA to implemented through the VITEMA office to ensure the accuracy of the project	$15,000.00	$0.00	$15,000.00
FY 2005	FMA-PJ-02-VI-2005 (0)	VITEMA/DPW	**St. Andrews Episcopal Church Flood Mitigation Project - St. Thomas, USVI** Minimize repetitive flooding of St. Andrews Episcopal Church and surrounding community. It will increase the intake capacity of the existing box culver adjacent to the church and along Sixth Street near the intersection of F	$115,900.00	$0.00	$115,900.00

FISCAL YEAR	Grant Number	Grantee/ Sub-Grantee	Project Title	Federal	Non-Federal	Total Project
Pre-Disaster Mitigation Program						
FY 2006	PDMC-PJ-02-VI-2006-001 (0)	VITEMA/WAPA	**Christiansted Electrical Distribution System Mitigation Project** Mitigate and restore the electrical distribution system. Bury distribution lines of the feeder (Feeder No. 1) and replace existing pole mounted transformers with pad-mounted transformers.	$2,758,927.51	$920,000.00	$3,678,927.51
FY 2007	PDMC-PL-02-VI-2007-001 (0)	VITEMA/VITEMA	**USVI State Hazard Mitigation Plan Comprehensive Review and Update** VITEMA will be updating its existing multihazard mitigation plan to comply with FEMA's regulation requiring that State Mitigation Plans be updated and submitted to FEMA for approval every 3 years in order to continue eligibility for non-emergency Stafford Act assistance.	$187,500.00	$62,500.00	$250,000.00
FY 2007	PDMC-PJ-02-VI-2007-005	VITEMA/WAPA	**St. Thomas Underground electrical Distribution Mitigate and restore the electrical distribution system. Bury distribution lines of the feeder and replace existing pole mounted transformers with pad-mounted transformers.**	$1,632,469.83	$547,935.98	$2,180,405.81
FY 2007	PDMC-PJ-02-VI-2007-006	VITEMA/WAPA	**Charles Harwood Memorial Hospital Electrical Underground Mitigate and restore the electrical distribution system at hospital by burying distribution lines, etc.**	$407,647.29	$135,882.43	$543,529.72
FY2007	PDMC-PJ-02-VI-2007-007	VITEMA/WAPA	**Christiansted Electrical Distribution System Mitigation Project Phase II Mitigate and restore the electrical distribution system. Bury distribution lines of the feeder and replace existing pole mounted transformers with pad-mounted transformers.**	$2,381,856.59	$793,952.20	$3,175,808.79

3.4.1.2 Post-Disaster Project Administration

The process for identify the history of HMGP mitigation projects in the USVI over the past ten years.

TABLE 3.3 ***Hazard Mitigation Grant Program Projects in the US Virgin Islands***

Disaster Number	Applicant/Project Name	Total Project Cost Estimated	Total Approved Net Eligible Project Cost	Federal Share	Non Federal
1503	**Virgin Islands Department of Education/** Upgrade Existing storm water system to Pearl B. Larsen School in St Croix, VI.	$38,220	$38,220	$37,700	$0.00
1567	**Virgin Islands Department of Education/**Installation of Shutters at the Oliver Benjamin School Shutters in St Thomas. Acquisition and Installation of RE-60 rollup shutters to protect the Benjamin School Cafeteria and Library Storefront.	$113,870	$113,870	$113,870	$0.00
1807	**Department of Property and Procurement/** Hurricane High Impact Windows (STT)	$466,667	$466,667	350,000.25	$116,666.75
1807	**Department of Public works/** Hurricane High Impact Windows (STT)	$146,667	$146,667	$110.000.25	$36,666.75
1807	**Department of Human Services/** Hurricane High Impact Windows (STT)	$192,414	$192,414	$144,310.50	$48,103.50
1807	**Department of Education/** Hurricane High Impact Windows (STT)	$32,467	$32,467	$24,350.35	$8,1116.75
1807	**American Red Cross/** Storm Shutters (STX)	$64,509.33	$64,509.33	$48,382.00	$16,127.33
1807	**Virgin Islands Fire Service (Emilie Henderson)/** Storm Shutters (STX)	$18,467.00	$18,467.00	$13,850.25	$4,616.75
1807	**Virgin Islands Fire Service (Renceliar Gibbs)/** Roll-up Doors (STX)	$22,916.00	$22,916.00	$17,187.00	$5,729.00
1807	**Virgin Islands Port Authority/ Henry E. Rohlsen/** Fabric Shutter System (STX)	$236,044.00	$236,044.00	$177,033.00	$59,011.00
1807	**Department of Health (DeCastro Clinic)/**Storm Shutters (STJ)	$21,305.33	$21,305.33	$15,979.00	$5,326.33
1939	**Water and Power Authority (WAPA)**Wind Retrofitting of the Pad Mounted Transformers on St Croix (Replacing large pole mounted transformers banks with pad mounted transformers at local elementary schools in STX.	**$315,000**	**$315,000**	**$236,250**	**$78,750**
1939	**VI Fire Service** Roll Up Doors at Emile Henderson Fire Station	**$43,509**	**$43,509**	**$32,632**	**$10,877**
1948	**Water and Power Authority (WAPA)**Wind retrofitting of Pad Mounted Transformers	**$307,052**	**$307,052**	**$230,289**	**$76,763**
1949	**Water and Power Authority (WAPA)**Replacement of three phase transclosures with pad mounted transformers, St. Croix	**$499,255**	**$499,255**	**$374,441**	**$124,814**

3.4.2 US VIRGIN ISLANDS DEPARTMENTS, AGENCIES AND AUTHORITIES

As part of a study entitled "*Mitigating the Impact of Natural Hazards in the US Virgin Islands*" (IRF, 1995), the major agencies and utilities of the US Virgin Islands responded to a questionnaire regarding their perceived role in hazard planning and mitigation activities. The following matrix is still valid as the Government portfolio and responsibilities of agencies have not changed since the 2005 Plan.

TABLE 3.4 ***Primary and Secondary Mitigation Responsibilities of Agencies in the US Virgin Islands***

	VITEMA	DPNR	DPW	Fire Service	Police	Tourism	OMB	P&P	Port Authority	WAPA
Planning / Management Issues										
Acquisition		S					S	P		
Location of Public Buildings		S								
Warning Systems	P			P	P					
Flood / Hazard Insurance		P								
Disaster Loans and Grants						S	S			
Education / Public Information	P	S				S		S		
Demarcation of Hazard Areas	S	P		S						
Building / Health Code Revisions			P							
Inspection Programs		P	P	S						
Floodplain Easements		P	P					P		
Floodplain Regulation		P								
Hazard Risk Assessment	S			S				P		
Development Restrictions		P								
Hazard Disclosure Regulation		S		P				S		
Zoning Regulations		P								
Wetland Regulations		P								
Acquisition of Development Rights		P					S	P		
Areas of Particular Concern		P								
Open Space Planning		P								
Relocation			P							
Special Fees and Taxes		S					S	S		
Hazard Monitoring	P	S	P	P				S	P	P

Flood Proofing			P					P		
Preparedness Planning	P	S	P	P		S	S			P
Structural Issues										
Flood Proofing, Gut Maintenance										
Preparedness Planning	P	P								
Stormwater Systems			P							
Modify Structures			P					P		P
Breakwaters, Bulkheads, etc.		S						S	P	
Shore Protection Measures		S						S	S	
On-Site Detention / Dams		S	P					S		
Channel Modifications / Culverts		S	P					S		

Legend

P = Perceived primary responsibility
S = Perceived secondary responsibility

It may not always be clear which agency is responsible for taking the lead role, and which department exists under, or works closely with, which agency. The following shows the relationship between Departments and Agencies:

US Virgin Islands Departments and Agencies

- Virgin Islands Territorial Emergency Management Agency (VITEMA)
- Department of Planning and Natural Resources (DPNR), including the Divisions of Permits (DOP) and Subdivisions; Coastal Zone Management; Environmental Protection; and Fish and Wildlife.
- Department of Agriculture
- Department of Education
- Department of Public Works
- Office of Management and Budget

US Virgin Islands Committees

- Hazard Mitigation Monitoring and Evaluation Committee
- Hazard Mitigation Committees
- Coastal Zone Management Commission Committees
- Non-Point Source Pollution Steering Committee

University of the Virgin Islands (UVI) Departments

- UVI Cooperative Extension Service
- UVI Center for Marine and Environmental Studies
- Virgin Islands Conservation Data Center of the Eastern Caribbean Center of UVI
- Water Resources Research Institute

As a result, it is evident that several departments, agencies and authorities in the US Virgin Islands continue to have existing and potential roles in the implementation of the updated 2014 Virgin Islands Territorial Hazard Mitigation Plan.

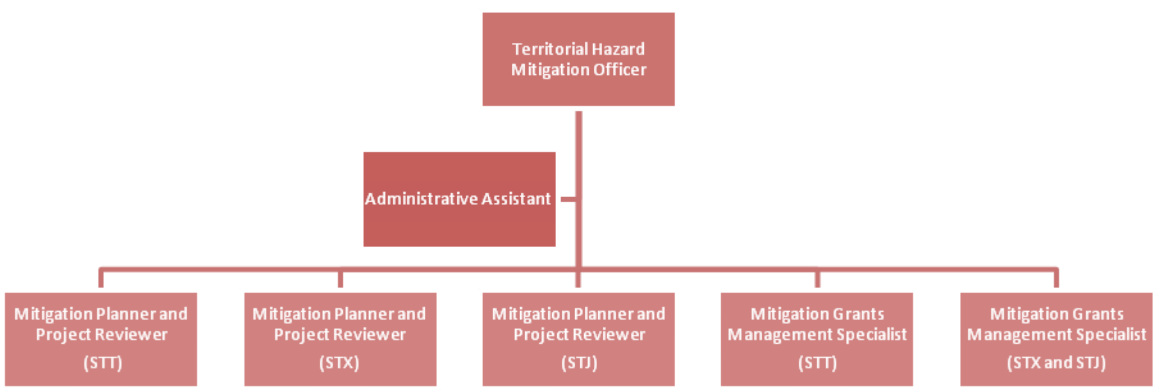
3.4.3 STAFFING

As previously stated, VITEMA, DPNR and DPW are the key governmental agencies that have the primary responsibility for the development and implementation of Hazard Mitigation in the Territory. This is particularly true for Floodplain Management, Environmental Planning and Permitting, Building Code Enforcement, Coastal Zone Management, and Capital Improvement Projects.

While each of these agencies is tasked with the success of territorial hazard mitigation, each agency presently is overwhelmed with the implementation of its core program or department mandates. Faced with the budgetary constraints of the central government and the uncertainty future general revenues, each of these agencies has need for additional staffing to be fully able to address the concerns of Hazard Mitigation. Each agency has numerous unfilled positions making full compliance with the program mandates almost untenable. The lack of essential personnel and insufficient experience exacerbates both compliance and enforcement. The problem is most critical in DPNR, which oversees the divisions of Coastal Zone Management, Permits and Subdivisions, Fish and Wildlife and Environmental Protection.

This situation is likely to persist throughout the life of this revision period. Even though each agency is insufficiently staffed, each agency, as well as the administration of the central government, have the dedication to, and the concern for, the mandates of the Virgin Island Territorial Hazard Mitigation Plan and will actively pursue its implementation.

For VITEMA, consideration should be given to increasing the Mitigation Planning staff structure. The following organizational chart shows, as suggested in the previous Plan Update (2011), to be one possible way staff could be increased and organized to better manage the hazard mitigation planning and project needs of the Territory.



For DPNR, a serious need for qualified GIS staff exists, which will allow for a more thorough and more effective permitting process. Since 2011, all inspectors will be certified by the International

Code Council and will be required to maintain that certification through the completion of CEUs. This is expected to result in a better trained, better qualified workforce. Serious consideration is also being given to increasing the number of Certified Floodplain Managers (CFMs) in the DPNR, as this will also result is better floodplain management throughout the Territory.

3.4.4 TECHNICAL CAPACITY

The evaluation for this Plan Update highlighted the urgent need for data collection and management of hazard information. Currently there are very limited technical capabilities in the Territory.

VITEMA has limited technical data management capabilities. Most critical, is the need for archiving and managing data related to hazards and/or hazard mitigation programs. VITEMA presently does not have a dedicated staff person for the collection and archiving hazard plans or studies (i.e. hurricane plans, earthquake plans, riverine and coastal flood plans). The collection of such information would facilitate a more thorough assessment of the hazards such as the location of events, previous occurrences within the Territory, and facilitate a better prediction of probability of future events. This would also facilitate a more comprehensive assessment of hazards and risk.

The technical capabilities for the implementation of hazard mitigation programs and plans also remain weak. While VITEMA has maintained its capabilities for the implementation of hazard mitigation programs and plans since the 2011 Plan; most of the staff are relatively new and have limited experience in hazard mitigation. For many, the most recent disaster declaration is their first real exposure to hazard mitigation issues, programs and plans. VITEMA staff, therefore, must continue to require extensive training in hazard mitigation concepts (i.e. flood plain management, benefit-cost analysis, etc.) as well as hazard mitigation grant support (i.e. grant writing, project and application development and review, accounting and financial reporting, etc.).

3.5 SUMMARY AND RECOMMENDATIONS

This section points the way to specific recommendations to be included in the mitigation strategy: The first table relates Territorial plans / programs / regulations to the relevant IFR requirements and assesses effectiveness in supporting hazard mitigation. The second table provides a summary of important “gaps” in the Territory’s capabilities and recommendations to address the gaps.

3.5.1 REGULATORY COMPLIANCE WITH DMA 2000

Section 3.1 identified the basic requirements of the IFR for Capability Assessments. Key components of those requirements ask to what extent the Territory’s policies, programs and capabilities support:

- Pre-disaster hazard mitigation;
- Post-disaster hazard mitigation; and
- Regulation of development in hazard-prone areas

The findings of the evaluation for this Plan Update illustrate that the US Virgin Islands' capabilities to address hazard mitigation has not changed since the development of the 2011 Plan. Many of the requisite tools are currently in place or are continuing to evolve. Therefore, the Virgin Islands have not reached its full potential to support hazard mitigation.

TABLE 3.5 ***Regulatory Compliance with DMA 2000***

Description	Pre-Disaster Hazard Mitigation	Post-Disaster Hazard Mitigation	Regulation Development
General Plans and Policies			
Coastal Zone Management Plan	1	1	1
Comprehensive Land Use Planning	1	1	1
Pre-Disaster Hazard Mitigation Plans, Rules and Regulations			
National Floodplain Insurance Program	1	0	1
Multi-Hazard Flood Map Modernization Program	1	0	1
US Virgin Islands Flood Mitigation Plan	1	1	1
Flood Damage Prevention Rules	1	0	1
Coastal Zone Management Permitting	1	0	1
Areas of Particular Concern	1	0	1
Coastal Barrier Protection System	1	1	1
Zoning	1	0	1
Subdivision Regulations	1	0	1
Building Codes	1	1	0
Post-Disaster Hazard Mitigation Plans, Rules and Regulations			
Emergency Management Council	1	2	0
US Virgin Islands Flood Mitigation Plan	1	1	1
Hazard Mitigation Grant Administrative Plan	0	1	0
Emergency Operations Plan	0	1	0
Hurricane Evacuation Plan(s)	1	0	0
Other Related Programs			
Unified Watershed Assessment and Restoration Priorities Program	1	1	1
Non-Point Pollution Control Program	1	1	1
Sediment Reduction Program	1	1	1
Protection of Endangered Species	1	1	1

Legend

0 = No potential relationship
1 = Potential exists to support activity but is not fully realized
2 = Supports activity to full potential of the plan, program or policy

3.5.2 SPECIFIC RECOMMENDATIONS

Table 3.6 was included in the 2011 Plan and has been updated, where appropriate. It summarizes the recommendations (organized according to the major categories) that can help continue the process of making hazard mitigation more integrated into the day-to-day operations and long-range planning efforts of the US Virgin Islands government.

TABLE 3.6 *Recommendations*

Description	Recommendations for Addressing Issues Identified in Capability Assessment	Implemented in Previous Plan Update Cycle
General Plans and Policies, including: ▪ Coastal Zone Management Plan ▪ Completion and adoption of Subdivision and Zoning Code Revisions	✓ Incorporate hazard mitigation directly into existing and proposed general purpose plans in the US Virgin Islands to increase the "profile" of hazard mitigation and ensure incorporation of hazard mitigation in the resulting and related rules and regulations ✓ Institutionalize hazard mitigation into Territorial public investments	✓ Revision of Subdivision and Zoning Code Revisions underway, with help from technical experts
Pre-Disaster Hazard Mitigation Plans, Rules and Regulations, including: ▪ National Floodplain Insurance Program ▪ Flood Damage Prevention Rules ▪ Coastal Zone Management Permitting ▪ Areas of Particular Concern ▪ Coastal Barrier Protection System ▪ Zoning ▪ Subdivision Regulations ▪ Building Codes	✓ Decrease numbers of repetitive loss properties ✓ Continue to increase participation in the NFIP ✓ Avoid development in hazard prone areas ✓ Increase freeboard requirements for development that is approved in flood prone areas ✓ Require buildable areas in lots outside of Special Flood Hazard Areas ✓ Extend CZM permit requirements to all the islands ✓ Require major permit application procedures for subdivision (island wide), i.e., remove Tier 1 and Tier 2 distinctions to the extent possible ✓ If tiered system remains, revise Tier 1 boundaries to included regulated natural features such as floodplains, wetlands, salt ponds, mean high tide, and associated buffers. ✓ Increase hazard assessment aspects of EAR process ✓ Continue APC management planning ✓ Assess development suitability in terms of hazard vulnerability as a first step in revising zoning designations to better reflect risk and exposure ✓ Strengthen planning and enforcement	✓ All building inspectors are now required to be certified by ICC, and are required to maintain that certification

Description	Recommendations for Addressing Issues Identified in Capability Assessment	Implemented in Previous Plan Update Cycle
	capabilities through increased staffing and training ✓ Strengthen data collection and management capabilities, to create database and sources for use in project development and justification	
Post-Disaster Hazard Mitigation Plans, Rules and Regulations, including ▪ Emergency Management Council ▪ Hazard Mitigation Grant Administrative Plan ▪ Emergency Operations Plan ▪ Hurricane Evacuation Plan(s)	✓ Improved management of federal grants ✓ Increase funding for matching federal grants ✓ Integrate hazard mitigation and sustainability considerations into post-disaster recovery process	✓ HMGP sub-grants have been made available in the aftermath of 3 Presidential declarations in 2010
Other Related Programs, including: ▪ Unified Watershed Assessment & Restoration Priorities ▪ Non-Point Pollution Control Program ▪ Sediment Reduction Program ▪ Protection of Endangered Species	✓ Extend watershed approach from related programs to hazard mitigation and development review process.	

The capability assessment evaluated both the "written word" on mitigation (i.e. the adopted or proposed legislation, regulations, plans and policies in the US Virgin Islands) and the administrative capabilities of US Virgin Islands agencies, departments and authorities.

In summary, many of the necessary policies, regulations and programs are already in place. Likewise, the Government of the Virgin Islands can draw upon the existing expertise in a number of key departments charged with implementing many of the mitigations recommended in this Plan.

To provide support for Hazard mitigation planning the US Virgin Islands Government should try to augment existing resources and agency operating budgets to make a significant impact over the next five years in creating a more sustainable future for the Territory.

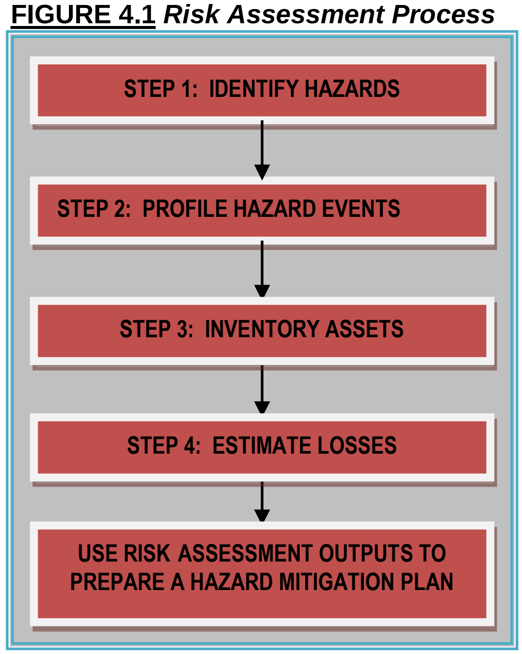
This section is organized around the risk assessment process that includes the following eight subsections:

- 4.1 Introduction and Methodology
- 4.2.IFR Requirements for Risk Assessment
- 4.3 Hazard Identification
- 4.4 Hazard Profile
- 4.5 Inventory of Assets
- 4.6 Vulnerability Assessment
- 4.7 Loss Estimates
- 4.8 Loss Estimation Summary and Hazard Ranking

4.1 INTRODUCTION & METHODOLOGY

The risk assessment methodology utilized in this Plan Update is the same as was utilized in the 2008 Plan. It is consistent with the process and steps presented in FEMA Publication 386-2, “State and Local Mitigation Planning How-To Guide, Understanding Your Risks—Identifying Hazards and Estimating Losses” (FEMA 2001) and utilizes a risk assessment methodology similar to HAZUS-MH. Figure 4.1 shows the four major steps that comprise the risk assessment process: Hazard Identification, Hazard Profiling, Vulnerability Assessment, and Loss Estimation.

FIGURE 4.1 ***Risk Assessment Process***



Step 1 – Hazard Identification

The hazard identification was compiled by investigating the various natural hazard occurrences within the Territory.

Because it is assumed that hazards that occurred in the US Virgin Islands in the past may be experienced in the future, the hazard identification process for this Plan Update included extensive discussions with VITEMA, its Hazard Mitigation Steering Committee, island Hazard Mitigation Committees and the general public.

Discussions with these groups focused on the identification of hazards for this Plan Update. Information of past hazards was obtained from historical hazard assessment documents, and hazard specific plans and reports developed by experts over the past two decades.

Step 2 – Hazard Profiling

This step involved determining the extent where possible (i.e. maps), the frequency or probability of future events, their severity, and factors that may affect their severity. Each hazard type has unique characteristics that can impact the Territory in different ways. At the hazard identification phase, several important natural hazards that could affect the US Virgin Islands were considered. The following natural hazards have been documented for the US Virgin Islands and have been assessed as risks for the purpose of this Plan Update. They are listed in the order that they will be discussed in the Plan Update:

- Drought,
- Earthquake,
- Riverine Flooding,
- Coastal Flooding and Erosion,
- Hurricane Winds,
- Rain-Induced Landslide,
- Tsunami, and
- Wildfire

The results of the hazard identification process and discussions reveal that the hazards listed above warrant a vulnerability assessment. It is important to note, however, that the consultant team formally indicated to VITEMA, that there was a concern about the availability of data concerning the mapping (extent) and historic data required to understand the frequency and vulnerability of several of the identified hazards, specifically rain-induced landslide, drought and wildfire.

It is necessary to note that several of these hazards were identified as concerns during the 2011 plan update and mitigation actions were included in the 2011 Plan and 2014 Plan to collect information concerning the location, frequency and history of these events in the Territory. No data has been collected for use in this Plan Update and that data gap will limit the ability to fully profile these hazards – i.e. catalog of events from which to ascertain their frequency of occurrence and/or estimate the magnitude of historical events, let alone to accurately estimate vulnerability and losses (i.e. future impacts).

It is also necessary to note that each hazard model or map that was developed for the 2011 Plan update, with the exception of the Tsunami hazard. The potential impact of climate variability on natural hazards identified in the plan has been discussed qualitatively in the description of the hazards as well as the deficiencies in addressing the impacts of climate change in a more quantitative manner. As such, actions have been added to the Mitigation Strategy (Section 5) of this Plan Update.

Step 3 – Inventory of Assets
The inventory of assets quantifies what can be lost when a hazard occurs. Specifically, the people, places, and property that could be injured, damaged, or destroyed are quantified. The following data was collected and calculations were made:

- Estimate or count the total number of buildings, value of buildings, and population in the Territory.
- Determine the proportion of buildings, the value of buildings, and the population in located in hazard prone areas, and
- Calculate the proportion of assets located in hazard areas.

In order to understand that vulnerability of people, buildings and infrastructure to natural hazards, a comprehensive inventory of assets was conducted. Inventory data was classified into a number of asset categories, including population, general building stock, and infrastructure.

Population.
2010 U.S. Census information was updated using projected annual population growth rates for the Territory. A series of calculations were performed to identify the number of people less than 18 years of age and the number of people over 65 years of age. These two demographic subgroups help define the territory's social vulnerability as these two population groups are the most likely to need assistance during and/or after a hazard event.

General Building Stock.
The Virgin Islands Tax Assessors Office (Division of the Office of the Lt. Governor) provided the consultant project team an assessment of the Tax Assessment database in 2014 to assist in the classification of the general building stock. The 2014 database was updated to categorize the built environment into two general occupancy categories: commercial and residential. Detailed below are the procedures used to identify the number of buildings and to estimate the exposure values of the general building stock (replacement and content values).

1. Tax lot or parcel information was aggregated for each estate on each island to identify the number of buildings per occupancy class, per estate. Analysis was limited to commercial and residential type buildings. Data limitations within the tax assessment database precluded the consideration of other occupancy classes, i.e., industrial, government, agricultural, and religious institutions.

2. A matrix was developed to relate the number of building and occupancy classes to specific building types, showing the distribution of model building types throughout each island. Distribution information was compiled to determine the number of building types per specific occupancy class. Collected data was aggregated at the estate level for each island.

3. An average replacement cost was developed for each building type. Replacement costs were based on average construction costs per square foot, reflecting labor and material costs for each island. For each occupancy class, content values were determined as a percent of the replacement

costs (i.e. multiply building replacement costs by content cost percentage to calculate content value).

4. This analysis facilitated a determination of the number of buildings per occupancy class and an aggregate estimate per estate of exposure costs (i.e. replacement value added content value). To enable an island by island comparison, the number of buildings and aggregate replacement and content values of each island were delineated to identify total exposure values for general building stock.

The data utilized in this Plan Update was aggregated from values in the Tax Assessor building stock data and contains estimates of residential and commercial values based on price indexes for housing and construction costs. Annual data sets were derived from publicly available data from the Bureau of Economic Analysis (BEA). The value of structures identified as residential and commercial purposes in this Plan Update are considered to be of "fair market value" for the US Virgin Islands.

Critical Facilities and Infrastructure.
A detailed list of critical facilities and infrastructure was developed by VITEMA with the input from the Hazard Mitigation Steering Committee. The list was based on critical facilities included in the 2011 Plan, the Critical Facility Infrastructure Plan and from information collected from Department of Property and Procurement. Detailed procedures used to update exposure values of critical facilities (replacement and content values) are provided below:

1. VITEMA provided the consultant team with a current listing of critical facilities and infrastructure. It was revealed that the listing was the same as was utilized in the 2011 Plan Update. Therefore, there were not any new critical facilities added to the listing nor were there any site visits undertaken in the 2014 Plan Update. Site visits were not necessary as the general structural characteristics and general conditions of each critical facility identified by VITEMA did not change significantly since the last Plan Update.

2. Facilities/structures were categorized by structural characteristics relevant to the prominent hazards addressed in the vulnerability assessment. The approximate square footage for each facility/structure or group of buildings.

3. Replacement and content values for facilities for the 2011 Plan were provided by the VI Department of Property and Procurement. An evaluation of this data revealed that approximate building areas and construction costs (i.e. exposure) were overstated. Therefore, this Update Plan relied on construction price indices and inflation factors derived from the U.S. Department of Commerce, Bureau of Economic Analysis to update replacement estimates for critical facility classes for this plan update.

The final step of the inventory process is a **vulnerability assessment**, which facilitates an understanding of the proportion of buildings, the value of buildings, and the population that is located in hazard areas. The results of the hazard identification and profile were used to understand characteristics of hazards (i.e. wind speed, flood depth, etc.) in order to assess the vulnerability parameters (specific damage and loss characteristics) of each asset identified. For instance, a wood frame building will have different damage and loss characteristics for a hurricane than a reinforced concrete structure. A hazard vulnerability assessment level (very low, low, medium, high, and very high) was assigned to each building type or facility to express the vulnerability for the general building stock (model building types) and critical facilities and infrastructure in qualitative terms. It is necessary to note that vulnerability estimates were not conducted for all hazards, especially drought, rain-induced landslides and wildfires. Instead, hazard overlays were performed to identify the number of buildings in hazard susceptibility zones identified on newly created maps for these hazards.

Step 4—Loss Estimation

Based on the vulnerability assessment for the general building stock, damage functions were developed to translate the hazard intensity data (given in terms of wind speed, ground shaking, depth of flooding, etc.) into its respective economic loss potential. In its simplest form, a damage function estimates the potential economic damage (e.g., cost to repair/replace the damaged components) of a building or group of buildings to a specified level of hazard intensity. For this study, damage functions were developed based on standard damage ratios obtained from HAZUS^{MH} for hurricane wind, earthquake and flooding, various published reports, expert opinion and other propriety information. Data limitations did not allow for the development of damage functions or the newly identified hazards: drought, rain-induced landslide and wildfire. The vulnerability assessment only provides a rough estimate of the built environment that is exposed to these hazards and does not allow for a characterization of how a structure or group of structures would perform at a certain level of hazard intensity.

Below are procedures for a prototypical estate in the US Virgin Islands:

1. Hazard maps (location) and hazard profile information (intensity) were used to identify the natural hazard affecting a particular area. Based on the intersection of hazard areas, each estate was assigned a particular hazard intensity level (i.e. hurricane wind speed).

2. Exposure to a specific hazard (i.e. number of buildings, % percentage of total buildings, and value) was determined for identified buildings (general building stock and critical facilities).

3. A qualitative vulnerability level was assigned to each model building type to understand the vulnerability of buildings. This is expressed as a percentage of damage based on a specific hazard level.

4. Qualitative vulnerability levels were related to specific loss estimation tables to determine a specific percentage of damage to a structure (i.e. replacement and content value).

5. To calculate losses, the expected percentage of damage was multiplied by the structure replacement cost and content value.

The loss estimation process provides the US Virgin Islands with a relative ranking of risk to general building stock and critical facilities and infrastructure from various hazards.

Loss estimates associated with drought, wildfire and rain-induced landslides were not analyzed using a risk assessment methodology based on the same principals as described above. Instead, available historical data for each hazard are used and statistical evaluations are performed using manual calculations. The general steps used in this methodology include: compilation of data from national and local sources; verification of data using statistical analysis; determine the frequency of hazard occurrence; and, estimate damages associated with a specific hazard occurrence.

It is important to note that loss estimates in this risk assessment used the best available data and methodologies, but should still be considered approximate. These estimates should be used to understand relative risk from hazards and potential losses and are not intended to be predictive of precise results. Uncertainties are inherent in any loss estimation methodology arising in part from incomplete scientific knowledge concerning natural hazards and their effects on the built environment. Uncertainties also result from approximations and simplifications that are necessary for a comprehensive analysis (e.g., incomplete or outdated inventory, demographic or economic parameter data).

4.2 IFR REQUIREMENTS FOR RISK ASSESSMENT

4.2.1 IFR Requirements for Hazard Identification and Profiles

§201.4(c)(2) of the IFR states that "[the State plan must include a risk assessment] that provides the factual basis for activities proposed in the strategy portion of the mitigation plan. Statewide risk assessments must characterize and analyze natural hazards and risks to provide a statewide overview. This overview will allow the State to compare potential losses throughout the State and to determine their priorities for implementing mitigation measures under the strategy, and to prioritize jurisdictions for receiving technical and financial support in developing more detailed local risk and vulnerability assessments."

The IFR includes two specific requirements for the identification and profiling of natural hazards:

- **Hazard Identification** per **Requirement §201.4(c)(2)(i): "**[The State risk assessment shall include an] overview of the type … of all natural hazards that can affect the State …."
- **Hazard Profiles** per **Requirement §201.4(c)(2)(i)**: "[The State risk assessment shall include an overview of the] location of all natural hazards that can affect the State, including information on previous occurrences of hazard events, as well as the probability of future hazard events, using maps where appropriate …"

4.2.2 IFR Requirements for Vulnerability Assessment and Loss Estimation

The IFR includes two specific requirements regarding vulnerability assessments and loss estimates:

- **Vulnerability Assessment** per **Requirement §201.4(c)(2)(ii): "**[The State risk assessment shall include an] overview and analysis of the State's vulnerability to the hazards described in this paragraph (c)(2), based on estimates provided in local risk assessments as well as the State risk assessment. The State shall describe vulnerability in terms of the jurisdictions most threatened by the identified hazards, and most vulnerable to damage and loss associated with hazard events. State-owned critical or operated facilities located in the identified hazard areas shall also be addressed."

- **Estimated Losses** per **Requirement §201.4(c)(2)(iii): "**[The State risk assessment shall include an] overview and analysis of potential losses to the identified vulnerable structures, based on estimates provided in local risk assessments as well as the State risk assessment. The State shall estimate the potential dollar losses to State owned or operated buildings, infrastructure and critical facilities located in the identified hazard areas."

US Virgin Islands local risk assessments were not available. In order to provide risk comparisons among the islands, the Plan Consultant performed, for each island, local risk assessments that meet the IFR **Requirement §201.6(c)(2)** for local mitigation plans. These local risk assessments, while not required by the State IFR guidelines, provide information valuable to the mitigation process.

4.3 HAZARD IDENTIFICATION

Since the completion of the 2011 Plan there have not been any new Presidential Disaster Declarations in the US Virgin Islands. As a result, the Territory has not suffered significant loss of property from natural hazards. Since 1995, the US Virgin Islands has received eleven presidential disaster declarations. As shown in Table 4.1, the main sources of damages in recent years have been hurricanes and flooding.

Table 4.1 Presidential Disaster Declarations in the US Virgin Islands, 1994 – 2010

Year	Date	Declaration / Disaster Type
2010	11/24	Severe Storms, Flooding, Rockslides, and Mudslides associated with Tropical Storm Tomas
2010	11/05	Severe Storms, Flooding, Mudslides, and Landslides associated with Tropical Storm Otto
2010	09/28	Hurricane Earl
2008	1/29	Hurricane Omar
2004	10/07	Major Disaster / Tropical Storm (Jeanne)
2003	12/09	Major Disaster / Flooding
1999	11/23	Major Disaster / Hurricane (Lenny)
1999	11/18	Emergency / Hurricane (Lenny)
1998	09/24	Major Disaster / Hurricane (Georges)
1996	07/10	Major Disaster / Hurricane (Hortense)
1995	09/16	Major Disaster / Hurricane (Marilyn)

These hazards have challenged the US Virgin Islands to develop ways to reduce future damages. This subsection describes the process used to identify those hazards addressed in detail in the risk assessment of this Plan Update.

The process included reviewing and identifying a list of natural hazards. The review and evaluation of the hazards included those identified in the 2011 Plan Update. There were not any new additions It is important to note that the Tsunami section in this Plan Update was updated due to new hazard mapping data. The list of hazards addressed in this Plan Update include:

- Drought,
- Earthquake,
- Riverine Flooding,
- Coastal Flooding and Erosion,
- Hurricane Winds,
- Rain-Induced Landslide,
- Tsunami, and
- Wildfire

Each hazard was discussed in detail during the Hazard Mitigation Evaluation Committee and island specific Hazard Mitigation Committee meetings, in addition to summarizing the hazards evaluated and risk assessment process to the general public during public informational workshops. Citizens were given a chance to review this listing and express concerns about hazards on their respective islands.

Citizens on St. John expressed concerns about hurricanes, earthquakes and landslides, while residents on St. Thomas and St. Croix spoke about hurricanes, earthquakes and a greater concern about riverine flooding.

Hazard identification was conducted during a series of steering committee meetings and public informational meetings. The result of this community input and pursuant discussions with VITEMA allow for an evaluation of each of the hazards with criteria that was set forth in the 2014 Plan Update. The evaluation criteria included the following five major benchmarks:

- Ability to describe the hazard,
- Ability to describe the nature of the hazard in USVI,
- Ability to identify the location and map the extent of the hazard,
- Ability to document previous occurrences and frequency of the hazard, and
- Ability to quantify losses for the hazard

The participants at all of the public informational meetings contributed through a lively discussion of both the reasons for inclusion and conversely the reasons for exclusion of hazards that should be addressed in this Plan Update. The decision for the inclusion for the following hazards was made by the Hazard Mitigation Steering Committee. This was indicated to the consultant team that all hazards included in the 2011 Plan are still valid and are of concern to VITEMA.

TABLE 4.2 ***Hazard Identification Evaluation Matrix, 1994 – 2010***

Hazard/Criteria[1]	Ability to describe the hazard	Ability to describe the nature of the hazard in USVI	Ability to identify the location and map the extent of the hazard	Ability to document previous occurrences and frequency of the hazard	Ability to quantify losses for the hazard.
Drought	3	3	2	1	1
Earthquake	4	4	4	4	4
Riverine Flooding	4	4	4	4	4
Coastal Flooding and Erosion	4	4	4	4	4
Hurricane Winds	4	4	1	4	4
Rain-induced Landslide	3	3	3	1	2
Tsunami	4	4	4	4	4
Wildfire	2	2	2	1	1

Based on the results, the consensus was to endeavor to undertake an assessment of all of the identified hazards. The Hazard Mitigation Steering Committee and island Hazard Mitigation Committees felt that the several key hazards posed the highest threat to the Territory and demanded attention. These hazards are Hurricane, Earthquake, Flooding and Landslides.

Discussion focused on the fact that there were not sufficient credible and historic data for drought, rain-induced landslides and wildfire hazards to address these hazards in a thorough manner during the last Plan Update. In this regard, the Territory should include specific actions to collect more reliable information for these and other hazards. Actions to collect more reliable information for these and other hazards were included in the 2011 Plan Update. The territory lacks sufficient resource to collect data for specific hazards and such recommendations to collect hazard specific data were removed from this Plan Update.

Nevertheless, VITEMA believes the Territory's position is justified as per key language included in the IFR, specifically the *IFR Requirement §201.4 (c)(2)(ii),* which states: **"***The State shall describe vulnerability in terms of the jurisdictions …* ***most vulnerable*** *to damage and loss associated with hazard events."* By identifying the most prevalent hazards, based on the experience of VITEMA, the Territory in effect is pursuing a meaningful evaluation of the *most vulnerable* areas on the three major Islands[2].

[1] Rating:

1 –low ability
2- moderate ability
3 –high ability
4 –very high ability

[2] *The US Virgin Islands Territorial Hazard Mitigation Plan, consistent with the intent of the Disaster Mitigation Act of 2000 (DMA 2000) is focused on natural hazards. The plan does not include consideration of any manmade hazards beyond the secondary effects of natural disasters on sites and facilities with technological, hazard materials or other manmade considerations.*

4.4 HAZARD PROFILE

4.4.1 HAZARDS AND CLIMATE VARIABILITY

The hazard profiles in this section provide a characterization of each of the hazards, along with a map that delineates the spatial extent of the hazard to identify hazard prone areas within the study area. Each hazard model or map that was developed for the 2011 Plan update has not changed as there was insufficient data to incorporate long-term meteorological data from the selected global climate change models and downscale them for the United States Virgin Islands, specifically for use in the update of hazard maps.

This, however, does not negate the fact that there is a potential impact of climate variability on natural hazards identified in the plan. The impact of climate change has been discussed qualitatively in the description of the hazards in this section of the plan, and deficiencies related to addressing the impacts of climate change in a more quantitative manner have been addressed in the Mitigation Strategy (Section 5) of this Plan Update.

The distinction of natural hazards must be made between those hazards that are potentially affected by climate change and those that are not. In general, all hazards that are of hydro-meteorological origin are potentially affected by climate change, while geo-hazards are generally not influenced by climate variability. The only exception is landslides, which can be caused by intense rainfall events. The figure provides a characterization of hazards identified for this study effort.

Natural hazard			Affected by Climate Change
Geo-hazards		Earthquake	No
Geo-hazards		Tsunami	No
Geo-hazards	Hydro-meteorological hazards	Landslide	Yes
	Hydro-meteorological hazards	Flood	Yes
	Hydro-meteorological hazards	Coastal Flooding	Yes
	Hydro-meteorological hazards	Drought	Yes
	Hydro-meteorological hazards	Hurricane	Yes
	Hydro-meteorological hazards	Wildfire	Yes

Source: Revised from Schmidt-Thomé 2005

It is necessary to note that projections simulated by global climate models are often simulated at space scales too coarse for direct use in impact studies at regional scale or smaller. Several organizations have employed techniques to derive the 21st century temperature and rainfall scenarios for the Caribbean from projections simulated by various global climate models, but there are to-date no models that are specific for use in the US Virgin Islands.

While acknowledging the above data and associated limitations, a set of reference projection ranges are used to allow for an understanding of the potential impacts of climate change in the Territory, which are summarized in the table below:

Hazard	Location	Climate Change Projected Impact	Potential Future Change in Hazard
Earthquake	St. Thomas, St. John, St. Croix	N/A	N/A
Tsunami	St. Thomas, St. John, St. Croix	N/A	N/A
Landslide	St. Thomas, St. John	Expected increase in intense precipitation events.	+
Flood	St. Thomas, St. John, St. Croix	Expected increase in intense precipitation events.	+
Coastal Flooding	St. Thomas, St. John, St. Croix	Projected rise in sea level will augment surge and wave heights to increase projected costal flood depths and extents.	+
Drought	St. Croix	Expected reduction in average rainfall which impact of drought; Average temperature increases reduce the water availability for drought and wildfire hazards.	+
Hurricane	St. Thomas, St. John, St. Croix	Percent increases in wind speed may be applied over the hurricane hazard to derive projected hurricane wind speeds taking into consideration variability	–
Wildfire	St. Croix	Expected reduction in average rainfall which impact of wildfire; Average temperature increases reduce the water availability for drought and wildfire hazards.	+
Legend: + increase in hazard intensity due to climate change; – decrease in hazard intensity due to climate change			

4.4.2 DROUGHT

Hazard Description

Drought is a normal part of virtually all climatic regimes, including areas with high or low average rainfall. Drought is the consequence of a natural reduction in the amount of precipitation expected over an extended period of time, usually a season or more in length.

Droughts can be classified as meteorological, hydrologic, agricultural, and socioeconomic. Table 4.3 below presents definitions for these types of droughts.

TABLE 4.3 *Drought Classification Definitions*

Term	Definition
Meteorological Drought	The degree of dryness or departure of actual precipitation from an expected average or normal amount based on monthly, seasonal, or annual time scales.
Hydrologic Drought	The effects of precipitation shortfalls on stream flow and reservoir, lake, and groundwater levels.
Agricultural Drought	Soil moisture deficiencies relative to water demands of plant life, usually cropland but can also include rangeland.
Socioeconomic Drought	The effect of demand for water exceeding supply as a result of a weather-related supply shortfall.
Source: *Multi-Hazard Identification and Risk Assessment: A Cornerstone of the National Mitigation Strategy*, FEMA	

Nature of the Hazard

In the U.S. Virgin Islands, adequate water supplies are critical for the wellbeing and economic security of the islands. Water resources or access to them are already limited and subject to competing demands (i.e. growing population and a growing tourist industry). The US Virgin Islands has extremely limited surface-water resources and limited ground-water resources, receives only moderate rainfall, much of which is lost to evaporation and surface run-off.

Therefore, droughts can exacerbate the problem of ensuring a sustainable yield of potable water. With no year-round streams and only limited ground water resources, 65% of drinking water supplies are provided by desalination (removing the salt from seawater). Groundwater provides 22% of the drinking water supply and the remaining 13% is from rooftop catchments.

Because the US Virgin Islands never has enough freshwater and a majority of the drinking water supplies are provided by desalination, it is already the most expensive publicly supplied water in the United States.

Any reductions in the amount or type of precipitation will only increase those costs. http://www.usgcrp.gov/usgcrp/nacc/education/islands/islands-edu-3.htm

Droughts also increase the potential for wildfires, adversely affect farming, and can cause strains on already strained water resources throughout the territory.

Hazard Location, Extent and Distribution

Figure 4.2, 4.3, and 4.4 illustrate the geographic coverage of drought on all three islands. The entire Territory is susceptible to the effects of drought. There are, however, some useful distinctions between islands which should be noted:

- **St. Croix** – drought can have an impact in southern coastal areas on St. Croix, where historically large sections of land were allocated to agriculture, primarily dairy and livestock. Impacts included reduced productivity of rangeland and reduced milk production. Small scale agriculture can also be impacted. Production costs can increase owing to the cost of water supply, transport and/or transfer.

- **St. John** – Coral Bay is at risk to drought as precipitation shortfalls can impact small scale agriculture and impact residential developments because of increased costs for water supply, transport and/or transfer.

- **St. Thomas** – In terms of specific locations, the East End of the island is the most susceptible to the impact of droughts. Although, urban areas of Charlotte Amalie are not immune to drought due to increased costs for water supply and transfer.

Disaster History

The recorded history of droughts is very limited for the US Virgin Islands. There are scant references to droughts in historical reports. For instance, in 1733, when the islands were administered by the Danish, the islands were severely affected by drought, suffered an insect plague, and were affected by two hurricanes.

In the 1920's to 30's, St. Croix experienced a period of drought. During this time the U.S. Government assisted with the construction of Creque Dam (1923) to capture rain water. This program was expanded throughout the islands. Several reservoirs and catchment areas were constructed near the towns to collect rain water. Ponds were created for maintenance of livestock. Windmills were converted to cisterns and wells were sunk in former cane fields to fill water troughs.

The first Federal declaration in US Virgin Islands for drought was in June 8, 1964. Although the effects of this event are were not reported, it is listed on FEMA's website as an extreme event.

In recent years, droughts have been more frequent and severe. Minor shortfalls in rainfall have dramatically affected agriculture and have required water rationing. In 2002, the Virgin Islands Daily News reported that

East End of St. Croix was suffering a localized severe drought. According to local farmers this drought compares to the drought of the early 1970s. This event predicated the need for organized feeding programs and consequently had a major impact to cattle farmers. The National Weather Service reported that accumulated rainfall for St. Croix through 2002 was deficient. During the last seven months of that year, approximately 55 percent of normal rainfall was received.

According to the National Climate Data Center, there have been no new drought events reported in the Territory since 2002.

FIGURE 4.2 ***Drought Hazard Map, St. Thomas***

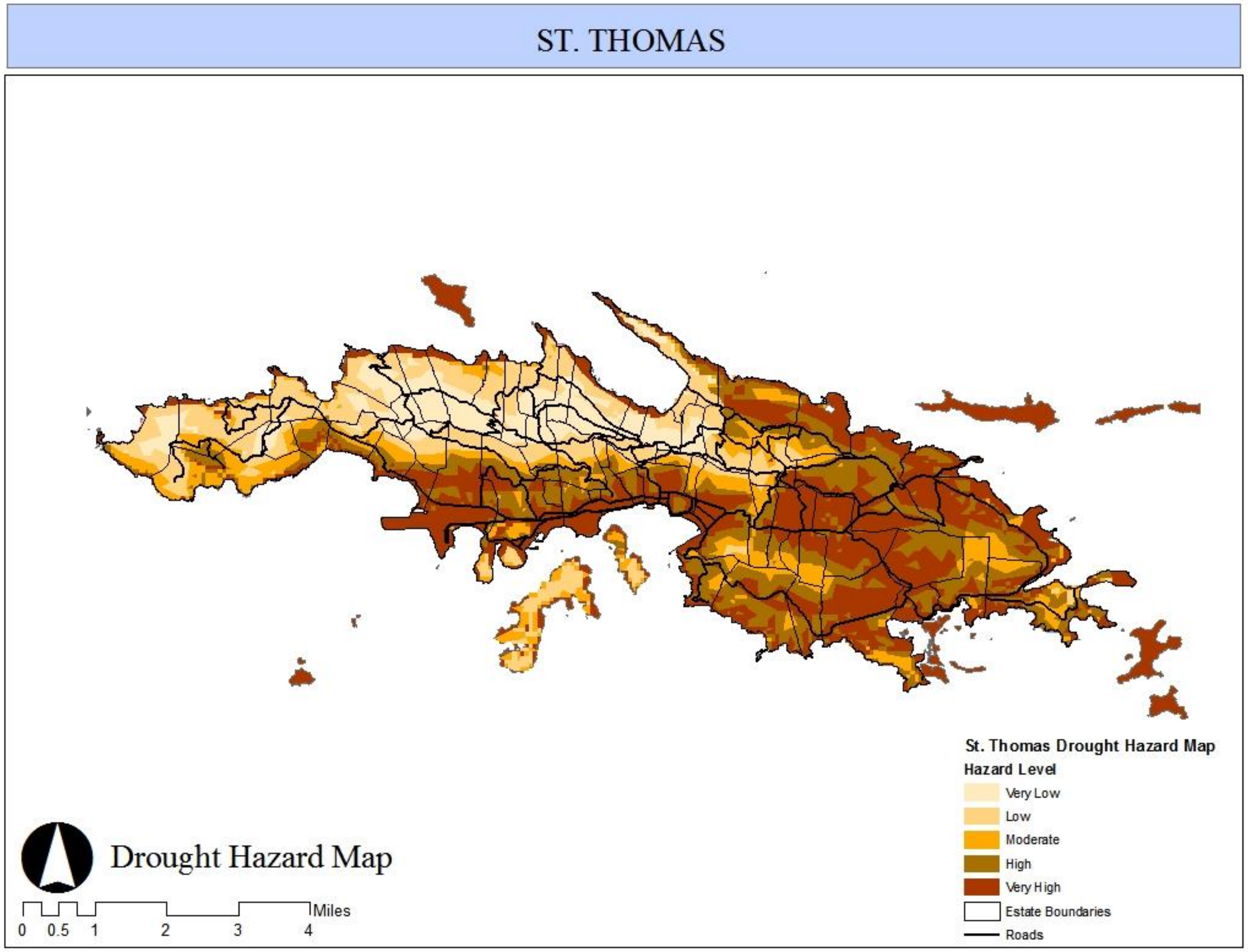


FIGURE 4.3 ***Drought Hazard Map, St. Croix***

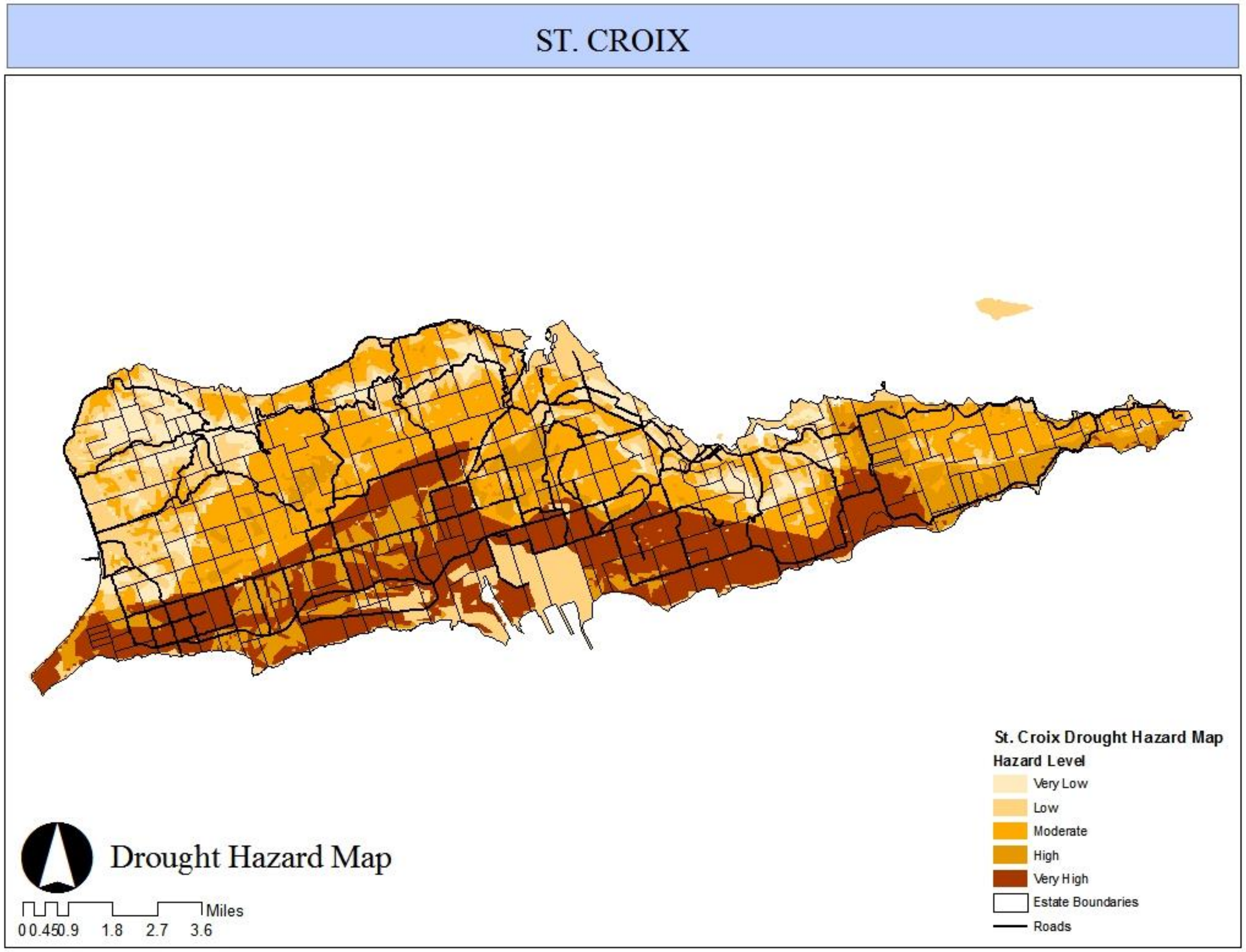
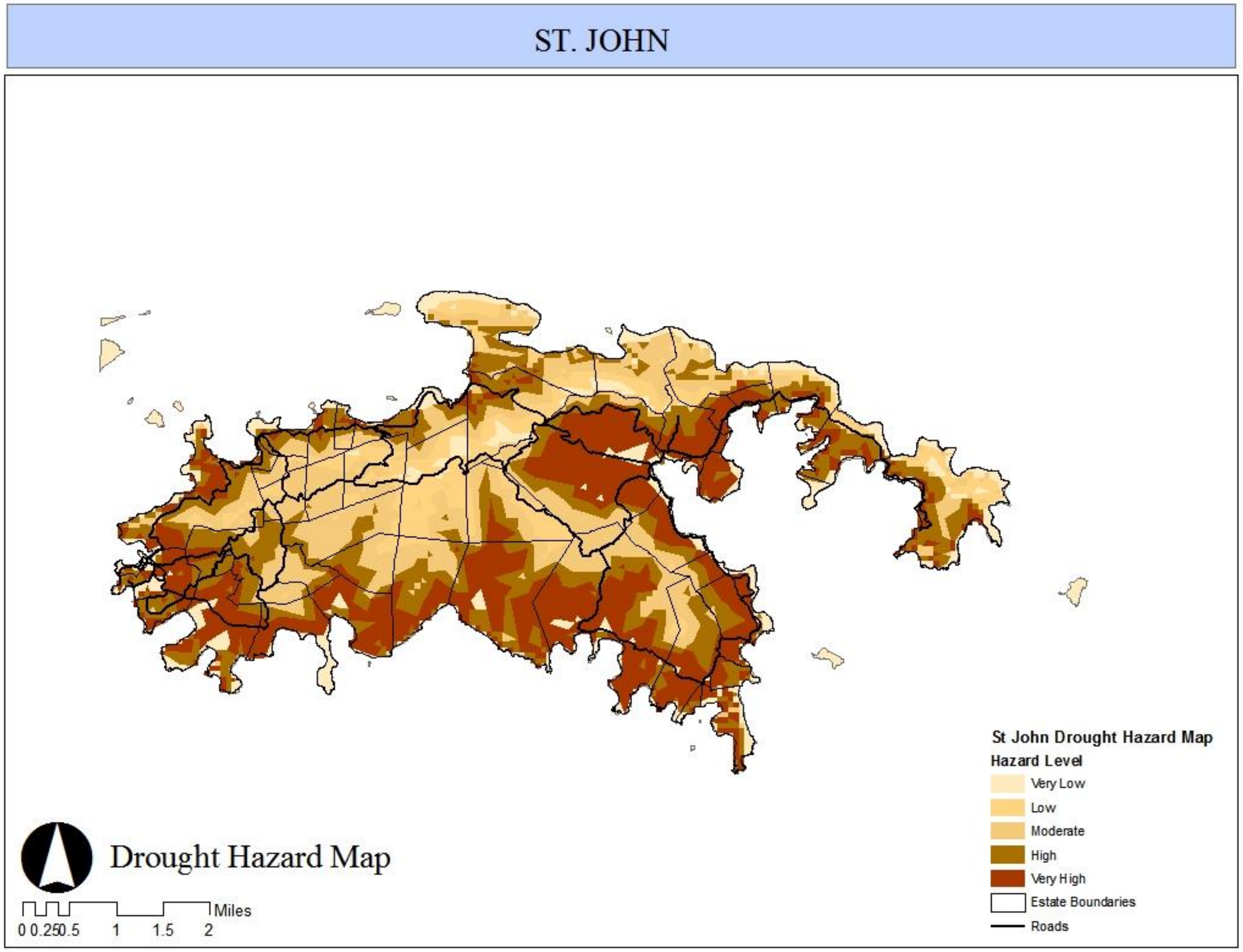


FIGURE 4.4 ***Drought Hazard Map, St. John***



Climate Variability, Hazard Frequency and Magnitude

There is a general lack of understanding on the definition, on-set, and frequency of drought in the U.S. Virgin Islands.

However, based on regional information gathered from the Caribbean Institute for Meteorology and Hydrology and the Brace Centre for Water Resources Management, McGill University, the frequency of drought hazards in the Caribbean will increase due to climate variability.

Taking into consideration climate change data, the McGill University furthers that climate change models indicate that temperatures are very likely to rise (90-99% probability) and that there is expected to be a decrease in annual precipitation in the region of 5 to 15% with the greatest change during the months of June to August.

Such data provides a clear indication that the occurrence of drought events will increase in the future, which in turn means that there is likely to be a decrease in reported incidence of periods defined as having no drought.

Therefore, drought probability, which is tied to annual average precipitation, for Caribbean region which includes the US Virgin Islands is estimated to be 40% below normal[3].

Data Sources, Models and Methodologies

Base Data

- (2010): Average Annual Rainfall 1971 -2000, Oregon State University (OSU) Spatial Climate Analysis Service.
- USACE Digital Terrain Model (2008)
- Hydrologic Units for USVI (2002) U.S. Geological Survey in cooperation with the U.S. Department of Agriculture, Natural Resources Conservation Service.
- The United States, Caribbean and Pacific Basin Major Land Resource Areas (MLRA) Geographic Database serves as the geospatial expression of the map products presented and described in Agricultural Handbook 296 (2006).

Drought Hazard Assessment and Determination

- (2009): The Caribbean Drought and Precipitation Monitoring Network: The Concept and its Progress http://www.wamis.org/agm/meetings/wies09/S3B-Trotman.pdf

[3] Drought and Precipitation Monitoring for Enhanced Integrated Water Resources Management in the Caribbean (2008)

- (2010): Drought Impacts and Early Warning in the Caribbean: The Drought of 2009-2010; Adrian R. Trotman David A. Farrell; http://www.wmo.int/pages/prog/drr/events/Barbados/Pres/4-CIMH-Drought.pdf
- UN/ISDR, 2007. Drought Risk Reduction Framework and Practices: Contributing to the Implementation of the Hyogo Framework for Action. United Nations Secretariat of the International Strategy for Disaster Reduction (UN/ISDR), Geneva, Switzerland, 98+vi pp.
- US National Assessment of the Potential Consequences of Climate Variability and Change Educational Resources Regional Paper: US-Affiliated Islands of the Pacific and Caribbean, http://www.usgcrp.gov/usgcrp/nacc/education/islands/islands-edu-3.htm

Inventory Data (Assets)

- General Building Stock: Office of the Lt. Governor, Office of the Tax Assessor, Computer Mass Appraisal System Database and GIS Parcel Maps
- Critical Facilities and Infrastructure: VI Department of Property and Procurement, VITEMA

4.4.3 EARTHQUAKE

Hazard Description

An earthquake is a sudden motion or trembling of the earth caused by an abrupt release of stored energy in the rocks beneath the earth's surface. The rocks that make up the earth's crust are very brittle. When stresses due to underground tectonic forces exceed the strength of the rocks, they will abruptly break apart or shift along existing faults. The energy released from this process results in vibrations known as seismic waves that are responsible for the trembling and shaking of the ground during an earthquake. Earthquakes are also caused by tremendous rock slides that occur along the ocean floor.

There are several different ways to express the severity of an earthquake. The two most common are: *magnitude*, which is the measure of the *amplitude* of the seismic wave and is expressed by the Richter scale, and *intensity*, which is a measure of how strong the shock was felt at a particular location, expressed by the Modified Mercalli Intensity (MMI) scale. The Richter scale represents a logarithmic measurement where an increase in the scale by one whole number represents a tenfold increase in measured amplitude of the earthquake. Table 4.4 shows the rough correlation between the Richter scale, Peak Ground Acceleration (PGA), and MMI. The relationship between PGA, magnitude, and intensity are, at best, approximate, and also depend upon such specifics as the distance from the epicenter and depth of the epicenter.

TABLE 4.4 ***Earthquake Magnitude / Intensity Comparison***

PGA (in %g)	**Magnitude (Richter)**	**Intensity (MMI)**	**Description (MMI)**
<0.17	1.0 - 3.0	I	I. Not felt except by a very few under especially favorable conditions.
0.17 - 1.4	3.0 - 3.9	II - III	II. Felt only by a few persons at rest, especially on upper floors of buildings. III. Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
1.4 – 9.2	4.0 - 4.9	IV - V	IV. Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rock noticeably. V. Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
9.2 - 34	5.0 - 5.9	VI - VII	VI. Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight. VII. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
34 - 124	6.0 - 6.9	VIII - IX	VIII. Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
>124	7.0 and higher	VIII or higher	X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent. XI. Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly. XII. Damage total. Lines of sight and level are distorted. Objects thrown into the air.

Source: Wald, D., et al., “Relationship between Peak Ground Acceleration, Peak Ground Motion, and Modified Mercalli Intensity in California.”

Nature of the Hazard

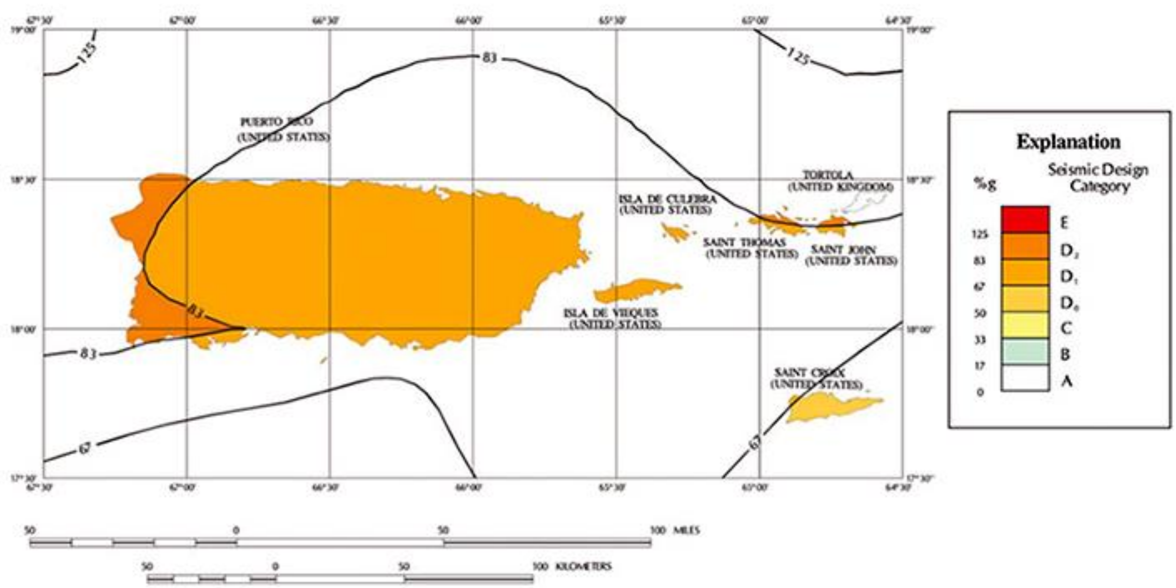
The US Virgin Islands are located on the northeastern edge of the Caribbean Plate. Although there has been what is referred to as a "seismic gap" where no significant events have been recorded for a long period, the area is still considered very seismically active. The US Virgin Islands is actually considered as earthquake prone as many areas of California. However, the difference of these two areas is that the plate that affects the Virgin Islands is deep compared to the rather shallow fault line in California producing less harmful seismic events.

It also appears from research that the rate of attenuation for earthquakes in this region is lower, i.e., earthquake shocks propagate longer and farther in this region given the same initial earthquake intensity, than earthquakes that occur in the northeastern United States (IRF 1984).

The exact configuration of the Caribbean Plate boundary in the vicinity of the Virgin Islands is poorly understood and is also quite complex. The Island of Puerto Rico and all the northern Virgin Islands are considered a "microplate" caught within the plate boundary. Zones of continuing deformation surrounding this microplate pass through the Anegada Passage separating the northern Virgin Islands from St. Croix, as well as along the eastward continuation of the Puerto Rico Trench to the north (EQE International 1994). These two features comprise the principal source of earthquakes that affect the US Virgin Islands.

Generalized seismic maps were developed by USGS to provide guidance for construction in 2010. Figure 4.5 below provides a depiction of the hazard intensity so as to provide guidance to building design and construction professionals. The seismic design categories for Puerto Rico and the Virgin Islands have been developed for low rise occupancy Category I and II structures located on sites with average alluvial soil conditions.

***FIGURE 4.5*: Seismic Design Map for Puerto Rico and the Virgin Islands**



source: http://www.fema.gov/earthquake/earthquake-hazard-maps

The colors in the maps denote "seismic design categories" (SDCs), which reflect the likelihood of experiencing earthquake shaking of various intensities. (Building design and construction professionals use SDCs specified in building codes to determine the level of seismic resistance required for new buildings.) The following table describes the hazard level associated with each SDC, and the associated levels of shaking. Although stronger shaking is possible in each SDC, it is less probable than the shaking described.

TABLE 4.5: Seismic Design Categories

SDC	Map Color	Earthquake Hazard	Potential Effects Of Shaking*
A	White	Very small probability of experiencing damaging earthquake effects.	
B	Gray	Could experience shaking of moderate intensity.	Moderate shaking—Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
C	Yellow	Could experience strong shaking.	Strong shaking—Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built structures.
D0	Light brown	Could experience very strong shaking (the darker the color, the stronger the shaking).	Very strong shaking—Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures.
D1	Darker brown		
D2	Darkest brown		
E	Red	Near major active faults capable of producing the most intense shaking.	Strongest shaking—Damage considerable in specially designed structures; frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations. Shaking intense enough to completely destroy buildings.
* Abbreviated descriptions from The Modified Mercalli Intensity Scale.; source: http://www.fema.gov/earthquake/earthquake-hazard-maps			

The Puerto Rico Trench runs E-W about 100 km to the north of Puerto Rico and the northern Virgin Islands. The deepest section of the trench, approximately 8 km, is located to the north of Puerto Rico. The Anegada Passage fault zone extends for approximately 375 km north-east and comprises a series of interconnected basins up to 4.4 km deep. This deep trench separates St. Croix from the Puerto Rico – Virgin Islands platform (EQE International 1994).

Hazard Location, Extent and Distribution

The extent of the earthquake risk is not uniform territory wide. Figure 4.8 illustrates the geographic coverage of earthquake hazard prone areas on the three major islands.

St. Thomas and St. John have been formed as a result of underwater volcanic flows and can be considered to have very similar geology. Both islands have a thin soil cover of sedimentary deposits, limestone, alluvium and recent beach deposits. The Cretaceous-aged Louisehoj and Water Island formations are highly weathered, jointed and fractured (Geoscience Associates 1984). From a geologic stand point the islands are essentially the same land mass, separated by a garden, Pillsbury Sound. .

As illustrated in the maps (Figure 4.6, 4.7 and 4.8), the hazard intensity varies throughout St. Thomas and St. John. On both islands, hillsides are susceptible to earthquake induced land sliding. Geoscience Associates (1984) point to several causes that have increased susceptibility on these islands. They include: increased hillside development; removal of slope vegetation; and steeper man-made slopes. Other critical areas include the waterfront area of Charlotte Amalie that is built upon alluvial soils and various land fill. The performance of such materials is notoriously poor.

FIGURE 4.6 ***Earthquake Hazard Map, St. Thomas***

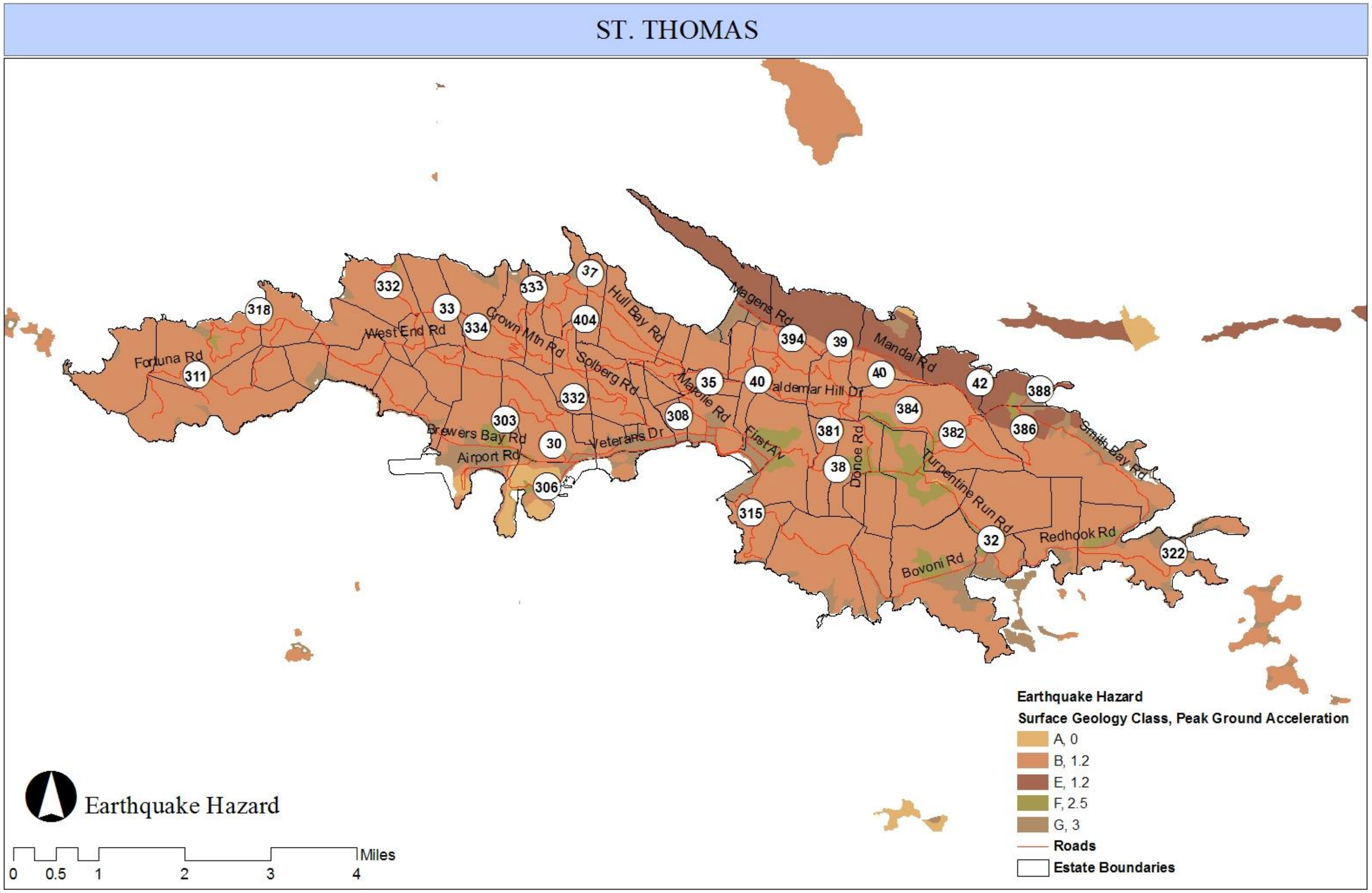


FIGURE 4.7 ***Earthquake Hazard Map, St. Croix***

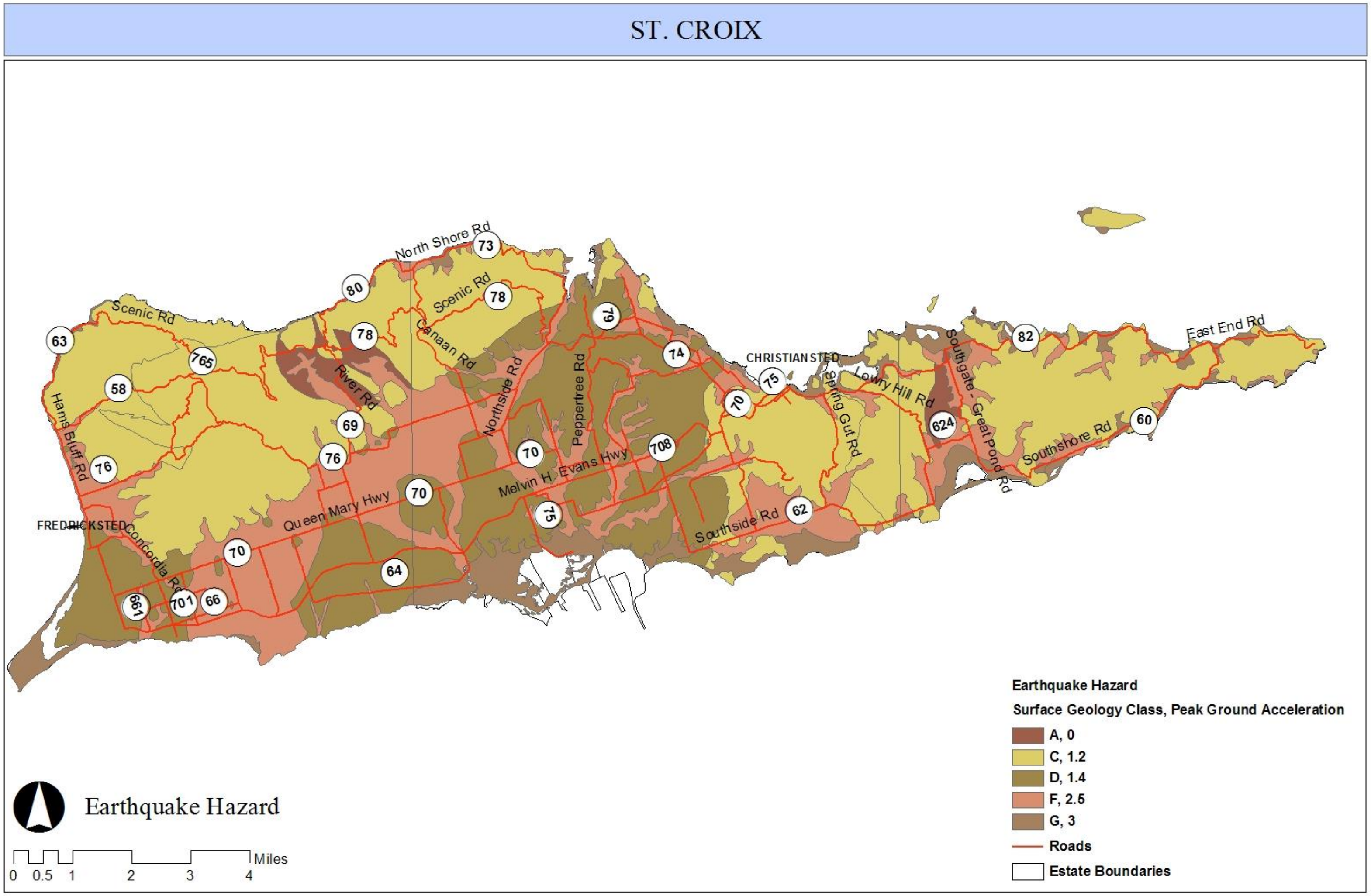
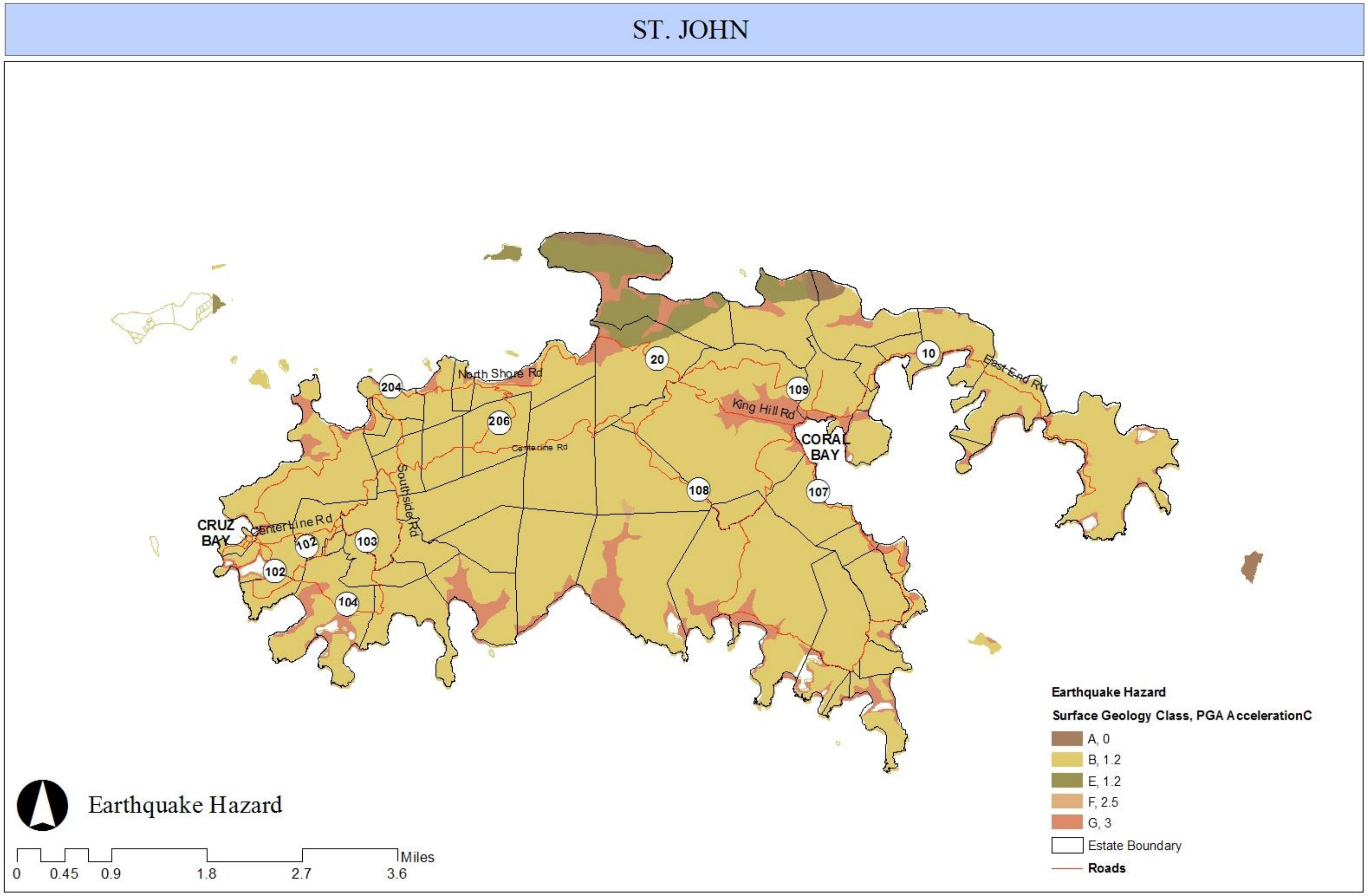


FIGURE 4.8 ***Earthquake Hazard Map, St. John***



St. Croix is not volcanic in origin. Its soils and rock formations have developed from sedimentary processes. The major rock types of St. Croix are siltstones, limestone, sandstones, conglomerates, marls, volcanic ashes, and minor granite intrusives. The rock formations are tilted up to near vertical orientation. The rock formations include Caledonia, Allandale, Cane Valley, and Judith Fancy formations, all of late Cretaceous age (Geoscience Associates 1984).

Much of Christainsted and Frederiksted waterfronts mimic the performance of the waterfront areas on St. Thomas. Much of the town of Frederiksted is supported on residual soils of the Kingshill Marl Formation, the most granular faces of which appeared to be liquefaction prone (Geoscience Associates 1984). Christiansted is built upon alluvial soils and various land fill also making it prone to liquefaction. On St. Croix, there are widespread structural concerns throughout the island. The 1984 Geoscience Associates report points out that hillside construction on St. Croix, especially houses supported on stilts, are quite susceptible to earthquakes.

Disaster History

There is a verifiable record of earthquake occurrences dating back more than 500 years. More than 200 “felt events” have been recorded in the area since the first reliable report on September 1, 1530 near the coast of Venezuela. The first recorded incident directly affecting what is now the US Virgin Islands was in 1777, when a shock with an estimated intensity on the Modified Mercalli scale of IV-V was reported on St. Thomas (see Table 4.4). Over the next two hundred years, as many as 170 individual events were recorded (IRF, 1984) but none have been of great consequence since 1867 when an earthquake estimated at MMI VIII on St. Thomas and VII-VIII on St. Croix as recorded. Since that time there have been no major events with the highest estimated intensity measured at MMI IV-V. Due to the moderate nature of these events and their non-destructive nature there has been no Federal disaster declaration for any of these occurrences

It is worth noting; however, that the Puerto Rico Seismic Network, for its area of responsibility (latitude 17.00 -20.00˚ N and longitude -63.50 -69.00˚), and for the period from April 2011 to April 2014 there have been 65 seismic events with a magnitude of 4.0 or greater on the Richter Scale. The strongest of these was an event that had a magnitude of 6.4 on the Richter Scale and occurred in the Puerto Rico on January 13, 2013.

Clearly the event that stands in our minds is the event in Haiti on January 2010. The 2010 Haiti earthquake was a catastrophic magnitude 7.0 Mw earthquake, with an epicenter near the town of Léogâne, approximately 25 km (16 miles) west of Port-au-Prince, Haiti's capital. An estimated three million people were affected by the quake; the Haitian government reported that an estimated 316,000 people had died, 300,000 had been injured and 1,000,000 made homeless.[4]

The region from Puerto Rico to the Virgin Islands is seismically active. In 2010, the majority of earthquakes occurred along the Puerto Rican Trench. This is worth noting, as in 2009, most earthquakes had epicenters massed to the north of the Virgin Islands. Earthquakes (above 4.0) averaged nineteen (19) per year.

4 a b "Red Cross: 3M Haitians Affected by Quake". CBS News. 13 January 2010. Retrieved 13 January 2010.
^ "Haiti raises earthquake toll to 230,000". AP. The Washington Post. 10 February 2010. Retrieved 30 April 2010.
^ "Haiti will not die, President Rene Preval insists". BBC News. 12 February 2010. Retrieved 12 February 2010.

Hazard Frequency and Magnitude

It has been estimated that an earthquake with the same magnitude as the 1867 earthquake event would have a 300 to 5,000 year recurrence interval (RI). For practical purposes, this is a longer RI than is useful for planning and design purposes. However, there are two useful references for assessing the probability of an earthquake of destructive proportions in the US Virgin Islands, the first of which uses the same value as the 1867 event.

The first is the "design earthquake" recommended by the Natural Hazards Planning Council. The Council selected a "design earthquake"[5] of level MMI VIII for use by engineers and planners to prevent damage from events that they believed have a reasonable expectation of occurring in the US Virgin Islands (IRF, 1984) given the region's general seismicity. The second reference is from a study prepared for the US Virgin Islands Water and Power Authority (WAPA, 1994). In this study, the authors determine that the earthquake intensity likely to have a recurrence interval on the scale of 100 years is in the MMI VI-VII range. Based on this estimate (100-yr), the US Virgin Islands has a 1/100 or a 1% annual probability of an event in the MMI VI-VII range.

The Seismic Hazard Map of 1994 (Earth Science Consultants, 1999), which provides ground shaking intensity (expressed in terms of Peak Ground Acceleration (PGA) for 50-, 100-, 250-, and, 1,000-year return periods). This study, utilized the 1000-year ground shaking map. This map was generated using an acceleration variability (σ) of 0.6 at a set of sites across each island. The Peak Ground Acceleration (PGA-%g) ranges from .48 to .91g for a 1000-year return period. Based on this return period (1000-yr), the US Virgin Islands has a 0.1% percent annual probability of observing the losses shown in this risk assessment.

Data Sources, Models and Methodologies

Information for the development of the Earthquake Risk Assessment came from a variety of sources, including:

Base Data (Earthquake)

5 design earthquake event is used for estimating the demands and predicting the supplies of the real three-dimensional soil-foundation-building system performance during an event.

- 1000-year probabilistic ground shaking intensity maps (Earth Scientific Consultants 1999).
- Earthquake vulnerability maps, which classified acceleration factors for local site geology, using NEHRP[6] provisions to define localized site amplification classification (Earth Scientific Consultants, 1999)
- Charles Mueller, Arthur Frankel, Mark Petersen, and Edgar Leyendecker (2010) New Seismic Hazard Maps for Puerto Rico and the U.S. Virgin Islands. Earthquake Spectra: February 2010, Vol. 26, No. 1, pp. 169-185.

Earthquake Hazard Assessment and Determination

- The hazard assessment was developed using the Seismic Hazard Map of 1994 (Earth Science Consultants, 1999), which provides ground shaking intensity (expressed in terms of Peak Ground Acceleration (PGA) for 50-, 100-, 250-, and, 1,000-year return periods)
- The 1000-year ground shaking map was generated using an acceleration variability (σ) of 0.6 at a set of sites across each island. Acceleration factors were identified based on local soil conditions and the surficial geology.
- Local site geology was classified using NEHRP provisions to define localized site amplification classification.
- GIS overlay techniques were used to assign an earthquake susceptibility factor (PGA) to. each estate.

Inventory Data (Assets)

- General Building Stock: Office of the Lt. Governor, Office of the Tax Assessor, Computer Mass Appraisal System Database and GIS Parcel Maps
- Critical Facilities and Infrastructure: VI Department of Property and Procurement, VITEMA

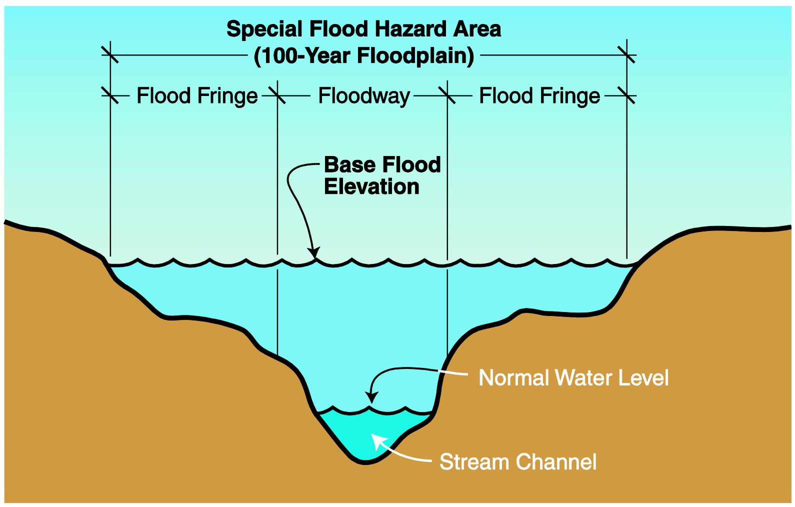
[6] NEHRP is the National Earthquake Hazards Reduction Program. This program's congressional mandate is "to reduce the risks to life and property from future earthquakes in the United States through the establishment and maintenance of an effective earthquake hazards reduction program".

4.4.4 RIVERINE FLOODING

Hazard Description

Floods are naturally occurring events for rivers and streams. Excess water from rainfall accumulates and overflows onto banks and adjacent floodplains — lowlands adjacent to guts, streams, or rivers that are subject to recurring floods (see Figure 4.9 below).

Figure 4.9 ***Definition Sketch for Floodplains***



Source: *Understanding Your Risks* – FEMA Publication 386-2, Page 2-12

FEMA's National Flood Insurance Program (NFIP) maps many floodplain boundaries. The *Digital Flood Insurance Rate Maps (DFIRMs)* have been updated and reissued in April 2007. They have been provided to the Territory. These maps provide the Territory with a more useful resource for planning and site specific decision making related to flood hazards. The *2007 US Virgin Islands Digital Flood Insurance Rate Maps (DFIRMs)* are used as reference for the National Flood Insurance Program. The Flood Insurance Study; however, provides more detailed information in certain areas where Base Flood Elevations (BFEs) and/or floodways have been determined.

Historically, floods often exceed the mapped floodplains in the Virgin Islands. The 2007 Flood Insurance Study for the US Virgin Islands indicates that the principle causes of flooding are associated with storm water run-off. In addition, flooding is caused by encroached upon artificial fills and structures (e.g., filling in floodplain or floodway areas, or increased imperviousness within the watershed from new development) and where guts in many areas are filled with debris (e.g., accretion, erosion, sedimentation, etc.).

Nature of the Hazard

Heavy floods are a common feature of Caribbean islands. This is due to tropical weather patterns that are exacerbated during hurricane season from June to November and to higher seasonal rainfall in the fall months of August, September, October and November. There have been a number of large-scale devastating flooding events through time. Historically, most of these large-scale events have had the greatest impact outside of the island's urban areas. Inland flooding from more frequent, but smaller storm events, has caused more cumulative damage over the long run in the more urbanized areas in the US Virgin Islands, although it is less damaging on an event-by-event basis.

The islands' mostly hilly to rugged and mountainous terrain, especially on St. Thomas and St. John, is coupled with thin soils and non-porous rock substrata. The steep drainage ditches or "guts" that receive most of the runoff create optimal conditions for over-bank flooding problems. Added to this natural tendency to generate flooding conditions are the following:

- Increases in impervious surfaces in the urbanizing areas of the islands as seen in Frenchtown Area in St. Thomas; Sub base Area in St. Thomas; Christiansted Area in St. Croix; Cruz and Coral Bay on St. John
- The placement of undersized culverts where roads cross guts as witnessed in Dorethea in St. Thomas or Gallows Bay in St. Croix;
- A failure to upgrade storm water management facilities to meet the needs of on-going development (i.e. Enighed Pond St. John),
- Lack of consistent maintenance of other storm water management facilities (i.e. Radets Gade St. Thomas, Garden Street on St. Thomas); and
- Encroachments to the floodplain built over many years (i.e. La Grande Princess in St. Croix).

As highlighted above, frequent inundation of property persists. Many of these problems are highlighted in the Mitigation Strategy and Severe Repetitive Loss Strategy of this Plan Update.

Hazard Location, Extent and Distribution

Figure 4.10, 4.11, and 4.12 illustrate the geographic coverage of riverine flooding on the three major islands. The extent and geographic distribution of the regulated 100-year floodplains differ amongst the three islands due to their geology, topography, soils, and rainfall distribution patterns.

The island of St. John overall topographic profile is lower than nearby St. Thomas. However, the average annual rainfall is the greatest of the three major islands of the Territory with 54" compared to 44" on St. Thomas and 40" on St. Croix. The steep terrain of St. John concentrates runoff in natural guts that transverse to the sea. Flooding, like all hazards, is not a problem unless development or infrastructure alters the landscape. This is because the majority of the island is a National Park and remains in its natural state. Coral Bay and the surrounding area have experienced rapid development without regard for effective storm water drainage systems both in the highland areas and lowland environs. The former disregard intensifies the problems of the latter.

Most of the flooding occurs in Cruz bay or Coral Bay. These areas are prone to flooding as they are both located at the bottom of steep hills. Problems are caused by development without regard for sufficient drainage and inadequate drainage systems or improper engineering for the critical roadways. Although these manifestations cause localized flooding the problem is severe enough to disrupt commerce and emergency access. Particular areas of concern identified by citizens include: Poor or inadequate storm water drainage infrastructure on Centerline and Bordeaux Mt. Roads; need to improve storm water drainage infrastructure to alleviate localized flooding at the Guy Benjamin School in Coral Bay; water drainage system at Guinea (Westin) Gut and localized flooding at Enighed Pond (i.e. WAPA building and treatment plant and areas of Route 102 and Route 104 by the Tennis Court).

St. Thomas, like St. John, is volcanic island, with steep terrain and significant topographical relief. The island is rather heavily developed with two major urban areas, an extensive road network and the accompanying infrastructure. The areas with the most serious flooding problems are in Estate Nadir. This is essentially a continuous drainage system with the drainage channel in Estate Nadir connecting with the natural gut (Turpentine Gut). In the event of heavy rains the Gut and man-made channels have proved to be inadequate to handle the water runoff from the surrounding hillside.

Flooding persists on the East End of the island, particularly in Red Hook, where intensive commercial development has put pressure on drainage infrastructure. The inadequate storm water drainage system in Frydenhoj (next to and across from ball field) has caused localized flooding to commercial and residential structures. The development of many residences in the East End area has either altered the natural flow of runoff or increased the impervious surface area through the construction of the residences and the attending access roads and driveways.

This is witnessed on Bolongo Bay Road from Intersection Hill going up to Sea View Home to the Bolongo Bay Hotel. Additionally, the flooding problem in the Tutu community is also exacerbated by dense development without regard for natural water runoff and an insufficient drainage system throughout the entire community, but especially along the valley floor. These problems are manifested at the Tutu Fire Station, a critical facility and adjacent to Metro Motors and Gomez school.

Charlotte Amalie is also impacted by flooding. This historic community does not have adequate systems for water runoff causing flooding to the business district and adjacent areas. There are a few guts for runoff but their maintenance is not consistent and of their overflow is frequently due to debris accumulation. The major runoff system is the Frenchtown Gut. This has a shallow pitch that flows into the harbor and in the event of torrential rains tends to backup and flood a rather large surrounding area. The historic business district is prone to shallow flooding that is caused by lack of an ample drainage infrastructure.

Throughout the island there are other areas of localized flooding where development and insufficient drainage systems allow for water accumulation. Severe flooding has taken place on lower Commandant Gade (Garden Street) and Norre Gade (Main Street) where commercial and residential structures have been flooded. Further to the west of town, existing storm water drainage infrastructure systems on highway from Pueblo to Addelita Cancryn School (sub base) and from Pueblo (sub base) to Crown Bay Port Facility continue to flood and cause traffic disruption, particularly when cruise ships are in port. Inadequate storm water drainage infrastructure continues to plague residential areas of Bournefield north through Kirwin Terrace Public Housing Units.

The geology of St. Croix is vastly different from either St. John or St. Thomas. The geologic history of the island is of a sedimentary origin and the major rock formations are limestone. The result is a landscape with much less topographic relief than St. Thomas. The center of the island is relatively flat, almost a plateau type of landscape. The steep terrain on the island is found along much of the coastline and in hilly, rolling terrain in the northwest portion of the island. There are extensive areas of riverine floodplains throughout St. Croix. However, due to the generally hilly rather than mountainous terrain, the natural flow of runoff water is less rapid causing the accumulation of flood waters to dissipate more slowly.

Consequently most natural waterways are subject to shallow flooding with a slow rise in flood depths. This is prevalent in Estate Welcome, Mon Bijou, La Reine, Williams Delight, Hannah's Rest, St. Georges and areas along Center Line Road. Western areas of Christiansted are prone to flooding in which problems are caused principally by poor siting design and/or developments without regard to adequate drainage systems. Improper drainage systems on road ways have exacerbated problems and have increased downstream flooding in areas like Gallows Bay and Spring Gut; in the vicinity of Paul E. Joseph School; the Grove at La Raine; Frederiksted Lagoon Area; on Prince Street (Christiansted); on King Cross Street (Christiansted); Fort Frederik Beach; East Golden Rock on Rt. 75 (North Shore Road) and the La Grange Gut and associated drainage systems.

FIGURE 4.10 ***Riverine Flooding Hazard, St. Thomas***

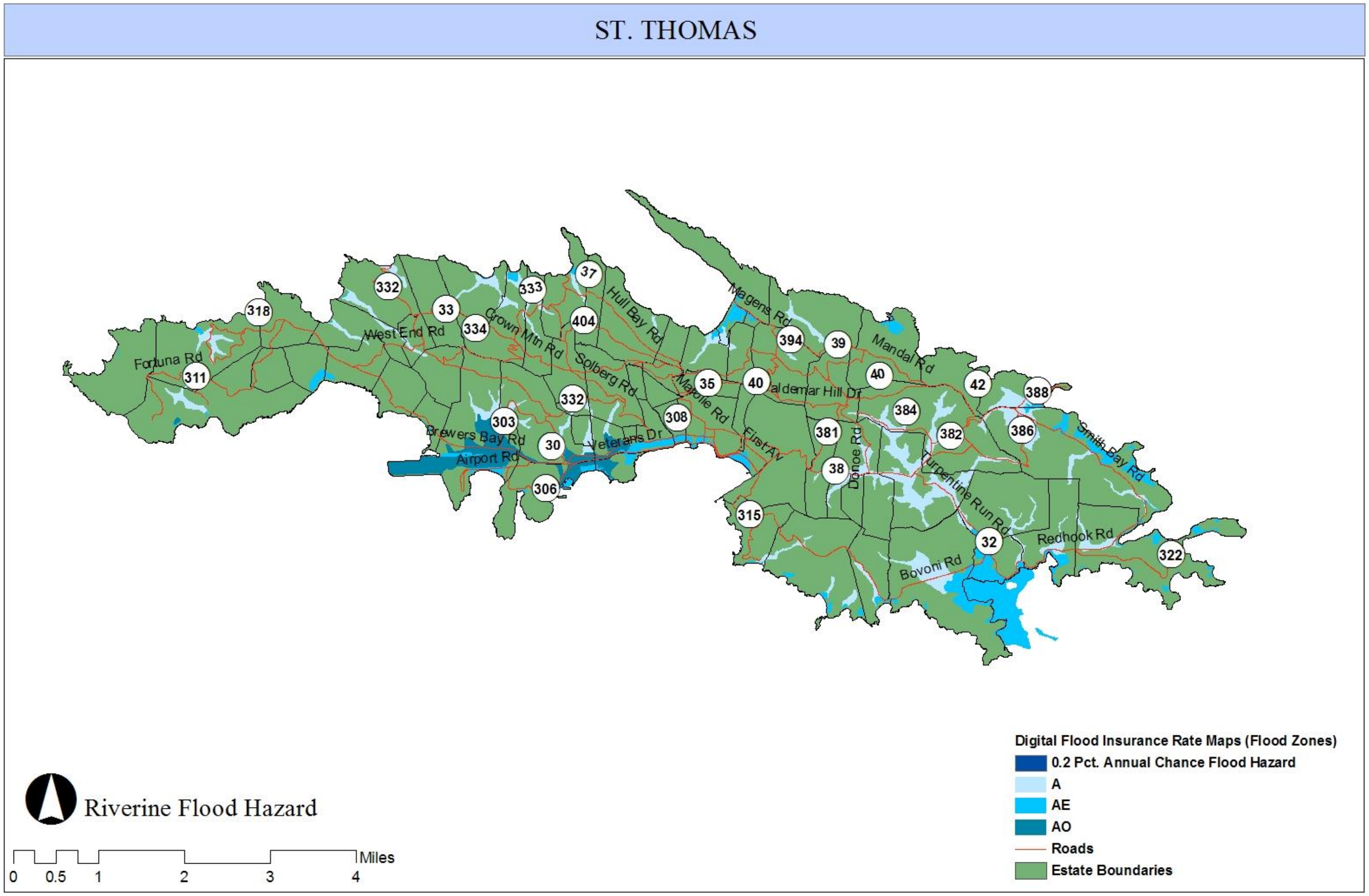


***FIGURE 4.11* Riverine Flooding Hazard, St. Croix**

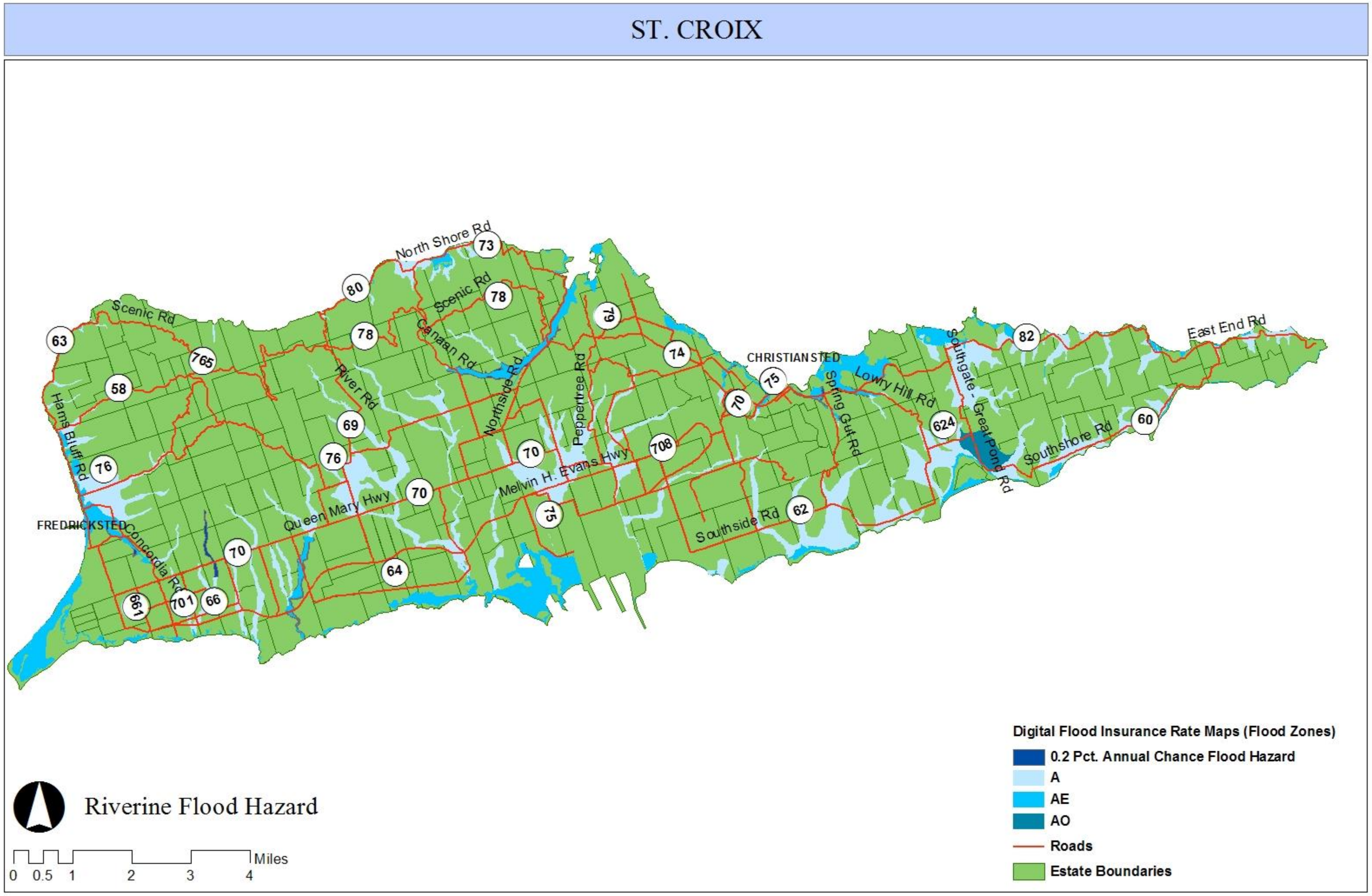
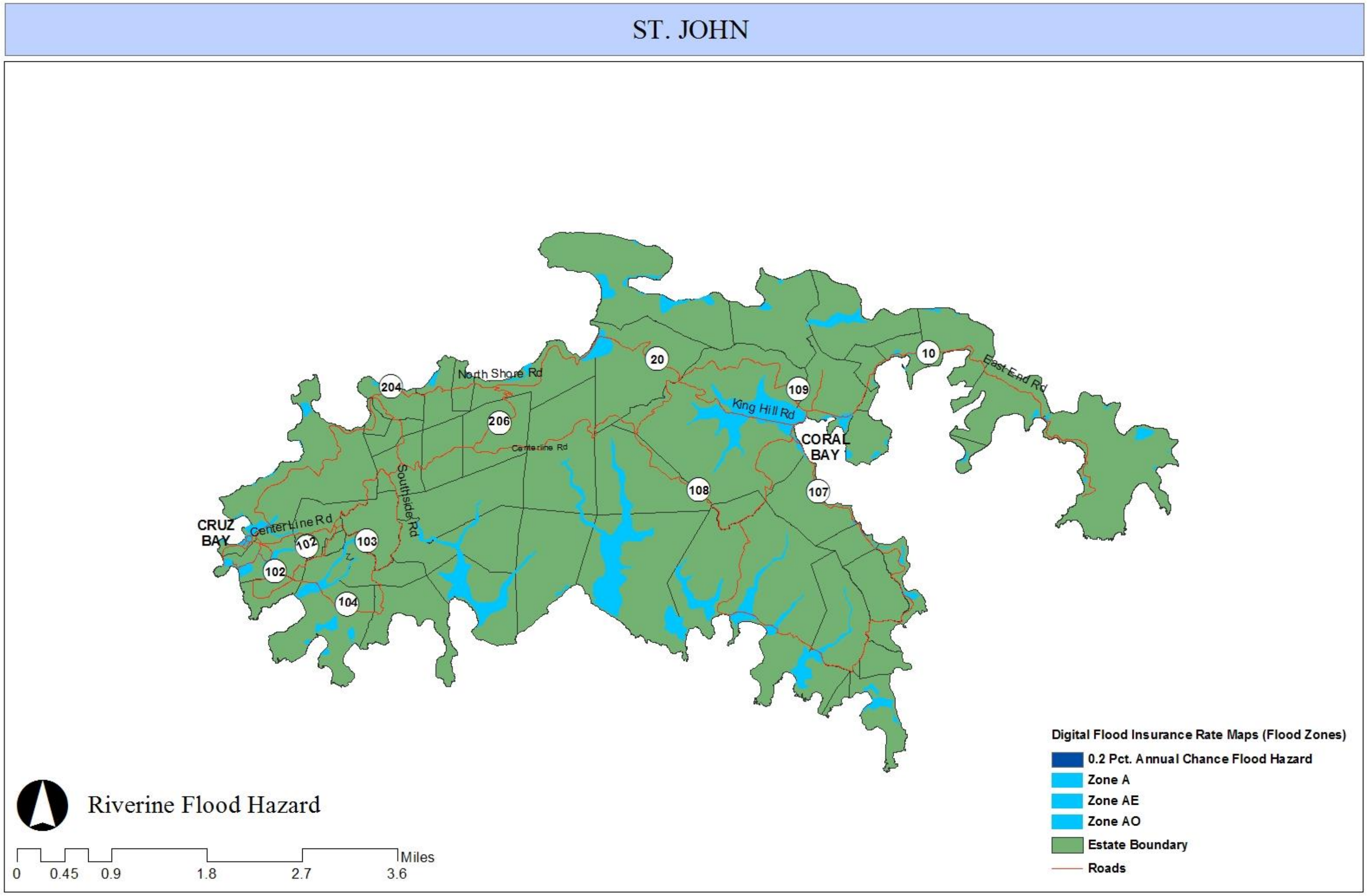


***FIGURE 4.12* Riverine Flooding Hazard, St. John**



Disaster History

Since the 2008 Plan development, there have been 4 Federal disaster declarations, of which 2 have been caused by a prolonged period of heavy rainfall. There is a lengthy record of the rainfall amounts that have occurred in the US Virgin Islands. There is also a good understanding of the factors that lead to riverine flooding as it is experienced in the US Virgin Islands as explained above. However, reliable records for specific occurrences of inland flooding are scarce which makes the reconstruction of many past floods and the determination of recurrence intervals difficult if not impossible. There are studies that have attempted to link higher than normal rainfall events with probable flood events but the results are not conclusive. But, there are good records for a few recent events.

In 2003, heavy rains over the US Virgin Islands during the week of November 12th led to widespread flash flooding. The US Virgin Islands was declared a federal disaster area with damages estimated at $25-30 million. The storm was the result of a two-day period with a stationary area of low pressure, which led to widespread and continuous rainfall across all the US Virgin Islands resulting in generalized flash floods and riverine flooding. This two-day period was followed by a series of showers that lasted for several more days. With the previous heavy rains, the ground was so saturated that most of the subsequent rain became runoff and contributed to additional flooding problems. The four-day accumulation of rain varied from 15 to more than 20 inches across the Islands.

Other significant flooding events have occurred on the island of St. Croix. In November 2004 heavy rains caused severe roadway flooding from Estate Mount Welcome to Gallows Bay depositing large quantities of dirt and debris at the Gallows Bay intersection. There was also general street flooding in Christiansted. In May 2005, severe thunderstorms brought as much as 2 and 3 inches of rain in a one hour period, causing wide spread street and gut flooding in town (Christiansted).

During October 2006, flash flooding caused an accumulation of one foot of water in the Gallows Bay area. This weather system also flooded portions of Mon Bijou, La Reine, Williams Delight, Hannah's Rest, St. Georges and areas along Centerline Road. This system also forced school and business closures. The areas on St. Croix most affected by this event were western suburbs of Christiansted. However, excessive flooding was also reported in Frederiksted, along the South Shore Road and the Northside Road.

In November, 2010, the Territory experienced torrential downpours associated with Tropical Storm Otto and Tomas. The flooding caused extensive damages throughout the islands and flooded cars, businesses, homes and streets. Areas of Charlotte Amalie were affected on St. Thomas where several stores in the historic shopping district were flooded. The Diamond Center was flooded with more than 2 feet of water. On Brookman Road, the tremendous volume of water rushing over the asphalt caused it to lift, prompting temporary closure of that road.

The passing of these systems presented major challenges to the Public Works crews, and while all roads on St Thomas and St John were passable, DPW recommended caution given the saturated soil conditions.. On St. John, flooding was particularly severe in the area of Enighed Pond. Sewers were overwhelmed in several locations and manhole covers were carried away as dirty water flowed down the streets.

On St Croix, roadways flooded and water pooled in several urban areas in Christiansted and Fredricksted, in places where motorists had not seen water standing before, causing some to stall out in the heavy downpours. The runoff from the rains collapsed a section of roadway that spans Gut#5 within Enfield Green cuttingthe Westside of that neighborhood off to vehiclar traffic and leaving no exit. The rush of rain runoff coming down from the hills and making its way to the sea overwhelmed storm water drainage infrastructure in William's Delight and Enfield Green. This high velocity flow caused a culvert crossing on the road within Enfield Green to give way.

In La Vallee on the island's North Shore, landslides and localized flooding in low-lying areas created some hazards by pushing debris into the roadways. There were weather-related electrical failures in Orange Grove, LBJ Gardens, Montpellier, Betsy Jewel, Grove Place, La Reine, Castle Coakley, Whim, William's Delight, Two Williams, Mt. Pleasant, Shoys, La Grange, Butler Bay, Spring Garden, Northside, Nicholas, Frederikshaab, Wheel of Fortune, Little Princess Hill, St. John, Grange Hill, Brookshill, Turner Hole, New Works, Bethlehem, and Mon Bijou.

Climate Variability, Hazard Frequency and Magnitude

Floods are described in terms of their extent (including the horizontal area affected and the vertical depth of floodwaters) and the related probability of occurrence. Flood studies use historical rainfall records and physical land characteristics to determine the probability of occurrence for different extents of flooding. The probability of occurrence is expressed in percentages as the chance of a flood of a specific extent occurring in any given year.

A specific flood that is used for a number of purposes is called the “base flood” which has a 1% chance of occurring in any particular year. The base flood is often referred to as the “100-year flood” since its probability of occurrence suggests it should only reoccur once every 100 years, although this is not the case in practice. Experiencing a 100-year flood does not mean a similar flood cannot happen for the next 99 years; rather it reflects the probability that over a long period of time, a flood of that magnitude should only occur in 1% of all years.

TABLE 4.6 ***Flood Probability Terms***

Flood Recurrence Intervals	Chance of occurrence in any given year
10 year	10%
50 year	2%
100 year	1%
500 year	0.2%

While the FEMA flood maps that were utilized for this assessment they do not incorporate the impacts of climate change, it will become an increasing important parameter for predicting flood hazard and mapping the extent of flood hazards.

To incorporate climate change into flood models FEMA flood mapping experts must work to incorporate projected data for future climatic conditions into hydrological and hydraulic models, which can be used to delineate the extent of flooding for certain return periods.

Since climate models indicate that there is a likely to be a potential increase in extreme rainfall events, it will be important to monitor such data to understand changes in susceptibility to flooding due to climate change throughout the territory. Greater frequency of intense rainfall events will translate into larger (deeper and more widespread) floods occurring in the Territory more often. Table 4.6 shows a range of flood recurrence intervals and their probabilities of occurrence.

The extent of flooding associated with a 1% probability of occurrence – the base flood - is used as regulatory boundaries by Federal, state and local agencies. Also referred to as the “Special Flood Hazard Area (SFHA)” (see Figures, 4.10, 4.11 and 4.12), this boundary is a convenient tool for assessing vulnerability and risk in flood prone communities, since many communities have maps available that show the extent of the estimated base flood event.

Data Sources, Models and Methodologies

Information for the development of the Riverine Flood Risk Assessment came from a variety of sources, including:

<u>Base Data (Riverine Flooding)</u>

- FEMA Digital FIRM data, which delineate the 100- year floodplain and VE SFHA boundaries
- USACE Digital Terrain Model

<u>Riverine Flood Hazard Assessment and Determination</u>

- FEMA Digital FIRM data were identified as the most comprehensive flood polygon data for the US Virgin Islands. This data was updated in April, 2007. GIS overlay techniques were utilized to identify structures in the flood zone flood polygons. Flood depths were estimated for each estate on each island by overlaying the Q3 flood zone data on a digital elevation model.

<u>Inventory Data (Assets)</u>

- General Building Stock: Office of the Lt. Governor, Office of the Tax Assessor, Computer Mass Appraisal System Database and GIS Parcel Maps
- Critical Facilities and Infrastructure: VI Department of Property and Procurement, VITEMA

4.4.5 COASTAL FLOODING & EROSION

Hazard Description

The most dangerous and damaging feature of a coastal storm is storm surge. Storm surges are large waves of ocean water that sweep across coastlines where a storm makes landfall. The more intense the storm, the greater the height of the storm surge.

Storm surge areas can be mapped by a number of computer-driven models. The coastal hazard mapping was developed for the USACE using the SLOSH (Sea, Lake, and Overland Surges from Hurricanes) computer model (developed by the National Weather Service to forecast surges that occur from wind and pressure forces of hurricanes), Bathymetry and coastline topography. The SLOSH model was developed primarily as an emergency management tool to aid in evacuation planning. In the USVI, hurricane category is the predominant factor in "worst case" hurricane surges. The resulting inundation areas are grouped into Category 1 and Category 3, and Category 5 classifications. The hurricane category refers to the Saffir-Simpson Hurricane Intensity Scale described in Table 4.7.

TABLE 4.7 ***Saffir-Simpson Hurricane Scale***

Category	**Storm Surge** (feet above normal sea level)
1	4–5 ft.
2	6–8 ft.
3	9–12 ft.
4	13–18 ft.
5	> 18 ft.

The IPCC Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC AR5) indicates that the frequency of the most intense storms and associated storm surges or coastal floods is more likely than not to increase by more than +10% (IPCC 2013, AR5), while the annual frequency of tropical cyclones and associated storm surges or coastal floods are projected to decrease or remain relatively unchanged for the North Atlantic.

This suggests no major change in the frequency of hurricanes and associated storm surges or coastal floods in North Atlantic region comprising US Virgin Islands. The model, however, that sea level rise is projected to increase by small magnitude of 0.35 m over the projected for the 2040s relative to the 1960-1990 baseline. These projections have implications for the USACE's SLOSH (Sea, Lake, and Overland Surges from Hurricanes) computer model (developed by the National Weather Service) that was utilized for this study and could increase the expected surge levels in Table 4.7 above.

Such parameters can be used by the USACE and NWS to understand the potential impact of climate change on coastal inundation levels and magnitude (Table 4.7).

As indicated in the 2011 plan, storm surge inundates coastal areas, washes out dunes, causes backwater flooding in rivers, and can flood streets and buildings in coastal communities. The biggest impact coastal flooding has is the wearing away or eroding of coastal land, which is commonly described as **coastal erosion**. While erosion is considered a function of larger processes of gradual shoreline change, which includes erosion and accretion, it is tied in the US Virgin Islands to hurricane events. This is particularly true in the short-term, where storms can erode a shoreline that may, over the long-term, be accreting.

- Erosion results when more sediment is lost along a particular shoreline than is re-deposited by the water body.
- Accretion results when more sediment is deposited along a particular shoreline than is lost.

Over a long-term period (years), a shoreline is considered to be either eroding or accreting or stable. It is very difficult to measure erosion as a rate, with respect to either a linear retreat (i.e., feet of shoreline recession per year) or volumetric loss (i.e., cubic yards of eroded sediment per linear foot of shoreline frontage per year). This is primarily due to the fact that erosion rates are not uniform, and vary over time at any single location.

Nature of the Hazard

Coastal flooding in the US Virgin Islands is common and associated with low-pressure systems, including tropical storms and hurricanes. In the limited shoreline areas of the US Virgin Islands coastline that slopes gradually inland, the coastal areas are also vulnerable to large coastal sea swells generated by winter storms over the Atlantic Ocean. Rising storm surge levels are a function of wind, atmospheric pressure, tide, waves, and/or swell. Coastal topography and immediate offshore bathymetry (sea bottom contours) directly affect the extent of coastal flooding.

Shoreline changes, on the other hand, are the result of both natural forces and human activities, such as sand mining and beach construction. Environmental awareness has been slowly growing. Hurricane events, such as Hurricane Hugo, Marilyn and Lenny, have illustrated the vulnerability of the US Virgin Islands' beaches. High waves and tides and ocean currents accompanying these storms, are the most significant forces affecting erosion in the US Virgin Islands. Their turbulent energy stirs up and moves the beach sand, eroding the coastline.

Hazard Location, Extent and Distribution

Figure 4.13, 4.14, and 4.15 illustrate the geographic coverage of coastal flooding on the three major islands. The high winds literally pile the water up to create storm surges. The coastal hazard mapping was developed for the USACE using the SLOSH (Sea, Lake, and Overland Surges from Hurricanes) computer model and indicates that the following areas are most susceptible to storm surge on an island by island basis:

- **St. Croix** – Events like Hurricane Hugo were major disaster events due to high winds. However, historically, storm surge has probably been associated with more fatalities. On St. Croix, Christiansted and Frederiksted are located such that it would take an improbable strike to generate significant water threats. Nevertheless, they are at high risk from storm surge if hurricane forces are aggravated by severe wave conditions. Increased industrial and commercial construction in coastal areas has resulted in the removal of coastal vegetation such as mangroves and grasses which have increased vulnerability to coastal flooding.

- **St. John** – Cruz Bay is at risk to storm surges and any waterfront developments along the coastline that could be affected by a surge up to a maximum of 12 feet in elevation above mean sea level.
- **St. Thomas** – In terms of specific locations, Charlotte Amalie and Red Hook are most vulnerable from increased water heights along with much of the shoreline development between those two locations. Although strong storm surges from the south or west are much less frequent, the marinas and large waterfront developments along St. Thomas' south coast would be severely impacted by a large storm from that direction. There are two very large school facilities (Charlotte Amalie High School and Eudora Kean Gymnasium at Red Hook) that offer considerable safe refuge from storm surge. One of their favorable aspects is that they can be accessed by walking.

In addition to Hurricanes, swell waves that are experienced in the US Virgin Islands between the months of October and April may have an impact on USVI shorelines. The storms are caused by intense mid-latitude storms in the North Atlantic and travel thousands of kilometers south to affect the west, north and east coasts of the islands.

FIGURE 4.13 ***Coastal Flooding Hazard Map, St. Thomas***

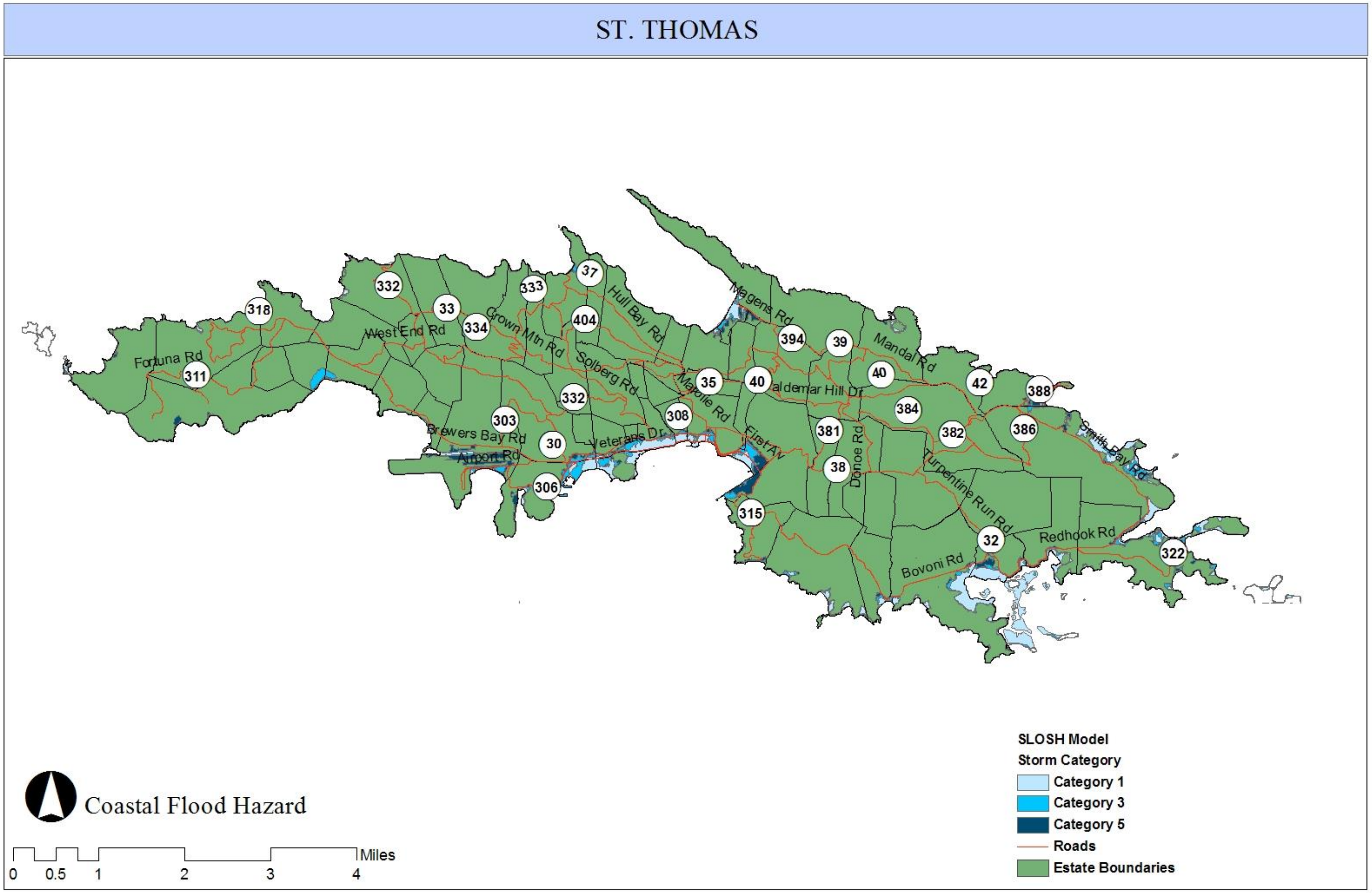


FIGURE 4.14 ***Coastal Flooding Hazard Map, St. Croix***

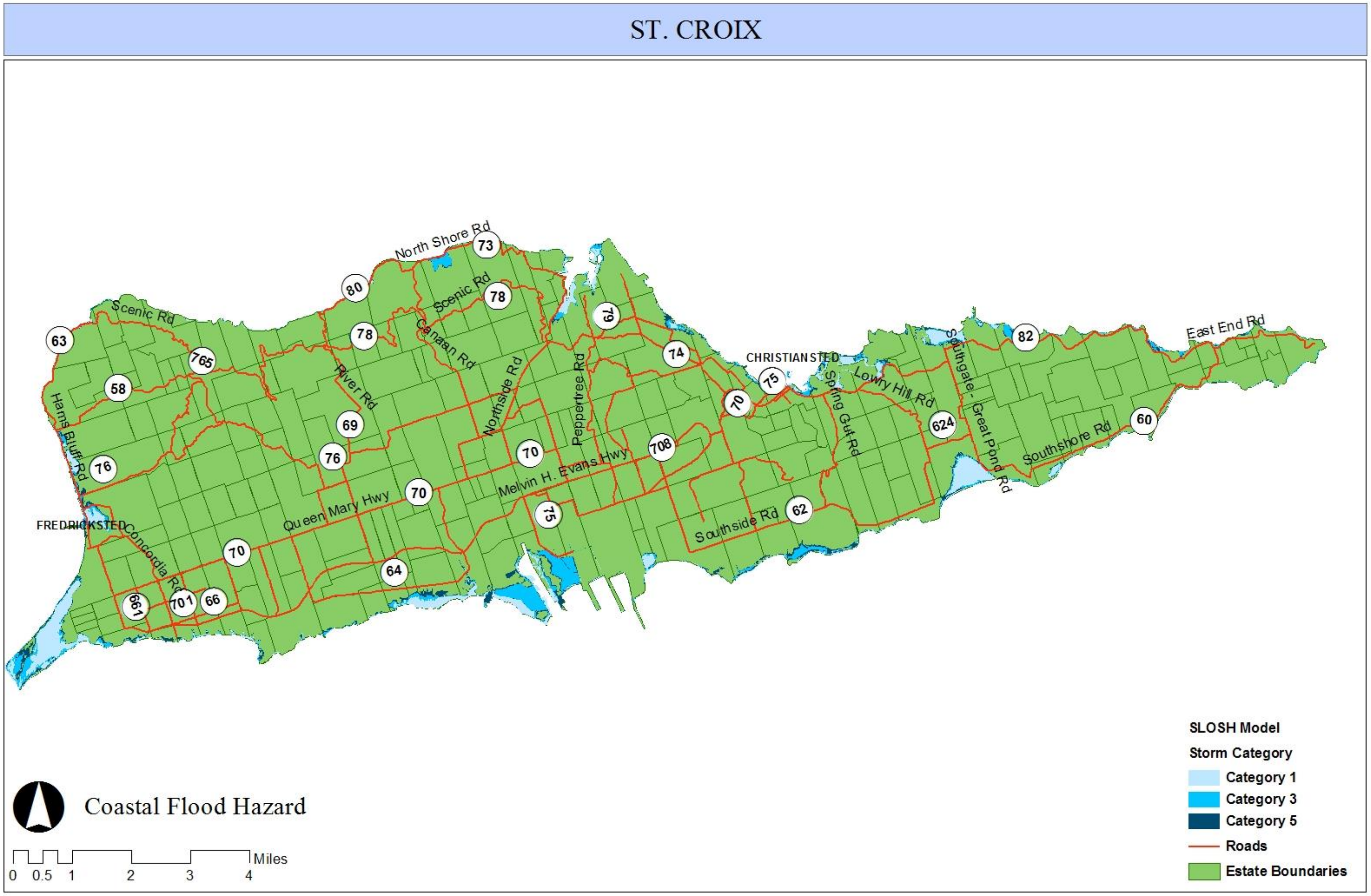
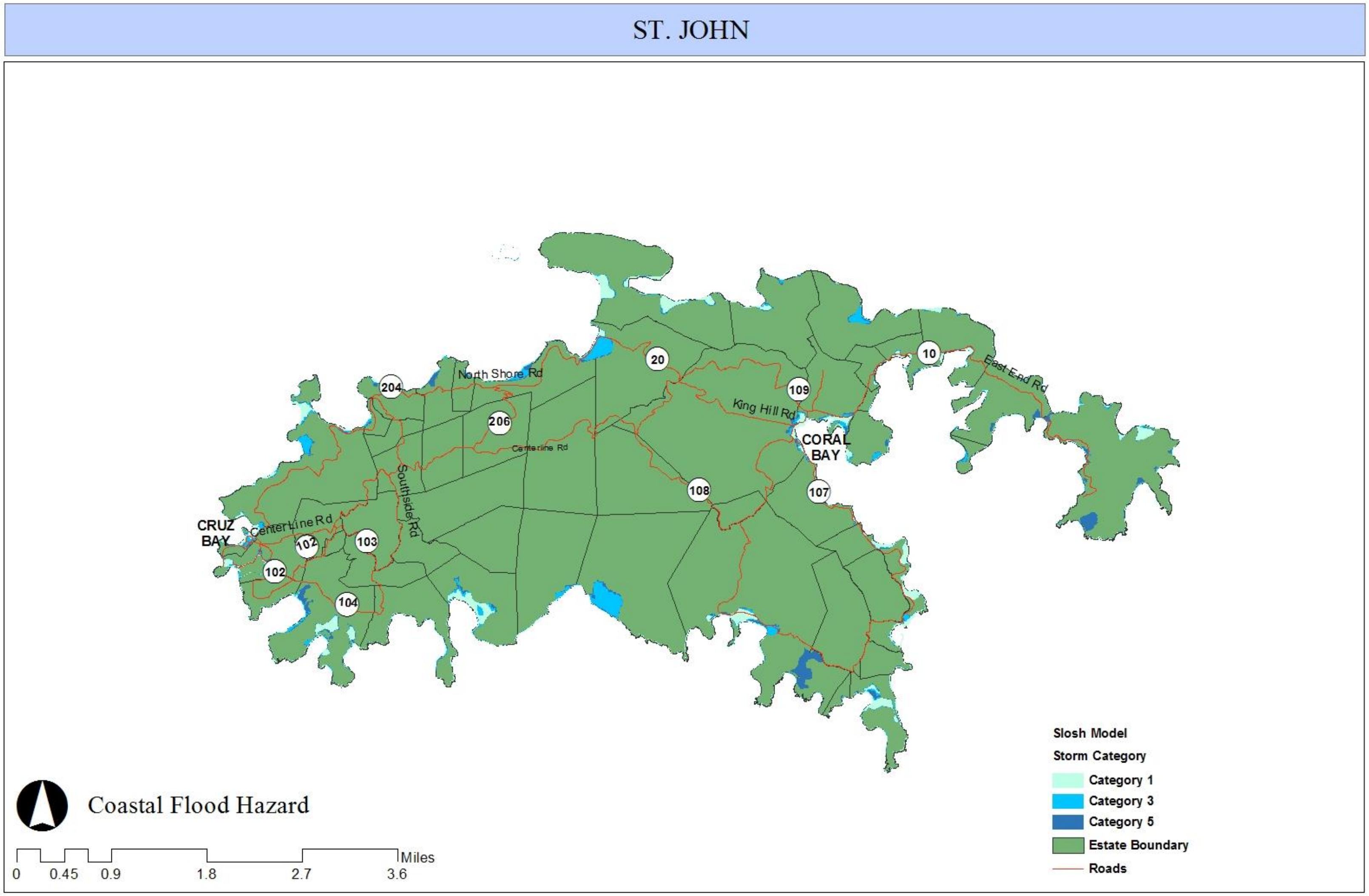


FIGURE 4.15 ***Coastal Flooding Hazard Map, St. John***



Disaster History

Since the last Plan Update (2011), there have not been any major coastal flooding Federal disaster declarations that have caused damage to residential and/or commercial buildings. During the last planning period (2008-2011), Hurricane Earl was the strongest storm to past the islands, but did not have much impact on the shorelines besides washing several boats ashore.

There is limited available information from the US Virgin Islands that isolates coastal flooding from other hazard impacts. One undocumented source lists 15 recorded accounts of storm surges in the local news records from 1867 to 1960. These ranged in magnitude from as little as 1 foot in elevation to the 12 foot mark in 1867. Nearly one half of the occurrences recorded maximum surge elevations of at least 8 feet with commensurate damage.

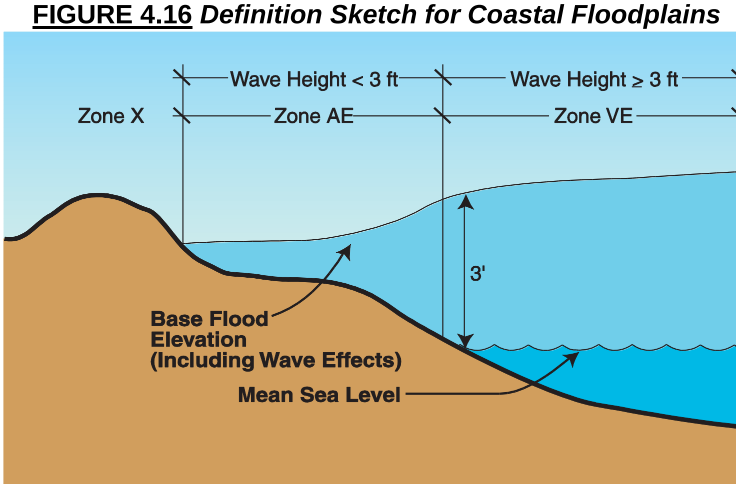
During Hurricane Lenny, tremendous storm surge and wave action affected structures well inland of the coastal high hazard zone (Zone VE) as shown on the FIRMs. The beach and dune systems in the coastal impact areas were destroyed causing increased storm surge inundation levels and wave action in areas previously modeled as being outside the Zone VE.

Between September 16-21, 2010, large, long-period northeast and then north swells of 9 to 13 feet generated by Hurricane Igor began affecting the U.S. Virgin Islands. These long period swells produced very large breaking waves of 15 to 20 feet or higher along local reefs, beaches, and shoals of the local islands. The swells produced minor coastal flooding, beach erosion, and minor structural damage. There was one reported drowning near the Carambola Beach Resort, 2 miles northeast of Christiansted, Saint Croix.

Climate Variability, Hazard Frequency and Magnitude

Much like riverine flooding, predictive modeling has been used by FEMA to create NFIP mapping that reflects the 1% recurrence interval events for storm surge or coastal flooding.

FIGURE 4.16 ***Definition Sketch for Coastal Floodplains***



Source: Understanding Your Risks – FEMA Publication 386-2, Page 2-24

While the “100-year floodplain” for inland and coastal purposes is usually referred to as the “A” zone, there is an additional designation in coastal areas, a “V” or “VE” zone that is the area subject to the 1% recurrence interval flood and in areas where the flood waters create waves that are 3 ft. or greater in height, are anticipated to be moving with velocity and associated forces. The velocity and force of the water make storm surges even more destructive than riverine flooding.

In low-lying coastal areas, such as estuaries, wetlands and mangroves, storm surge can cause problematic saltwater intrusion into freshwater systems. As rising water levels submerge low-lying portions of the lands, it has the potential disrupt sensitive ecosystems and potential diminish critical habitat for larval fish, natural sinks for sediments and pollutants, natural storage for floodwaters, and a cherished aesthetic quality of coastal regions (Incorporating Sea Level Change Scenarios at the Local Level, NOAA 2012).

However, to be consistent with the USACE SLOSH Model that depicts coastal hazard areas for Category 1, 3, and 5 hurricane events. There is an estimated 5% chance for the Territory to experience a Category 3 hurricane each year and the estimated annual probability of experiencing a Category 5 event is less than one percent a year.

Data Sources, Models and Methodologies

Information for the development of the Coastal Flooding Risk Assessment came from a variety of sources, including:

Base Data (Coastal Flooding)

- USACE SLOSH Model for Categories 1, 3, and 5 storms.
- USACE Digital Terrain Model

Coastal Flood Hazard Assessment and Determination

- USACE inundation maps derived from a SLOSH (Sea, Lake, and Overland Surges from Hurricanes) model computes storm were identified as the most comprehensive coastal flood polygon data for the US Virgin Islands.
- Surge inundation polygons were developed for three categories of hurricanes as defined by the Saffir-Simpson scale (Categories 1, 3, and 5).
- GIS overlay techniques were utilized to identify structures in the coastal flood polygons.
- Flood depths were estimated for each estate affected by coastal flooding by overlaying the Q3 flood zone data on a digital elevation model.
- NOAA Coastal service Center, Incorporating Sea Level Change Scenarios at the Local Level, NOAA 2012

Inventory Data (Assets)

- General Building Stock: Office of the Lt. Governor, Office of the Tax Assessor, Computer Mass Appraisal System Database and GIS Parcel Maps
- Critical Facilities and Infrastructure: VI Department of Property and Procurement, VITEMA

4.4.6 Hurricane Winds

Hazard Description

Hurricanes and tropical storms are large-scale systems of severe thunderstorms that develop over tropical or subtropical waters and have a defined, organized circulation. Hurricanes have a maximum sustained (meaning 1-minute average) surface wind speed of at least 74 mph; tropical storms have wind speeds of 39 mph to 74 mph.

Hurricanes and tropical cyclones get their energy from warm waters and lose strength as the system moves inland. Hurricanes and tropical storms can bring severe winds, inland riverine flooding, flooding in coastal areas, storm surges, coastal erosion, extreme rainfall, thunderstorms, lightning, and tornadoes. Hurricanes and tropical storms typically have enough moisture to cause extensive flooding throughout the Territory, often to the 100- or 500-year flood elevations. However, this subsection is focused on Hurricane Winds; flooding effects of hurricanes and tropical storms are covered in Sections 4.4.4 and 4.4.5 – Riverine and Coastal Flooding, respectively.

Hurricane magnitude is measured on the Saffir-Simpson hurricane scale, shown in Table 4.8, which categorizes hurricane magnitude by wind speeds and storm surge above normal sea levels.

TABLE 4.8 ***Saffir-Simpson Hurricane Scale***

Category	Wind Speed	Expected Damage
1	74–95 mph	**Minimal**: Damage primarily to shrubbery and trees; unanchored mobile homes damaged; some damaged signs; no real damage to structures.
2	96–110 mph	**Moderate**: Some trees toppled; some roof coverings damaged; major damage to mobile homes.
3	111–130 mph	**Extensive**: Large trees toppled; some structural damage to roofs; mobile homes destroyed; structural damage to small homes and utility buildings.
4	131–155 mph	**Extreme**: Extensive damage to roofs, windows, and doors; roof systems on small buildings completely fail; some curtain walls fail.
5	> 155 mph	**Catastrophic**: Considerable and widespread roof damage; severe window and door damage; extensive glass failures; entire buildings may fail.

Nature of the Hazard

The US Virgin Islands of the Caribbean are among the most hurricane-prone locations in the world. While the Atlantic Basin hurricane season officially extends from June 1 to November 30, over the last 117 years, the US Virgin Islands has experienced hurricanes no earlier than July 7th (unnamed storm in 1901) and as late as November 23rd (Hurricane Lenny in 1999).

In 2008, Hurricane Omar (2008) passed over the US Virgin Islands and caused damages to critical facilities and infrastructure that was estimated to be $2.2 million; while Hurricane Earl (2010), a much bigger storm, passed north of the Territory and caused $2.1 million in estimated damages. The Territory also experienced severe storms, flooding, rockslides, and mudslides associated with Tropical Storm Tomas in late November 2010.

The peak of activity occurs in September with half of the number of average annual storms occurring in that month.

Hazard Location, Extent and Distribution

One of the most serious components of hurricanes is high winds. Because of the extensive size of a catastrophic hurricane a storm need not pass directly over the Territory to cause severe damage. A hurricane passing within close proximity can also cause major damage to property and even loss of life. Due to the relatively small geographical size of the Territory, any storm passing within a radius of 100 miles is a potential for property loss. Within the past three years four Tropical Storm systems passed within this radius. Accompanying coastal and riverine flooding have a strong spatial context and are addressed in the later sections of this Plan.

Essentially there are no areas of the US Virgin Islands that are free from hurricane force winds. The coastal and low lying areas experience the first effects of damaging winds, but due to the hilly and mountainous nature of the Territory, winds are funneled in gullies and passes between mountainous terrain seeking to traverse the mountains and ridges, and are often compacted and intensified causing damage to structures at higher elevations. While the entire territory is exposed to hurricane winds, there are variations in vulnerability primarily due to the number of properties and type of construction. The newer construction structures that have been built to codes are less vulnerable than the older structures. Another factor is the type of construction – i.e. wood frame structures – that are more susceptible to damages than reinforced concrete. The differences in vulnerability for each island in the Territory are highlighted in Section 4.5 below.

Disaster History

For this Plan Update, there have been no federal disaster declarations. Since the 2005 Plan, Tropical Storm Dean (8/17/07) traversed south of the Virgin Islands. Minimal damage was sustained and limited for the most part to downed trees and coastal road erosion. Between 1887 and 1989, 36 hurricanes passed within 125 miles of the US Virgin Islands (USACE *Hurricane Evacuation Study*, 1994).

Of the 22 most deadliest, costliest, and most intense hurricanes to strike outlying US territories and the State of Hawaii over the past 100 years, 7 have struck the US Virgin Islands including:

- San Ciprian (1932). US Virgin Islands and Puerto Rico (PR). Damages estimated at $494 million,
- San Mateo (1949). St Croix. Damages unknown,
- Donna (1960). St. Thomas and PR. Damages unknown,
- Hugo (1989). US Virgin Islands and PR. Damages estimated at $1.4 billion,
- Marilyn (1995). US Virgin Islands and PR. Damages estimated at $1.8 billion,

- Georges (1998). US Virgin Islands and PR. Damages estimated at $1.9 billion, and
- Lenny (1999). US Virgin Islands and PR. Damages estimated at $342 million.

Note: Damage estimates include Puerto Rico and were adjusted for inflation (NOAA 2004); damages for Omar and Earl are from Preliminary Damage Assessment Reports.

In 2004 four major storms passed through the Caribbean causing varying levels of damage with one – Tropical Storm Jeanne – resulting in a presidential disaster declaration. Tropical Storm Jeanne affected the Territory with high winds and torrential rains inflicting a total of $6.4 million in damage, mostly to the infrastructure, with downed power lines and damaged or debris filled roadways. Most damage was caused on St. Croix, but all three islands of the Territory experienced damage and received excessive rainfall and record flood levels. The damages associated with the Omar 2008 ($2.2 million) and Earl 2010 ($2.1 million) are minor in comparison.

The majority of presidential declarations in the US Virgin Islands result from hurricanes. A brief description of some recent hurricanes that have impacted the US Virgin Islands follows:

- **Hurricane Klaus** (October 1984). Hurricane Klaus traversed the islands leaving moderate damage to roads and bridges, and heavily damaging the Fredericksted Pier in St. Croix. The most significant hazard event was flooding caused by the heavy rains that accompanied the storm.
- **Hurricane Hugo** (September 1989). Hugo passed directly over the Island of St. Croix on a west northwest track at speeds of 3 - 10 mph. Hugo was a destructive Category 5 hurricane when it impacted St. Croix. As a result, St. Croix suffered damages of catastrophic proportion. The center of the storm passed west of St. Thomas, but still inflicted severe damage. St. Thomas received substantial damage to public and private facilities.
- **Hurricane Marilyn**[7] (September 1995). This time, St. Thomas bore the brunt of this large hurricane; the eye of the hurricane was more than 20 miles across. Hurricane Marilyn was at Category 1 strength, and intensified to nearly Category 3 strength by the time it reached the U.S. Virgin Islands. Marilyn caused 10 deaths and left thousands homeless. Marilyn damaged or destroyed nearly all 12,000 homes on St. Thomas and another 5,000 on St. Croix. Damage to commercial and residential roofs was extensive. The damages to the WAPA's electric distribution system alone were estimated at $44 million. The storm also destroyed warehoused food stocks and damaged the only hospital on St. Thomas.
- **Hurricane Lenny** (November 1999). An unusual hurricane that tracked across the Caribbean from the west. Lenny made landfall on the western coast of the St. Croix, causing extensive storm surge damages along it's coastline. Lenny's maximum winds reached 150 mph as it approached the US Virgin Islands.
- **Hurricane Omar** (October 2008). Hurricane Omar weakened from a Category 3 to a Category 1 storm as it quickly moved over the US Virgin Islands. A last minute shift to the east spared St.

[7] Hurricane Marilyn was at Category 1 strength, and intensified to nearly Category 3 strength by the time it reached the U.S. Virgin Islands.

Croix, the most populated of the U.S. Virgin Islands, which received just a glancing blow from the weaker side of the system. Omar knocked down trees, caused some flooding and minor mudslides.

- **Hurricane Earl** (August 2010). Hurricane Earl, a Category 3 storm, passed near or over the northernmost part of the U.S. Virgin Islands. Hurricane conditions spread across the northern U.S. Virgin Islands to Culebra and Puerto Rico. The eye of Earl passed just north of the British Virgin Islands, and its closest point of approach to the U.S. Virgin islands was around 3 pm on the 30th when it was located about 60 miles northeast of St. Thomas. By 5 pm Earl strengthened into a category 4 hurricane, with maximum winds of around 135 mph while it was moving away from the Virgin Islands.

It is important to note that prior to Hurricane Hugo, the last hurricane with winds of Category 3 or greater occurred 73 years earlier in 1916. During the period from 1916 to 1989, dozens of milder tropical storms and hurricanes came in close proximity or made landfall but none caused the damages associated with Hugo and Marilyn.

Climate Variability, Hazard Frequency and Magnitude

A 1994 study produced for the US Virgin Islands Water and Authority (WAPA)[8] used the available historical record to determine approximate return periods (probability of frequency) for hurricanes of different categories (see Table 4.8: Saffir-Simpson Hurricane Scale). For example, the Territory could expect a Category 3 hurricane once every 20 years as shown on the matrix below. The results are shown in Table 4.9

TABLE 4.9 ***Frequency of Hurricanes Passing By or Through the US Virgin Islands***

Intensity	Average Return Period
Category 3	20 years
Category 4	50 years
Category 5	120 years
Source: US Virgin Islands WAPA 1994	

[8] The study went on to note: "*that the above estimated return periods are for hurricanes with the corresponding intensity level passing by or through the islands and are not the return periods for a direct hit on the islands. Moreover, because the prevailing hurricane direction in this region is from east to west, the chance of a hurricane traveling north and hitting St. Croix first and then St. Thomas and St. John is very small. Thus, the worst possible realistic scenario is for a hurricane track to be located between St. Croix and St. Thomas/St. John having an east/southeast to west/northwest direction.*"

The Atlantic Oceanographic and Meteorological Laboratory's FAQ (Frequently Asked Questions) web site[9] indicates that there is an estimated 42% chance each year of experiencing a strike by a tropical storm or hurricane in the US Virgin Islands. These probabilities were developed from recorded data for the years 1944 to 1999 when a storm or hurricane was within about 100 miles (165 km) of a particular location.

The structure and areal extent of the wind field in tropical cyclones is largely independent of intensity storms and play an important role on potential impacts. With the use of satellite imagery and other instruments, intensity measurements have become more accurate, and as a result, the recorded intensities of wind storms in the Atlantic have been increasing. However, the IPCC Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC AR5, 2013) indicates that the frequency of the most intense storms is more likely than not to increase by more than +10% (IPCC 2013, AR5), while the annual frequency of tropical cyclones are projected to decrease or remain relatively unchanged for the North Atlantic. This suggests no major change in the frequency of hurricanes in North Atlantic region comprising USVI and that wind speeds are expected to actually decrease by very small magnitude of 0.25 m/s (0.559 mph) over the projected for the 2040s relative to the 1960-1990 baseline.

The design wind speed for the USVI in ASCE 7-05 is 145 mph (3-second peak gust) may actually decline marginally due to climate change projects, if it were indeed related to a return interval. This is equivalent to a Category 3 hurricane on the Saffir Simpson scale. There is an estimated 5% chance of experiencing a Category 3 hurricane each year.

Data Sources, Models and Methodologies

Information for the development of the Hurricane Risk Assessment came from a variety of sources, including:

Base Data

- NOAA National Climatic Data Center.
- American Society of Civil Engineers (ASCE) 7-05 Design Wind Speeds.
- *"Estimation of Potential Hurricane and Earthquake Losses to Water and Power Facilities"* (EQE international, 1994.)
- IPCC AR4, 2007, The IPCC Fourth Assessment Report of the Intergovernmental Panel on Climate Change
- IPCC AR5, 2014, IPCC Fifth Assessment Report of the Intergovernmental Panel on Climate Change

Hurricane Hazard Assessment and Determination

- The American Society of Civil Engineers (ASCE) 7-05 Design Wind Speed maps were the primary data input for the wind hazard model as probabilistic data were not readily available. The ASCE Design Wind Speeds take into account historical events such as hurricanes and tropical storms.

[9] http://www.aoml.noaa.gov/hrd/tcfaq/G11.html

The design wind speed in ASCE 7-05[10] for the US Virgin Islands is 145 Mph. In this study design wind speed refers to the sustained wind velocity that structures should be constructed to withstand without suffering catastrophic or total damage. The maps developed show the frequency and paths of hurricanes with winds of Category 4 or above.

Inventory Data (Assets)

- General Building Stock: Office of the Lt. Governor, Office of the Tax Assessor, Computer Mass Appraisal System Database and GIS Parcel Maps
- Critical Facilities and Infrastructure: VI Department of Property and Procurement, VITEMA

[10]Note that ASCE wind speeds are 3-second peak gusts

4.4.7 RAIN-INDUCED LANDSLIDE

Hazard Description

Landslides are described as downward movement of a slope and materials under the force of gravity. The term landslide includes a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Landslides are influenced by human activity (construction of buildings and highways) and natural factors (soils, precipitation, and topography).

Landslides occur when masses of rock, earth, or debris move down a slope. Therefore, gravity acting on an overly steep slope is the primary cause of a landslide. They are triggered by storms, earthquakes (not addressed in this analysis), and by human modifications to the landscape. Wildfires can increase the probability of rain-induced landslides occurring.

Mudflows (or debris flows) are flows of rock, earth, and other debris saturated with water. They develop when water rapidly accumulates in the ground, such as during periods of prolonged heavy rainfall, changing the earth into a flowing river of mud. Mudslides can flow rapidly down slopes or through channels and can strike with little or no warning at tremendous speeds. Other types of landslides include: rock slides, slumps, mudslides, and earthflows. All of these differ in terms of content and flow. In the USVI, hydrologic factors (rain, high water table, little or no ground cover) and human factors (development activities such as cutting and filling along roads and removal of forest vegetation) exacerbate the effects of landslides.

Nature of the Hazard

It is very hard to evaluate the location or geographic distribution of landslides across the U.S. Virgin Islands as there is not a historical record from which to reference the incidences of landslides in the Territory. Landslides occur because of a variety of factors in the Virgin Islands and are dues to such factors as topography, slope, climate, and soils. Locations at risk from landslides include areas with one or more of the following conditions:

- On or close to steep hills;
- Steep road-cuts or excavations;
- Existing landslides or places of known historic landslides (such sites often have tilted power lines, trees tilted in various directions, cracks in the ground, and irregular-surfaced ground);
- Steep areas where surface runoff is channeled, such as below culverts, V -shaped valleys, and steep intermittent stream channels; and
- Areas where slopes are not maintained or are altered by the property owners (clear-cutting).

Although spatial extent of landslides is hard to determine, human impacts have substantial effect on the potential for landslide failures. Proper planning and geotechnical engineering can be exercised to reduce the threat to people, property, and infrastructure.

Hazard Location, Extent and Distribution

Figure 4.17, 4.18, and 4.19 illustrate the geographic coverage of areas susceptible to rain-induced landslides on the three major islands. The landslide susceptibility maps were developed as part of this project through a constraint mapping methodology that combined elevation, slope, soils and hydrologic units in a Geographic Information System computer model. The following areas are most susceptible to rain-induced landslides on an island by island basis:

- St. John - Events like the severe rainfall experience in November 2010 triggered landslides along portions Centerline road between Cruz Bay and Coral Bay. Nine areas along Centerline Road were blocked and another major landslide in the Bordeaux Mountain area also blocked a major road.
- St. Thomas. The mountain areas, particularly northern facing slopes of the island are the most susceptible to the landslides. Areas in Dorothea and St. Peter Mountain road are especially prone to this hazard. These areas experienced washouts during the recent heavy rainfall events (November/December, 2010). Higher elevations on southern facing slopes, particularly in the area of Crown Mountain are also susceptible to landslides. On Crown Mountain road, a deluge of water shut down the road. A major landslide just beyond the intersection of Crown Mountain and Scott Free roads occurred, along with other smaller landslides. This left Crown Mountain Road impassable at one point.
- St. Croix. The greater variations of rainfall on St. Croix make the landslide hazard more dispersed. The northwestern part of the island receives the greatest amount of rainfall, and as a result, the northern slopes of the mountainous area are highly susceptible to landslides. There are some central areas with steep slopes in the south central area of the island (outside Christiansted) that are also susceptible to landslides. Eastern portions of the island are less susceptible to landslides, particularly lower portions of watershed basins.

Disaster History

Almost no published literature on the occurrence of landslides exists for the Virgin Islands[11].
A reconnaissance of landslide potential on St. Thomas (Brabb, 1984) indicates that earthflows, debris slides, and individual boulders are recognized landslide types on St. Thomas. Debris flows are not documented or reported as occurring on this island.

11 http://isis.uwimona.edu.jm/uds/Land_US Virgin Islands.html

- The largest landslide documented on St. Thomas is 60 meters long and 60 meters wide. It was mapped in an area about 1.5 kilometers north of Charlotte Amalie in 1979.

- On April 18, 1983, a storm drenched Dorothea Bay with nearly 400 millimeters of rain in 14 hours. In addition to extensive flooding, this storm event produced a number of landslides. Two earthflows developed in weathered colluvium (unconsolidated materials of various sizes). These are small features about 30 meters long and 30 meters wide. Very small debris slides occurred in colluvium exposed at the top of some road cuts. Boulders temporarily blocked several roads. One boulder which was 6 meters in maximum diameter traveled 10 meters downslope before stopping next to and above a house (Brabb, 1984).

- St. John (2010) nine (9) landslides occurred along portions Centerline road between Cruz Bay and Coral Bay.

- St. John (2010) another major landslide in the Bordeaux Mountain area also blocked a major road.

- St. Thomas. (2010) a major landslide just beyond the intersection of Crown Mountain and Scott Free roads.

FIGURE 4.17 ***Landslide Hazard Map, St. Thomas***

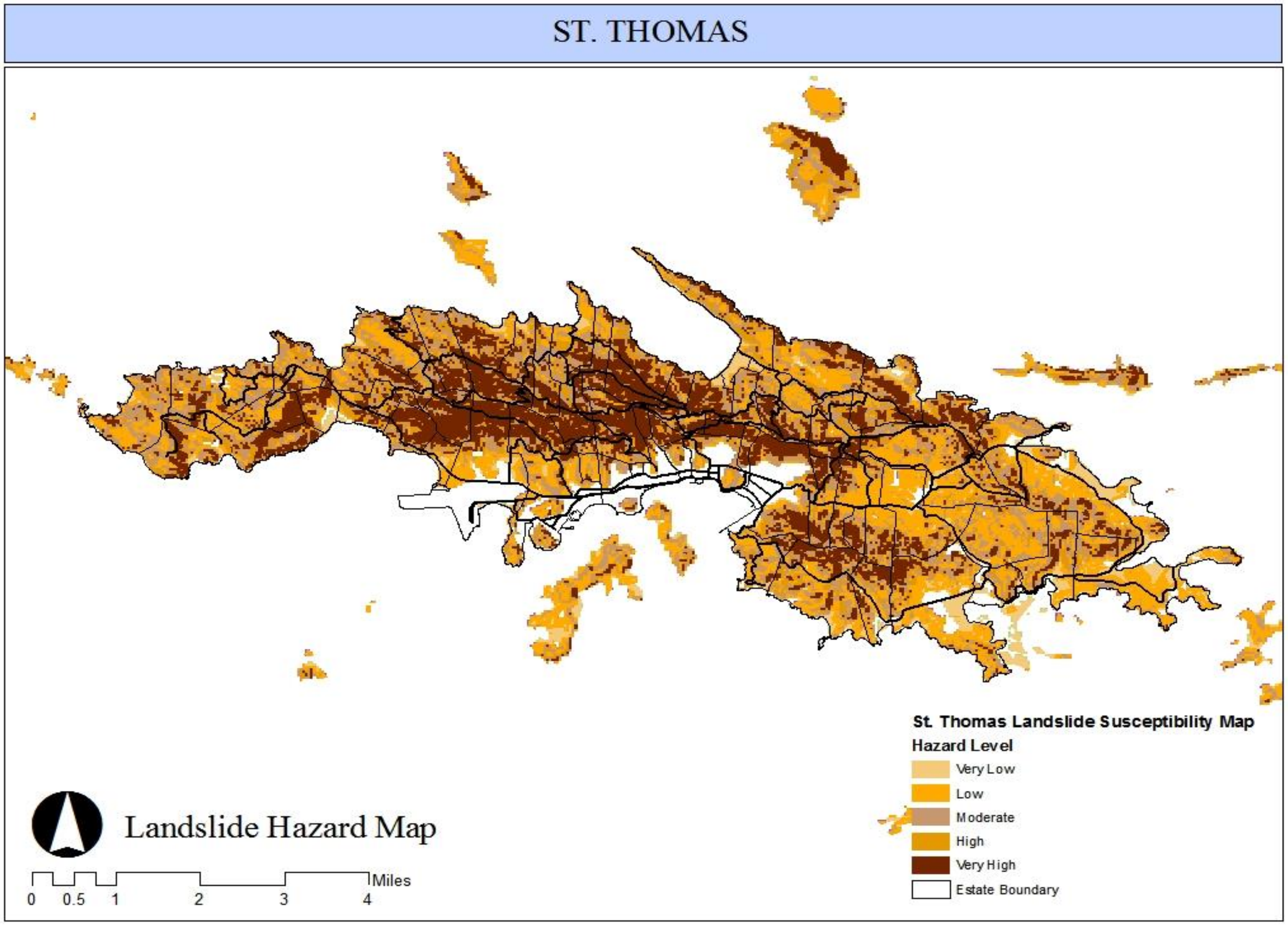


FIGURE 4.18 ***Landslide Hazard Map, St. Croix***

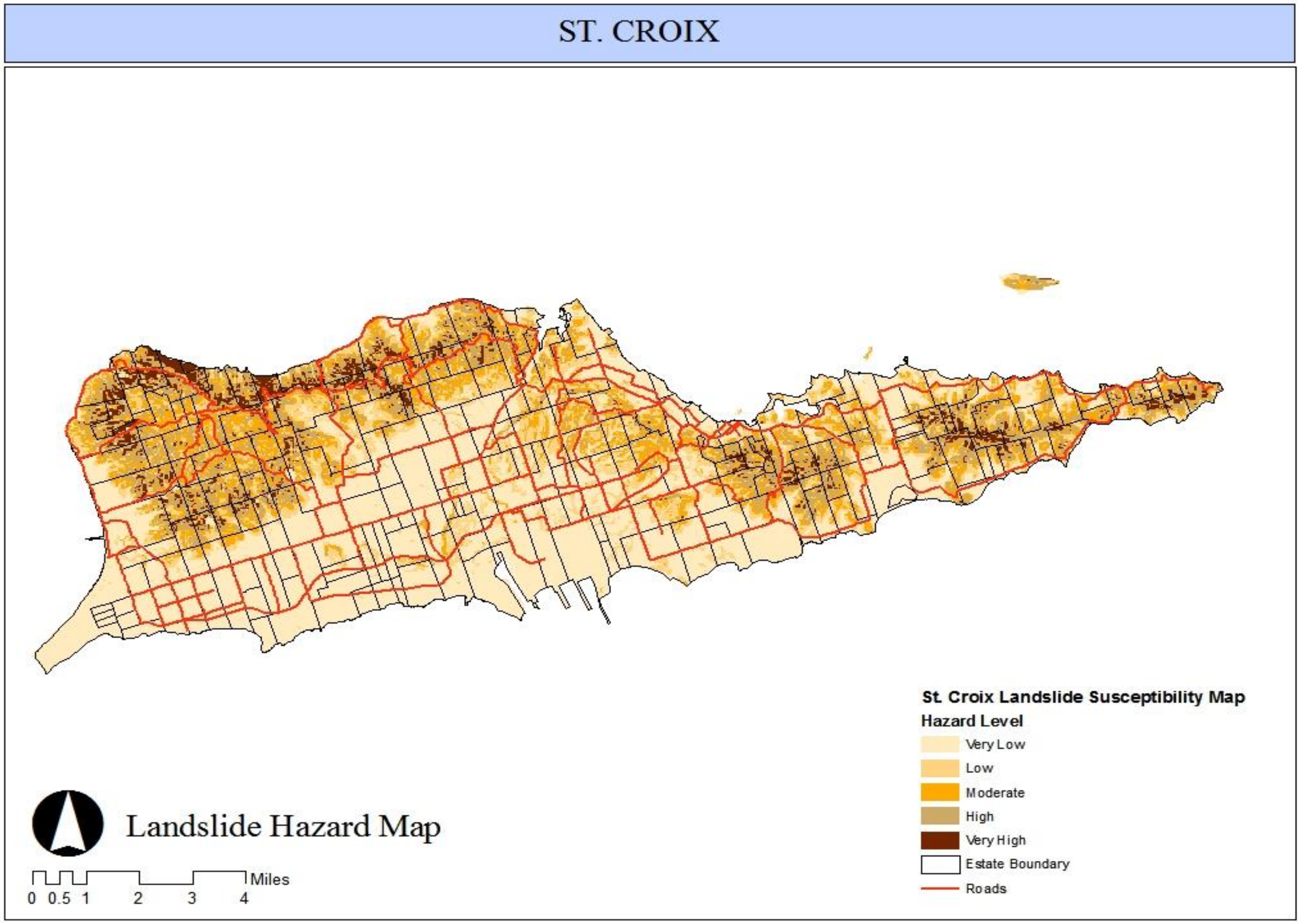
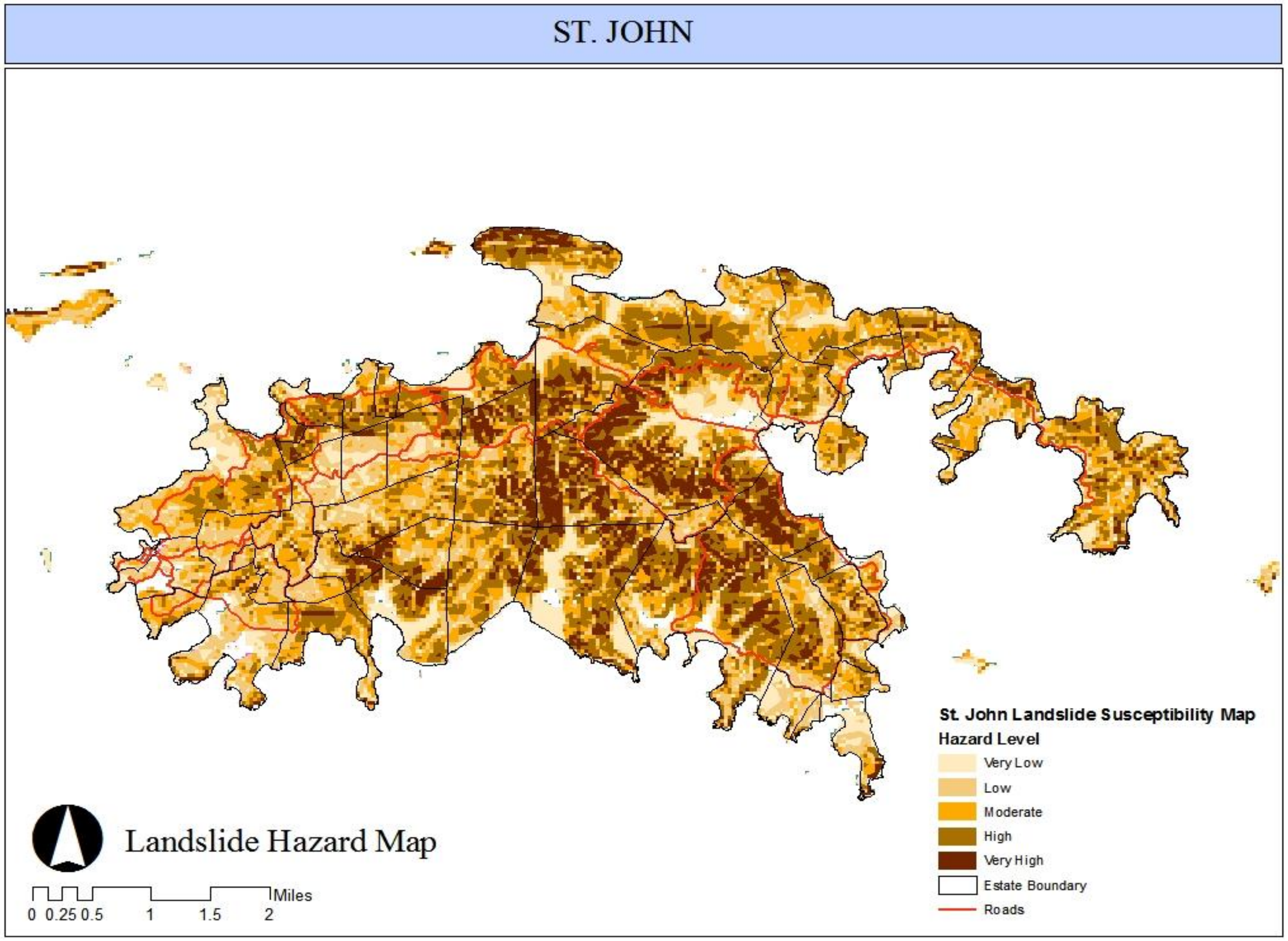


FIGURE 4.19 ***Landslide Hazard Map, St. John***



Climate Variability, Hazard Frequency and Magnitude

There is a general lack of understanding and information available to determine the frequency and/or magnitude of landslides in the US Virgin Islands. If we tied the incidence of rain-induced landslides to heavy rainfall events, it appears landslide activity is limited in magnitude as the economic data has not been captured for documenting the impact of each landslide. Based on the limited data, US Virgin Islands (territory-wide) can expect at least one (1) landslide event per year.

The implications of climate variability on the landslide hazard is tied to the intensity of past climate data so as to facilitate an understanding of whether data derived from regional climate models will increase the potential for landslide events in the study area. The hazard model that was used took into consideration precipitation, which indicates that landslide events are triggered by intense precipitation. Therefore, based on the IPCC projections which predict an increase intense precipitation events, the impact f climate change will increase the possibility of experiencing landslides will increase.

To incorporate climate change into future landslide hazard models will necessitate making use of detailed historic records.

Data Sources, Models and Methodologies

Base Data

- (2010): Average Annual Rainfall 1971 -2000, Oregon State University (OSU) Spatial Climate Analysis Service.
- USACE Digital Terrain Model (2008)
- Hydrologic Units for USVI (2002) U.S. Geological Survey in cooperation with the U.S. Department of Agriculture, Natural Resources Conservation Service

Hazard Assessment and Determination

- USVI Soil Survey, US Department of Agriculture, Natural Resources Conservation
- Brabb, E.E. 1984. Landslide potential on St. Thomas, Virgin Islands, p.97-102. U.S. Geological Survey Open –File Report 84-762

Inventory Data (Assets)

- General Building Stock: Office of the Lt. Governor, Office of the Tax Assessor, Computer Mass Appraisal System Database and GIS Parcel Maps
- Critical Facilities and Infrastructure: VI Department of Property and Procurement, VITEMA

4.4.8 TSUNAMI

Hazard Description

A tsunami is a series of long waves generated in the ocean by a sudden displacement of a large volume of water. Underwater earthquakes, landslides, volcanic eruptions, meteor impacts, or onshore slope failures can cause this displacement. Most tsunamis originate in the Pacific Ocean associated with the high level of seismic activity present.

Tsunami waves can travel at speeds averaging 450 to 600 miles per hour. As a tsunami nears the coastline, its speed diminishes, its wavelength decreases, and its height increases greatly. Unusual heights have been known to be over 100 feet high. However, waves that are between 10 to 20 feet high can be very destructive and cause many deaths and injuries. An earthquake need not originate in the near proximity to a land mass to be destructive. Simply put, tsunamis are known to have immediate, intermediate and distant ranges. Destructive waves are known to travel over 1000 miles at alarming speeds. Of course, the closer the epicenter of an event to a land mass, the shorter the period of warning and preparation.

After a major earthquake or other tsunami-inducing activity occurs, a tsunami could reach the shore within a few minutes. From the source of the tsunami-generating event, waves travel outward in all directions in ripples. As these waves approach coastal areas, the time between successive wave crests varies from 5 to 90 minutes. The first wave is usually not the largest in the series of waves, nor is it the most significant. One coastal community may experience no damaging waves while another may experience destructive deadly waves. Some low-lying areas could experience severe inland inundation of water and deposition of debris of more than 1,000 feet inland.

Nature of the Hazard

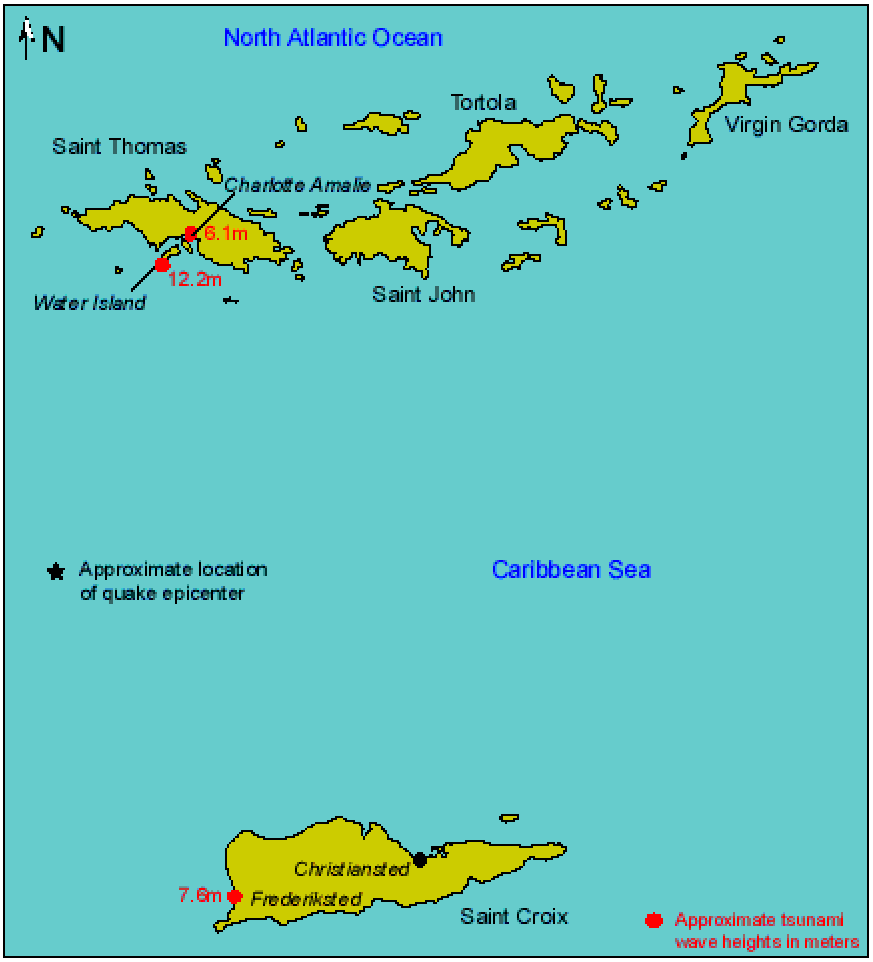
Due to the historical record of earthquakes in the region, it is considered reasonable to expect that tsunamis would be generated as well, and the historic record bears this out (see Disaster History below). It is important to note that the sites for tsunami generation are likely to be very close to the coast and so warning time is very short. Therefore, the types of strategies that will be more effective focus on proper siting of structures as opposed to implementing warning systems.

However, in 2000, the University of Puerto Rico established a tsunami warning system for both Puerto Rico and the U S Virgin Islands. The efforts to strengthen its reliability and effectiveness have increased, especially since the major event in the Pacific Basin in 2004 that affected Indonesia, W Thailand, Sri Lanka, SE India. The warning system has an estimated response time of twenty minutes after an earthquake event. But the close proximity of the Puerto Rican Trench and the Anegada Fault, a devastating tsunami could occur before warning is issued. Researchers estimate that should a strong tsunami occur in the northern Caribbean region, the increase in population within the potentially affected zone, 35,5 million people could be affected by such an event.

Tsunamis had a dramatic impact on the US Virgin Islands, when in 1867, a magnitude 7.5 earthquake occurred in the Anegada Trench. Two tsunami waves struck Charlotte Amalie, ten minutes apart. Both waves struck the harbor as a large recession of water, followed by a bore, which eyewitness accounts describe as a 6 meter wall of water. The waves destroyed many boats anchored in the harbor, leveled the town's iron wharf, and either flooded out or destroyed all buildings located along the waterfront area. The tsunami produced an estimated 2.4 meters of run-up at Charlotte Amalie, and a maximum 75 meters of landward inundation. Frederiksted, in St. Croix was also stuck by two tsunami waves, that same day, although of lesser magnitude, estimated at 7.6 meters high.

Figure 4.20 illustrates the projected epicenter of the 1867 earthquake in relation to St. Thomas and St. Croix.

FIGURE 4.20 ***Projected Epicenter of the 1867 Earthquake***



Hazard Location, Extent and Distribution

Tsunami hazard areas are all low lying, relatively flat coastal areas. Tsunami hazard areas in US Virgin Islands are depicted in Figures 4.21, 4.22 and 4.23. Tsunami impacts will vary in the Virgin Islands. The Tsunami hazard maps have been updated for this Plan Update to be more conservative. They have been developed in accordance national tsunami evacuation planning mapping documentation. The maps have been developed to define an evacuation zone for the US Virgin Island using an 82-foot elevation profile and an inundation of 2 miles from the coast. This evacuation criterion was based on historical events, tsunami modeling results from Puerto Rico and the BVI and the US National Tsunami Hazard Mitigation Program guidelines. This conservative estimate, however, did not consider offshore and near shore coastal topography (not considered in the tsunami hazard map developed in this study), vegetation and level and type of development. High waves will have only a serious impact, however, if the shoreline is low enough to be susceptible to flooding.

On St. Thomas, like St. John, the coastal areas are intensively developed. Charlotte Amalie and Cruz Bay are urbanized and have extensive infrastructure and road networks and are considered the most vulnerable areas to the tsunami hazard. On St. John, waterfront development, particularly port facilities and commercial development on the water such as shopping centers and hotels along the coastline could be affected by a tsunami. Both islands have secondary locations, Red Hook on St. Thomas and Coral Bay on St. John that are vulnerable to a tsunami. Both of these locations have experienced significant development in the past three years creating a potential for considerable property damage and possible loss of life.

In St. Thomas, cruise ships are highly vulnerable to tsunamis. In a recent paper given to the NSF Caribbean Tsunami Workshop, San Juan, March 30-31, 2004, Dr. Roy A. Watlington of the University of the Virgin Islands, indicated that on a three cruise ship day in St. Thomas, between 8:00 and 10:00 am as many as 12,000 tourists and crew may disembark to engage in recreational activities. The preferred activities of visitors, which include swimming at beaches, visits to the Coral World aquarium, sailing and boat sightseeing, keep them confined to tsunami prone coastal areas. Since the business district of Charlotte Amaile is also exposed to a tsunami, those visitors who elect to frequent the many stores, are also at risk. Furthermore, the report cites that several critical facilities are prone to tsunamis. These facilities include Virgin Islands Government offices (legislature, courts, and executive offices), electricity/desalination plants of the Water and Power Authority, the airport, port facilities and several schools.

The physiographic composition of St. Croix is vastly different from the previous two islands. The result is a landscape with much less topographic relief than St. Thomas and St. John. Nevertheless, it has two urban areas, Christiansted and Frederiksted that are particularly exposed to tsunami hazard. The town of Frederiksted suffered major damage from the 1867 tsunami, but not to the extent experienced on St. Thomas. Watlington, 1984 cites that on St. Croix several critical facilities are prone to tsunamis. These facilities include the electricity/desalination plant of the Water and Power Authority, HOVENSA (a large oil refinery), and the airport.

FIGURE 4.21 ***Tsunami Hazard Map, St. Thomas***

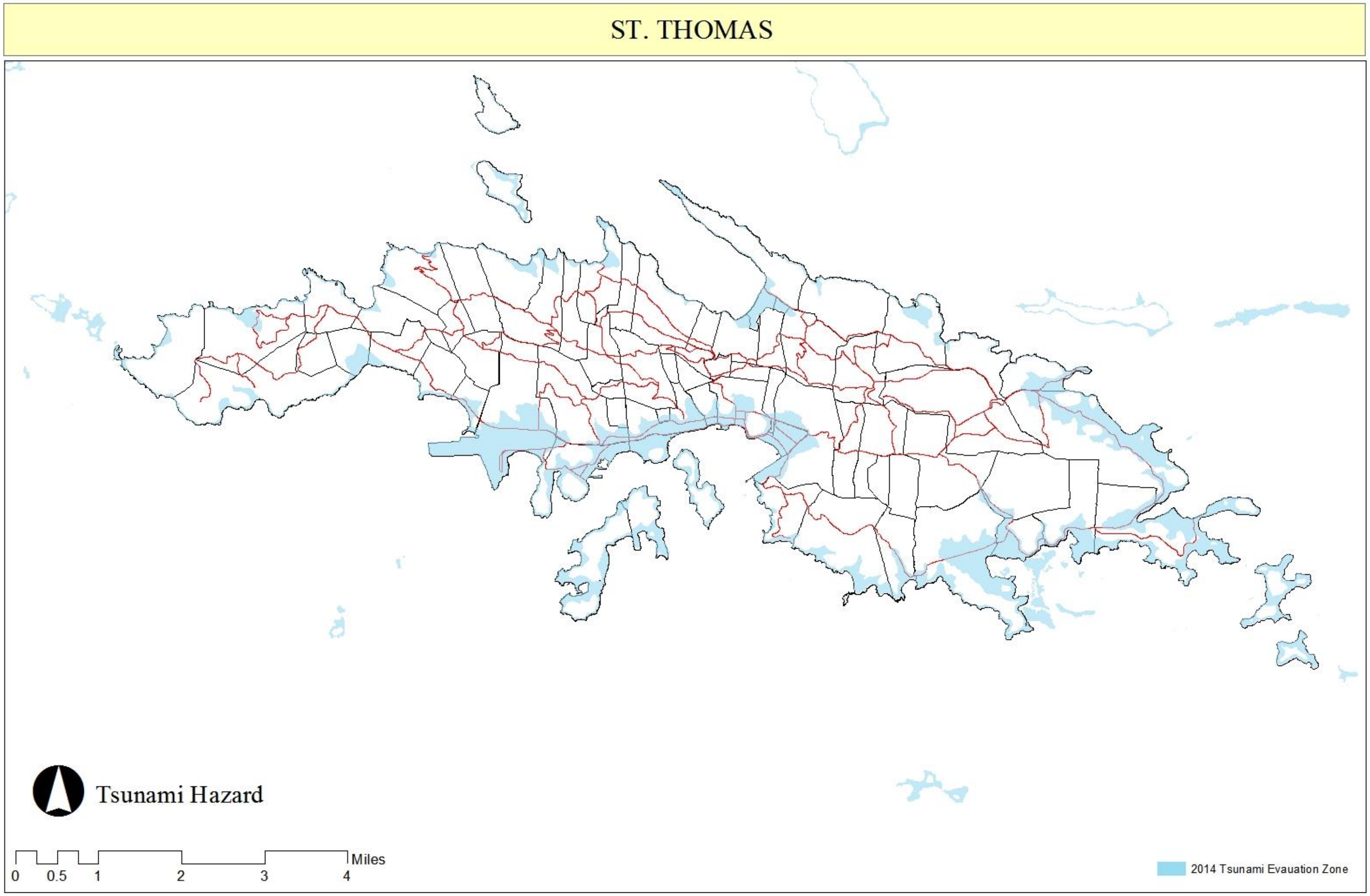


FIGURE 4.22 ***Tsunami Hazard Map, St. Croix***

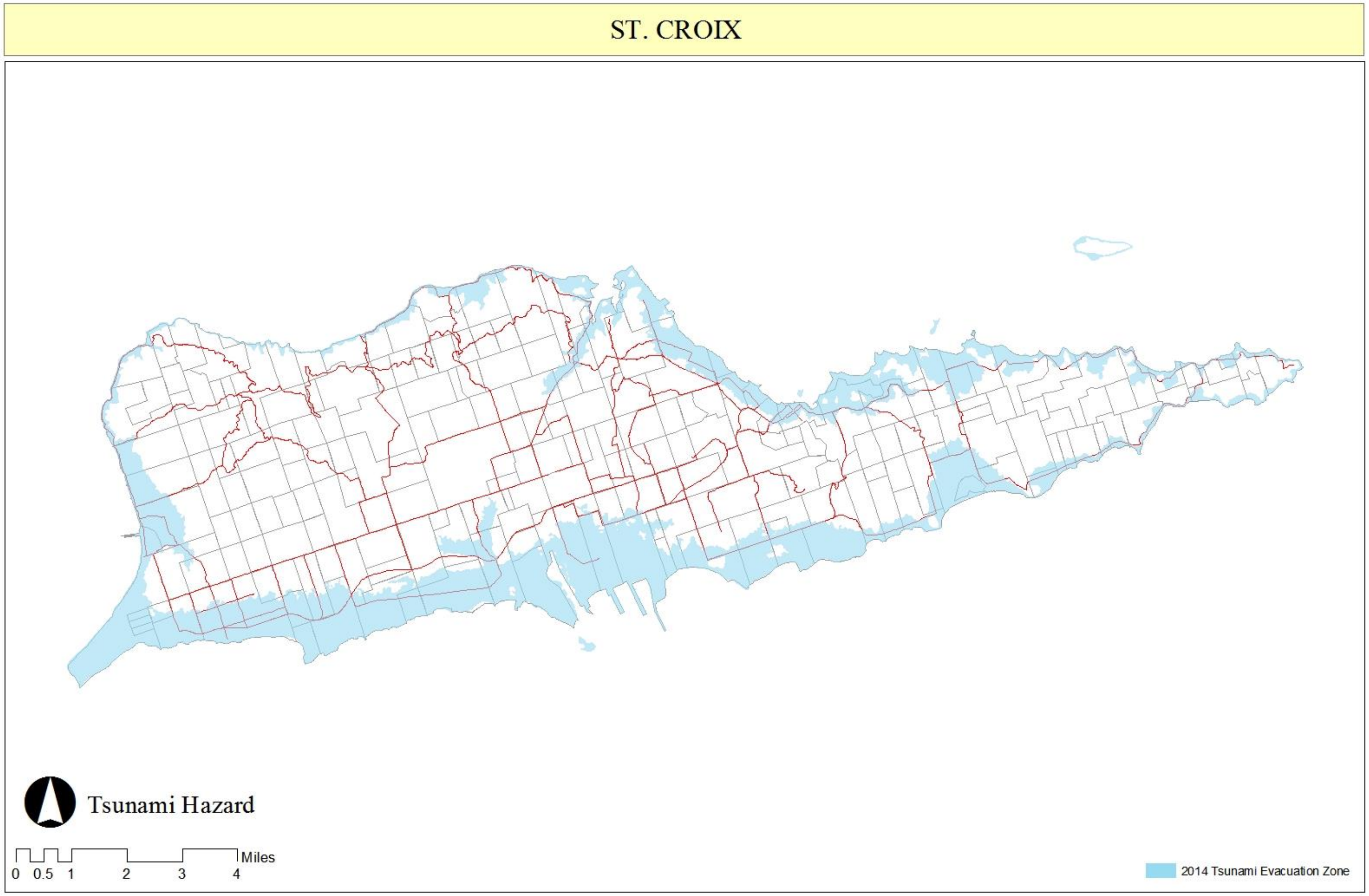
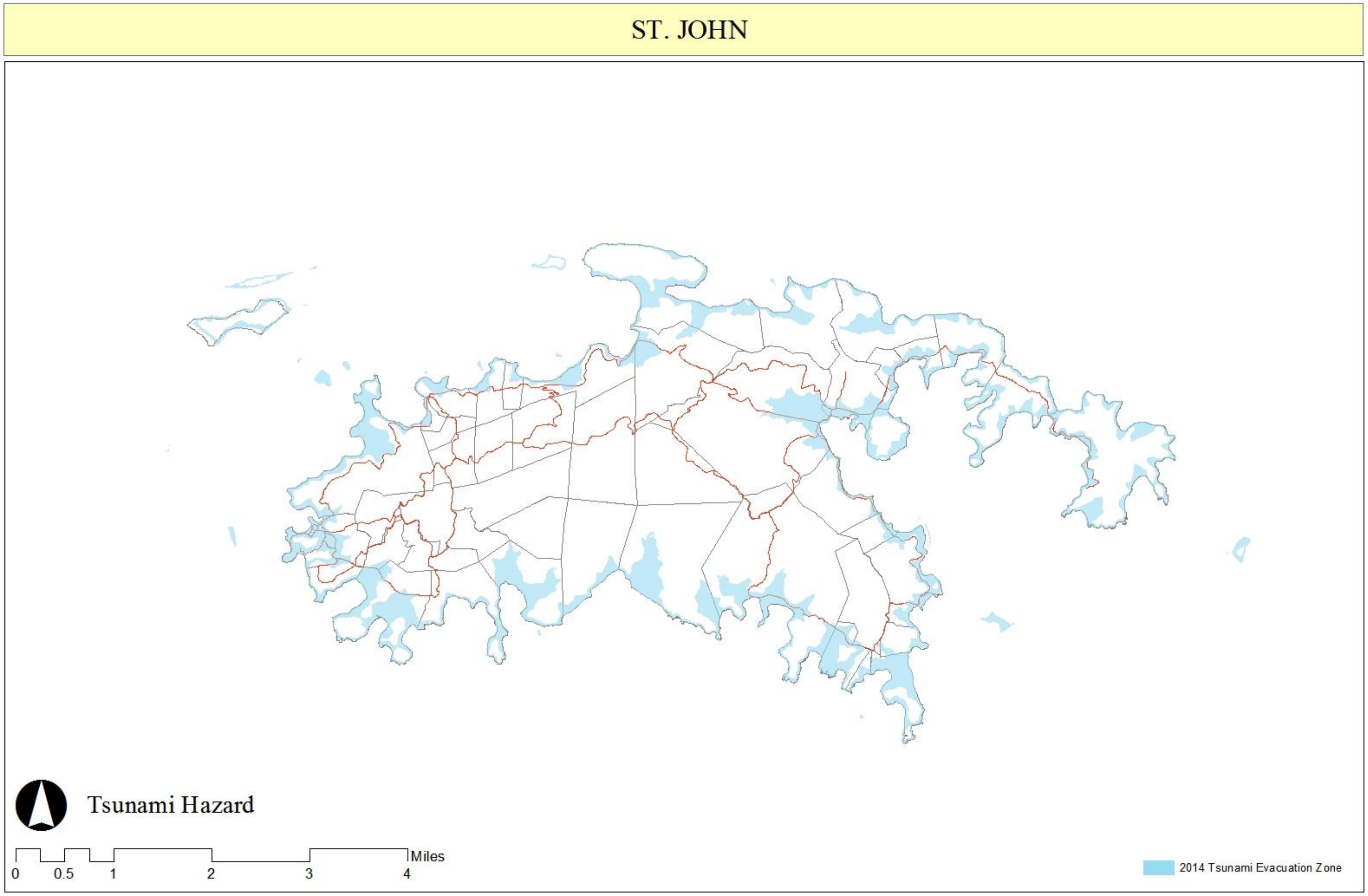


FIGURE 4.23 ***Tsunami Hazard Map, St. John***



Disaster History

Tom Parsons and Eric Geist[12] identify 116 individual observations of tsunami run ups in excess of 0.5 meters since 1530 (Caribbean-wide). Of these events, 14 tsunamis have been reported from Puerto Rico and the Virgin Islands (Lander et al., submitted). 30 tsunamis caused significant damage including reports of as many as 9,600 fatalities, which can be attributed to underwater earthquakes and tsunamis combined. 1,922 deaths are confirmed as being specifically related to tsunamis during the last 150 years. The following are events recorded for the Virgin Islands:

- May 7, 1842. Tsunami hit St. John. Maximum wave height was estimated to be 3 meters.
- Eyewitness reports of the 1868 St. Croix tsunami give a maximum wave height of over 20 feet in Frederiksted.
- A 1918 M 7.5 earthquake resulted in a tsunami that killed at least 116 people in northwestern Puerto Rico. A run up of about 20 feet has been documented by mapping, and sedimentary evidence for at least two earlier tsunamis in the area has been cited.

Hazard Frequency and Magnitude

In crude terms, based on a record of approximately 100 recorded tsunamis in the Caribbean over the last 500 years, on average, one tsunami should be expected somewhere in the basin every 5 years. Conversely, Tom Parsons and Eric Geist, in a regional tsunami probability study conducted in 2009 estimate that the 30-year probability of a tsunami with runs up greater than or equal to 0.5 m at Charlotte Amalie is 18%. This combines the probability estimate from the historic catalog with numerical modeling results. The numerical model is based on a coarse grid and not geographically specific, but provides a good indicator of hazard frequency and magnitude.

Data Sources, Models and Methodologies

Tsunami

- Based on oral communication with Tsunami hazard expert, Professor Roy Watlington, UVI
- USGS U.S. Geological Survey, "Earthquakes and Tsunamis in Puerto Rico and the U.S. Virgin Islands", Fact Sheet FS–141–00, 2001
- University of California Tsunami Research Group (http://www.usc.edu/dept/tsunamis/)
- Parson, T and Geist, E (2009): Pure and Applied Geophysics, Vol. 165, 2089-2116
- Guidelines and Best Practices to Establish Areas of Tsunami Inundation for Non-modeled or Low-hazard Regions" (see http://nthmp.tsunami.gov/modeling_guidelines.html).

[12] Database of Caribbean Tsunami observations with runup ≥0.5 meters. Sources NOAA n-line database and Lander 2003.

- Preparing Your Community for Tsunamis – A Guidebook for Local Advocates, Version 2.1, February 1, 2008, Laura Dwelley Samant, L. Thomas Tobin, Brian Tucker (http://www.preventionweb.net/files/3984_PreparingYourCommunityforTsunamisV21.pdf).

Tsunami Hazard Assessment and Determination

- The tsunami hazard maps used in this study were developed based on estimates of a historical event, the tsunami of 1867. The estimated maximum wave height of the tsunami of 1867 was 7 meters.
- Wave height estimates were intersected with a digital elevation model to develop tsunami inundation maps. These maps are based on a historical tsunami scenario and expert interviews. Inundation maps may have no significant bearing on any actual tsunami event and should not be used during a real tsunami event.
- GIS overlay techniques were utilized to identify structures in the inundation areas. Flood depths were not estimated.
- Database of Caribbean Tsunami observations with run up ≥0.5 meters. Sources NOAA n-line database and Lander 2003.

Inventory Data (Assets)

- General Building Stock: Office of the Lt. Governor, Office of the Tax Assessor, Computer Mass Appraisal System Database and GIS Parcel Maps
- Critical Facilities and Infrastructure: VI Department of Property and Procurement, VITEMA

4.4.9 WILDFIRE

Hazard Description

A wildfire is an undesirable, uncontrolled burning of grasslands, brush or woodlands. According to the National Weather Service, more than 100,000 wildfires occur in the United States each year. About 90% of these wildfires are started by humans (i.e., campfires, debris burning, smoking, etc.); the other 10% are started by lightning. Wildfires, by definition, occur in areas where development is sparse and as a result often begin unnoticed and spread quickly.

The potential for wildfire depends upon surface fuel characteristics, weather conditions, recent climate conditions, topography and fire behavior. Fuels are defined as anything that fire can and will burn, and are the combustible materials that sustain a wildfire. Typically, this is the most prevalent vegetation in a given area. Weather is one of the most significant factors in determining the severity of wildfires. The intensity of fires and the rate with which they spread is directly rated to the wind speed, temperature and relative humidity. Climatic conditions such as long-term drought also play a major role in the number and intensity of wildfires, and topography is important because the slope and shape of the terrain can change the rate of speed at which fire travels.

There are four major types of wildfires, they are:

- Ground fires burn in natural litter, duff, roots or sometimes even highly-organic soils. Once started they are very difficult to control, and some ground fires may even rekindle after being extinguished.

- Surface fires burn in grasses and low shrubs (up to 4' tall) or in the lower branches of trees. They have the potential to spread rapidly, and the ease of their control depends upon the fuel involved.

- Crown fires burn in the tops of trees, and the ease of their control depends greatly upon wind conditions.

- Spotting fires occur when burning embers are thrown ahead of the main fire, and can be produced by crown fires as well as wind and topographic conditions. Once spotting fires begin, the fire will be very difficult to control.

Nature of the Hazard

In the US Virgin Islands, the pattern of development in which structures are mixed in with or next to flammable vegetation, increases the territory's susceptibility to wildfires. The US Virgin Islands is considered to have a mixed wild land/urban interface where structures and other human development meet or intermingle with undeveloped vegetative lands.

On the islands of St. Thomas and St. John the wild land/urban intersection usually occurs in areas where homes developed are in steep vegetated areas. Furthermore, access to these areas is made difficult by the steep and narrow roadways. On St. Croix, residential and commercial structures are intermingled with grasslands and/or scrublands. Many of the wildfires on St. Croix tend to be caused by persons burning garbage or clearing their land for cultivation. These wildfires tend to occur in the dry season and spread for hundreds of areas across sparsely populated lands.

Hazard Location, Extent and Distribution

Because high-resolution data was not readily available to accurately identify the degree of wildfire hazard throughout the US Virgin Islands, a precise analysis to determine the geographic extent for the wildfire hazard could not be performed. Instead an approximate analysis mapping was utilized to identify general areas throughout the islands that could be prone to Wildfire (See Figures 4.24, 4.25 and 4.26).

It is necessary to note that historically fires have been man-caused, and limited primarily to St. Croix, and have spread over hundreds of acres.

FIGURE 4.24 ***Wildfire Hazard Map, St. Thomas***

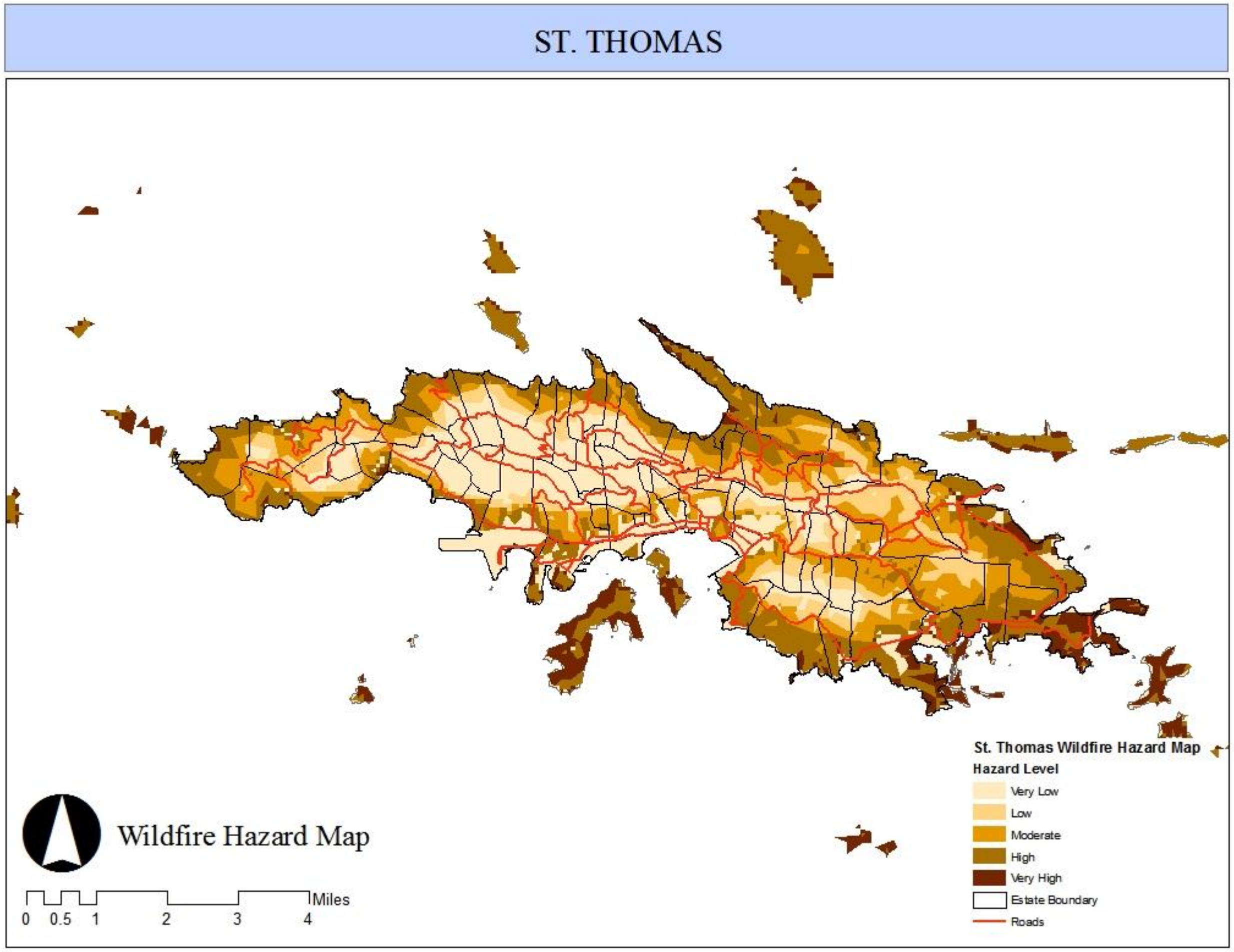


FIGURE 4.25 ***Wildfire Hazard Map, St. Croix***

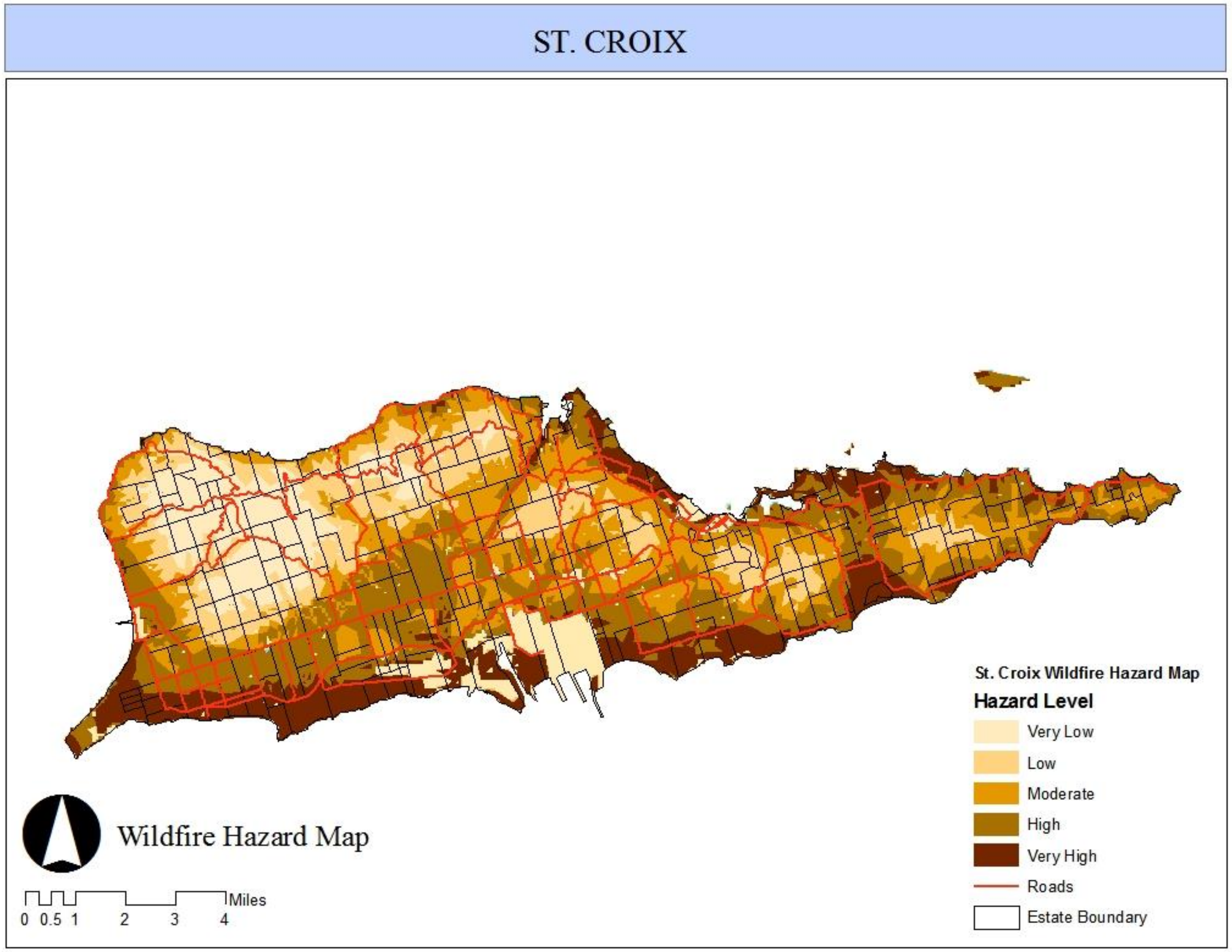
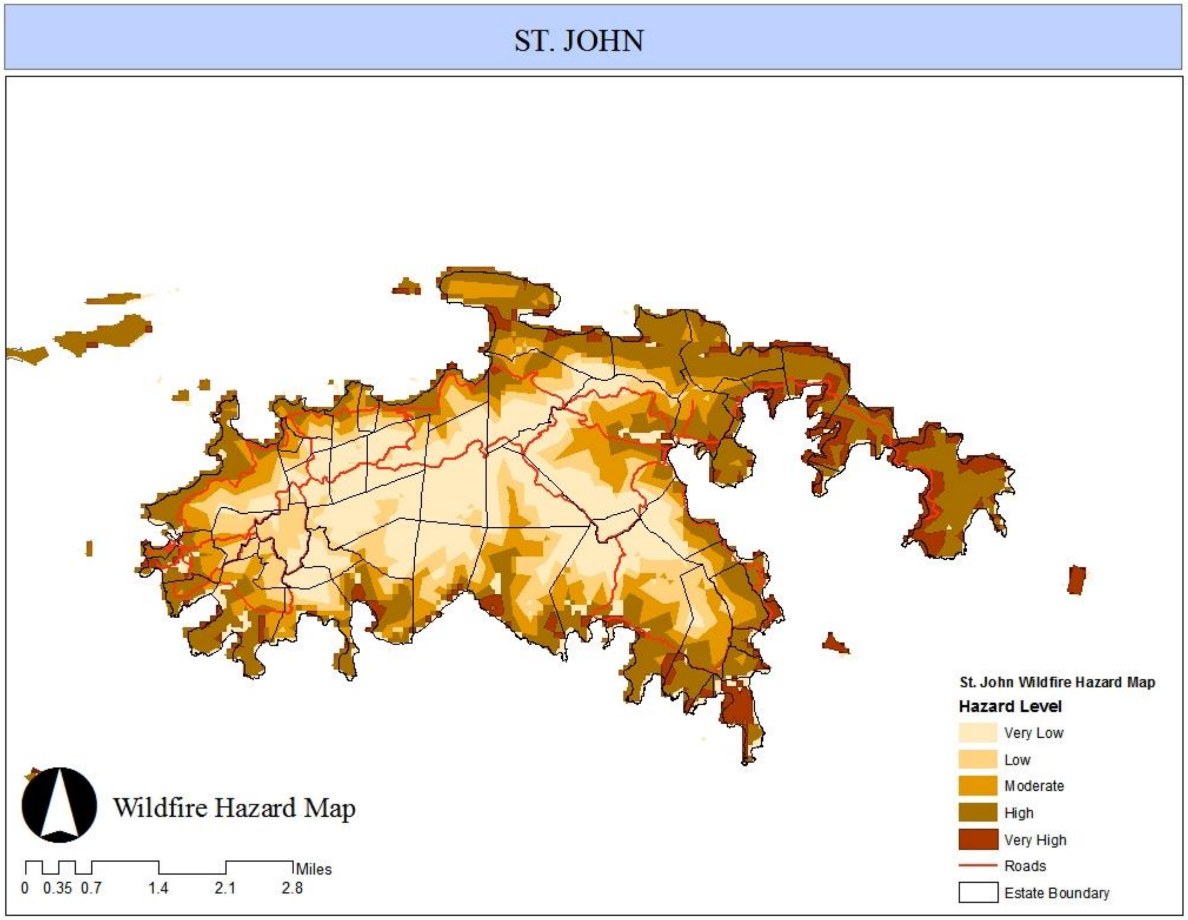


FIGURE 4.26 ***Wildfire Hazard Map, St. John***



Disaster History

The National Climatic Data Center record indicates that there have been only 18 confirmed wild/forest fires in the Territory between 2000 and 2010. All of these events were reported on St. Croix. Below are descriptions taken from the National Climatic Data Center (NOAA's on-line database):

1. April 14, 2000: Approximately 100 acres were burnt by brush fires fueled by dry, windy conditions in St. Croix western end hillsides. The fires began in Calqouhoun and spread to cover a broad area in William's Delight, Queen Louise and Estate Mountain. No homes were destroyed and nobody was injured.

2. March 13, 2000. Brush fires affected about 600 acres of land in Lowry Hill and Tide Village in East End. No damage was reported to homes, structures and nobody was injured. The cause of fire was unknown but arson was suspected.

3. March 18, 2001. Brush fires affected about 100 acres near Mount Welcome and Recovery Hill. No damages were reported on structures, homes or people. The suspected cause of the fire was an abandoned car that someone set afire.

4. March 29, 2001. A brush fire formed at Kingshill Area across the Centerline Road. The fire affected a nearby elementary school with smoke. Four students were taken to the Hospital with respiratory difficulties. All of them were unharmed.

5. April 2, 2001.Brush fires affected about 215 acres of land in Recovery Welcome, Peter's Farm and a section just east of Gallows Bay. No damages were reported on homes, structure or affected any people. The cause of these fires was unknown, but arson was suspected in Gallows Bay.

6. March 13, 2003. Brush fires fueled by strong winds scorched hundreds of acres on St Croix, at Estates Bethlehem, Calguohoun, Cobble, and Lowry Hill. The extremely dry conditions appeared to have spawned multiple fires. Several telephone poles were damaged, and some livestock may have perished. About 60 acres of pasture and brush were lost in Estate Lowry Hill.

7. April 3, 2003. A brush fire was reported near Grassy Point in St Croix. It was burning up in open terrain and hills. A substantial number of acres were burned. Lack of rainfall could have been a contributing factor.

8. March 4, 2005. A brush fire scorched more than 300 acres of vegetation near South Sore cafe in Estate Petronelli. Several utility poles were damaged.

9. March 8, 2005. More than 15 acres of brush was scorched when a fire crept over an open field between Estates Mon Bijou and Calquohoun.

10. March 11, 2011. A brush fire on the east end of the island consumed more than one 100 acres of parched vegetation near Grape Tree Bay. The fire damaged several utility poles.

11. March 13, 2005. Brush fires fueled by brisk winds scorched hundreds of acres on St. Croix. Fires were in estates Bethlehem, Calquohoun and Cobble. The fire damaged several telephone poles and some livestock could have perished.

12. April 13, 2005. Two brush fires developed on the west end of St. Croix, in a field next to Williams's Delight. Morev than 40 acres burned.

13. April 21, 2005. A massive brush fire was reported on the East End. The fire erupted near Tide Village and quickly spread to hillsides surrounding Lowry Hill and Estate Boetzberg. The fire consumed more than 200 acres of hillside and pastureland.

14. March 8, 2007. A large brush fire burnt more than 800 acres near Castle Nugent, Lowry Hill and Estate Sight on Saint Croix's East End.

15. March 14, 2007. A brush fire scorched four acres of grassland near Ha'Penny on the island's south shore.

16. March 19, 2007. A brush fire scorched more than 100 acres in an open field in Estate Concordia east of Frederiksted.

17. March 28, 2007. A brush fire scorched 40 acres at Estate Granard.

18. April 14, 2010. A brush fire broke out on Saint Croix's south shore to the west of Howard Wall Boy Scouts facility. More than 50 acres of pasture and dry vegetation were consumed.

Climate Variability, Hazard Frequency and Magnitude

The historic average occurrence of wildfires in the US Virgin Islands serves as the best value for predicting future expected recurrence. Based on the limited data, US Virgin Islands can expect at least one (1) wildfire event per year. Such predictions are limited by the number of years for which data was available and the recorded damages per event. Therefore, a thorough understanding of magnitude of wildfire events is very limited.

It is important to note that IPPC and PRECIS climate change models predict that temperatures will increase. Taylor et al. (2007) on the basis of the first round of PRECIS simulations driven by the HadAM3P GCM, have shown that the Caribbean is 1°- 5°C warmer in the annual mean by the

2080s (a 30-yr period from 2071 to 2100), and one also characterized by a greater warming in the northwest (Jamaica, Cuba, Hispaniola, and Belize) in comparison to the eastern Caribbean islands, which includes the Virgin Islands. They also predict a greater warming in the summer months than in the drier early months of the year (Taylor, M. A., and Coauthors, 2007).

This combined with the expected incidence of drought provides a clear indication that the occurrence of wildfire events is likely to increase in the future due to climate change.

4.5 INVENTORY OF ASSETS

For the Plan Update, VITEMA utilized a methodology that was consistent with FEMA Publication 386-2, “State and Local Mitigation Planning How-To Guide, Understanding Your Risks—Identifying Hazards and Estimating Losses” (FEMA 2001). This methodology is the same that was utilized for the development of the 2011 Plan. It includes:

- Estimate or count the total number of buildings, value of buildings, and population in your community.
- Determine the proportion of buildings, the value of buildings, and the population in your community or state that are located in hazard areas, and
- Calculate the proportion of assets located in hazard areas.

4.5.1 INVENTORY DATA COLLECTION

Specific assets evaluated for this Plan Update include population, buildings, and critical facilities, including infrastructure. General inventory information was collected from the Office of the Lieutenant Governor’s Tax Assessors Office and was used to classify the general building stock. Site specific data was also gathered from VITEMA and the Department of Property and Procurement and used to classify critical facilities and infrastructure. The data utilized in this Plan was aggregated from the fiscal cadastral (tax values) derived from the Lieutenant Governor’s Tax Assessors Office. Plans and contain estimates of the price and quantities of structures used for residential and commercial purposes in the U.S. Virgin Islands. The aggregation of data and all estimates of structure costs used actual prices for commercial and residential structures, which were derived from the Office of the Lieutenant Governor’s Tax Assessors Office. Update of critical facility information was derived from annual data sets were derived from publicly available data from the Bureau of Economic Analysis (BEA).

Detailed spatial and non-spatial local data were gathered, compiled, and analyzed in a Geographic Information System (GIS). These data are discussed below under the following categories:

- General Building Stock
- Critical Facilities and Infrastructure

General Building Stock

Local tax assessor information was used to develop a detailed inventory of the built environment in the US Virgin Islands. Specifically, the Virgin Islands Tax Assessors Office (Division of the office of the Lt. Governor), provided their parcel maps and property tax valuation database. The database has been updated and was reevaluated. The OLG data was found to be consistent with tax lot information and could be used to identify use of parcel and/or building.

Since the 2011 Plan Update, the Virgin Islands Tax Assessors Office (Division of the office of the Lt. Governor), have made revisions to the property valuations throughout the entire Territory of the Virgin Islands. This revised database was not made available to VITEMA, and as a result, the same database that was utilized during the 2011 Update was utilized to categorize the built environment.

The OLG database; however, had certain limitations related to structure classification and only classified building by general usage. Field surveys were eliminated from the budget and not conducted during this Plan Update. The field investigations that were conducted during the 2005 and 2008 Plan Updates were deemed to be satisfactory to determine the distribution of different building types and to gather structural information for each occupancy class.

In this Update, and in order to conduct basic analyses and gather information that would be useful to determine general loss estimates, structural categories remained the same as in the 2011 Plan Update. The ten (10) model building types remain consistent with field investigations conducted during this Plan Update, these include:

- Low Rise Wood Frame Dwelling,
- Mid-rise Wood Frame Dwelling,
- Low Rise Reinforced Concrete Dwelling,
- Mid Rise Reinforced Concrete Dwelling,
- Low Rise Steel Building,
- Mid Rise Steel Building,
- Low Rise Un-reinforced Masonry Building,
- Mid Rise Un-reinforced Masonry Building,
- Low Rise Reinforced Masonry Building, and
- Mid Rise Reinforced Masonry Building

The distribution of particular building types for each estate boundary for each island was then updated. This facilitated an understanding of the distribution of model building types for a specific occupancy class, at the estate level, for each island. It is necessary to note, however, that based on a rapid inspection of buildings that steel frame buildings a becoming more prevalent for larger institutional buildings.

This analysis provided a basis to estimate the total number of buildings and to aggregate replacement and content values for model building types.

Territorial Facilities and Infrastructure

There were not any changes made to the critical facility listing from the last plan. The listing of critical facilities provided by VITEMA was crossed checked with the listing of facilities included in the 2011 plan. Facilities such as schools, police and fire stations, and hospitals, are known as “critical facilities.” Infrastructure is separated into two distinct classes that have substantially different damage and loss characteristics: (1) transportation systems (key roads, ports, airports) and (2) utility infrastructure (electric power stations, potable water treatment plants, wastewater treatment plants, water pumps). The following three-part definition of critical facilities and infrastructure shall apply:

Critical Facilities

Critical facilities are those facilities that provide services to the community and should be functional after a hazard event. They include:

- Government buildings necessary for continuity of operations,
- Hospitals,
- Police stations,
- Fire stations,
- Schools, and
- Homes for the ageing.

Transportation Infrastructure

Transportation Infrastructures are facilities that enable the movement of goods, particularly emergency relief supplies. They include:

- Marine Facilities, and
- Airports.

Utilities and Infrastructure

Utilities and Infrastructure are facilities that, if damaged, could have far-reaching consequences for the environment. They include:

- Electrical Power Generating Plants,
- Water Treatment Plants,
- Wastewater Treatment Plants,
- Potable Water Pumps, and
- Water Tanks.

This list of facilities was provided by VITEMA for this Plan Update. No new data was provided by Department of Property and Procurement for this plan Update, despite several requests being made by the contractor and VITEMA. Therefore, it was determined that a detailed site inspection was not required during this plan update. Instead, information gathered from VITEMA was used to update inventory information.

The 2014 Plan has categorized facilities and infrastructure by their structural characteristics relevant to vulnerability to the prominent hazards identified in the study. In this Plan, like the 2011 Plan, replacement and content values for facilities were determined using the FEMA guideline of content value as a percentage of building replacement value. In the 2014 Plan Update, facility values were updated utilizing a compounded inflation factor for the three year period.

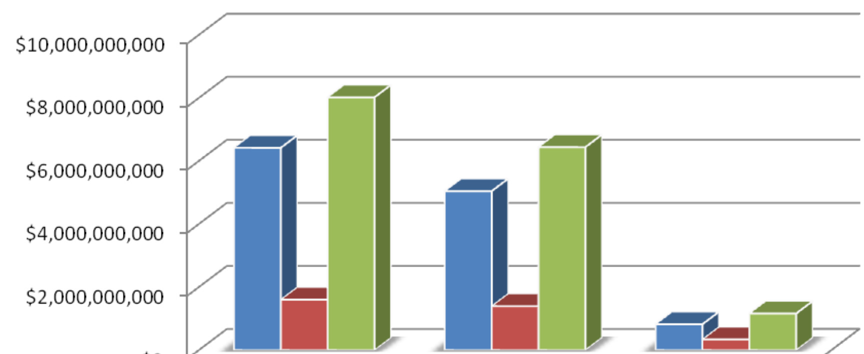
4.5.2 EXPOSURE VALUES

Exposure, as applied in this section of the Plan Update, means, the total amount of property value that are vulnerable to severe loss in the occurrence of a natural hazard event. Exposure is used to quantify the potential financial loss in the event of a natural hazard. Values shown include average building values, structural values (replacement costs), "content value," and total value.

General Building Stock

Figure 4.25 shows the average estimated value of individual buildings by occupancy class. Exposure values are based on data gathered at the Office of Lieutenant Governor's office and field investigations. The total inventory value for residential and commercial buildings is $16 billion, which represents an increase of approximately a $2 billion dollars since 2011.

FIGURE 4.25 ***Building Stock Values by Occupancy Class for US Virgin Islands***



	St. Thomas	St. Croix	St. John
Residential	$6,417,782,618	$5,042,503,925	$821,303,378
Commercial	$1,601,294,031	$1,394,636,244	$339,574,266
Total	$8,019,076,649	6,437,140,168	$1,160,877,643

Table 4.9 presents the estimated number of buildings and their dollar value by occupancy class, for each island in the Territory.

TABLE 4.10 ***Inventory of General Building Stock[13]***

Building Occupancy Class	Estimated Number of Buildings 2014	Estimated Aggregate Replacement Cost	Estimated Aggregate Content Value	Total Value
St. Thomas				
Residential	23,365	$ 4,281,518,328.05	$ 2,136,264,289.84	$ 6,417,782,617.89
Commercial	998	$ 800,647,015.35	$ 800,647,015.35	$ 1,601,294,030.70
Total	24,362	$ 5,082,165,343.40	$ 2,936,911,305.19	$ 8,019,076,648.59
St. Croix				
Residential	22,569	$ 4,345,185,802.97	$ 697,318,121.83	$ 5,042,503,924.80
Commercial	841	$ 697,318,121.83	$ 697,318,121.83	$ 1,394,636,243.67
Total	23,410	$ 5,042,503,924.80	$ 1,394,636,243.67	$ 6,437,140,168.47
St. John	0			
Residential	2,230	$ 549,521,425.04	$ 271,781,952.46	$ 821,303,377.50
Commercial	82	$ 271,781,952.46	$ 67,792,313.19	$ 339,574,265.65
Total	2,328	$ 821,303,377.50	$ 339,574,265.65	$ 1,160,877,643.15

For this Plan Update (2014), an in-depth analysis of building stock was not undertaken, but it is a fair assessment that the US Virgin Islands has been affected by the same housing downturn that has affected the US mainland. Values as reflected by inflation multipliers have remained stable in the Territory with St. John receiving the most new construction activity of all three islands. St. Croix, however, has suffered due to the closure of the HOVENSA refinery and has experienced only a modest increase in value of residential and commercial structures as opposed to the 15% increase experienced on St. Thomas and St. John.

Territorial Facilities and Infrastructure

Table 4.11 shows the estimated value of critical facilities and infrastructure in primary categories. Precise valuation information was not readily available from VITEMA or Department of Property and Procurement at the time of the Plan Update; therefore, the values presented in the section are a close approximation of the actual value of these important structures. The valuation of these facilities for this Update was based on the estimated area of the structures and an inflation factor of

[13] Single family dwellings are a subset of the total residential occupancy class. Total values include the sum of residential and commercial occupancy classes.

1.21 for the three year period. This inflation factor was developed through data supplied by the U.S. Department of Commerce, Bureau of Economic Analysis.

TABLE 4.11 ***Estimated Value of Critical Facilities and Infrastructure***

Facility	St. Thomas		St. Croix		St. John	
	# of Facilities in Class	Total Exposure	# of Facilities in Class	Total Exposure	# of Facilities in Class	Total Exposure
Critical Facilities						
Police Stations	5	12,727,552	6	63,719,946	2	4,321,296
Fire Stations	5	7,792,547	5	9,269,808	2	4,845,666
Emergency Response	1	6,472,875		-	1	5,142,339
Hospital/ Medical Clinic	5	95,838,253	3	135,990,389	2	17,590,586
Government Buildings	11	118,417,923	12	121,046,648	3	13,159,486
Shelters	8	123,556,219	11	173,286,506	5	52,473,202
Transportation Infrastructure						
Marine Ports	4	26,038,712	5	9,922,078	1	2,884,325
Airport	1	22,475,260	1	57,686,500	N/A	
Utilities						
Electrical Power Generating Plants	1	51,172,046	1	51,917,850	1	15,575,355
Water Treatment Plants Wastewater Treatment Plants Potable Water Pumps Water Tanks	5	61,792,356	36	110,067,300	4	33,518,154

4.6 VULNERABILITY ASSESSMENT

This section of the Plan Update facilitates an understanding of the proportion of buildings, the value of buildings, and the population located in hazard areas. VITEMA utilized information from the Hazard Identification and Profile information (i.e. wind speed, flood depth, etc.) to assess the vulnerability parameters (specific damage and loss characteristics) of each asset identified.

Vulnerable subgroups of the population for each island were determined using the Census 2010 data. For this Plan Update, population projections for 2014 were prepared accounting for annual growth rate of roughly -.56% (CIA Fact Book). This is lower than growth rate that was utilized in the 2011 Plan Update and is considerably lower than the estimated growth rate for the period 2000-2010. The annual growth rate was applied for four years 2010 to 2014, to estimate population for 2014.

Once the population was projected, the vulnerability analysis looked first at social impacts. The social analysis identified the number of people less than 18 years of age and the number of people over 65 years of age. These two demographic subgroups help define the territory's social vulnerability as they are the most likely to need assistance during and/or after a hazard event. A series of GIS hazard overlay queries were performed to indicate where the people reside within the territory relative to hazards.

Following, the vulnerability assessment was used to estimate potential losses to each hazard. The estimation of how many buildings that are susceptible to hazard related damage are based on either the location of buildings to a particular hazard (i.e. flood zone, earthquake ground shaking level) or based on hazard intensity expressed across each of the Territory's major islands (i.e. wind speed). The pursuant tables identify the number of buildings and value that are exposed to a certain level of hazard intensity. The extent and severity of damage to structural and nonstructural components of a building is described by one of five damage states:

- Very Low, (no, or negligible damage)
- Low, (easily repairable damage mainly to part of nonstructural components and/or contents)
- Moderate, (considerable, yet repairable damage to mainly non-structural components)
- High (considerable damage to both structural and non-structural components), and
- Very High (that the extent of damage is too much to be repaired; the facility has to be demolished and replaced).

The qualitative vulnerability ratings relate to a percentage of damage for each model building type across each island. The damage estimation methods for critical facilities and infrastructure are identical to those utilized to estimate damage with general building stock, except that classification or grouping of facilities was not needed and performed on a structure by structure basis.

4.6.1 DROUGHT

This section discusses the population and the proportion and value of buildings located in areas affected by a drought. It also provides an estimate of proportion of assets located in areas that are susceptible to drought.

Social Impacts

Table 4.12 shows an estimate of the affected population and area (in square kilometers) as indicators of the social vulnerability of each island. Two special needs population segments are broken out by hazard areas: the number of people less than 18 years of age and the number of people over 65 years of age.

TABLE 4.12 ***Social Impacts (Drought)***

Island Jurisdiction	Total Population	Less than 18 Years of Age in Hazard Area	% Less than 18 Years of Age in Hazard Area	Over 65 Years of Age in Hazard Area	% Over 65 Years of Age in Hazard Area
St. Thomas	54,229	8,876	16%	2,187	4%
St. Croix	56,404	8,271	15%	2,037	4%
St. John	4,447	925	21%	228	5%

Physical and Economic Impacts

- In this Plan Update, economic vulnerability relates to the extent of dollar exposure of its buildings that are susceptible to a hazard. The findings of the vulnerability assessment for this Plan Update indicate that there are 11,215 residential structures exposed to this hazard on St. Thomas and 787 commercial structures. On St. Croix, there are 9,458 residential structures and 192 commercial structures exposed to this hazard, while on St. John the total number of residential properties exposed is 1371and 11 commercial structures.

- On St. Thomas, approximately 48% percent of the residential building stock and 36% of the commercial building stock is considered to be vulnerable to drought. Of this percentage, approximately 26% of the residential building stock is of high vulnerability and the remaining 22% is of very high vulnerability to a drought event. Commercial structures are not considered to be vulnerable to drought events with 35% of the commercial stock being exposed to the hazard, none of which are classified as very high.

- On St. Croix, approximately 43% percent of the residential building stock and 23% of the commercial building stock is considered to be vulnerable to drought. Of this percentage, approximately 34% of the residential building stock is of medium vulnerability, 15% of the residential building stock is of high vulnerability, and the remaining 28% is of very high vulnerability to drought. None of the commercial building inventory is of medium vulnerability, none has high or very high vulnerability rating to a drought event.

- On St. John, approximately 61% percent of the residential building stock and 14% of the commercial building stock is considered to be vulnerable to a drought hazard. Of this percentage, approximately 26% of the residential building stock is of medium vulnerability, 28% of the residential building stock is of high vulnerability, and the remaining 33% is of very high vulnerability to a drought event. None of the commercial building inventory is of medium vulnerability, none has high or very high vulnerability rating to a drought event.

The tables below show potential dollar exposure to drought hazard on St. Thomas, St. Croix and St. John.

TABLE 4.13 ***Estimated Drought Exposure and Vulnerability (St. Thomas)***

Occupancy Class	Total Number of Buildings/ Percentage	Number, Percentage and Value of Buildings by Vulnerability Rating				
		Very Low	Low	Moderate	High	Very high
% of Residential	48%	13%	23%	16%	26%	22%
No. of Residential	11,215	1,404	5,262	3,836	6,148	5,193
Value of Residential	$3,085,163,402	$386,351,477	$694,754,849	$506,474,402	$811,865,287	$685,717,387
% of Commercial	36%	36%	64%	0	0	0
No. of Commercial	787	284	503	0	0	0
Value of Commercial	$655,447,244	$236,689,283	$418,757,961	$0.00	$0.00	$0.00

TABLE 4.14 ***Estimated Drought Exposure and Vulnerability (St. Croix)***

Occupancy Class	Total Number of Buildings/ Percentage	Number, Percentage and Value of Buildings by Vulnerability Rating				
		Very Low	Low	Moderate	High	Very high
% of Residential	43%	9%	14%	34%	15%	28%
No. of Residential	9458	822	117	39	6	2
Value of Residential	$2,492,165,251	216,673,928	30,756,222	10,393,800	1,583,133	444,630
% of Commercial	23%	41%	61%	0	0	0
No. of Commercial	192	79	48	0	0	0
Value of Commercial	$331,528,001	135,625,091	82,554,403	0	0	0

TABLE 4.15 ***Estimated Drought Exposure and Vulnerability (St. John)***

Occupancy Class	Total Number of Buildings/ Percentage	Number, Percentage and Value of Buildings by Vulnerability Rating				
		Very Low	Low	Moderate	High	Very high
% of Residential	61%	2%	12%	26%	28%	33%
No. of Residential	1371	24	164	352	385	446
Value of Residential	$500,995,060	8,631,645	59,792,124	128,575,545	140,893,622	163,102,125
% of Commercial	14%	14%	86%	0%	0%	0%
No. of Commercial	11	2	10	0	0	0
Value of Commercial	$47,540,397	6,791,485	40,748,912	0	0	0

Critical Facilities

The tables below highlight the results of the vulnerability assessment of each state-owned or operated facility to the earthquake hazard. Results define the potential exposure to Territorial Facilities and Infrastructure for the island of St. Thomas, St. Croix and St. John.

TABLE 4.16 ***Estimated Drought Exposure and Vulnerability, Critical Facilities and Infrastructure (St. Thomas)***

Facility	# of Facilities in Class	Vulnerability Rating					Total Exposure
		Very Low	Low	Moderate	High	Very High	
Critical Facilities							
Police Stations	5	2			2	1	12,727,552
Fire Stations	5	3	2				7,792,547
Emergency Response	1					1	6,472,875
Hospital, Clinics, and special needs	5	4		1			95,838,253
Government Buildings	11	9		9	9		118,417,923
Shelters	5	2	1		1	1	123,556,219
Transportation Infrastructure							
Marine Ports	4	4					26,038,712
Airport	1	1					22,475,260
Utilities							
Electrical Power Generating Plants	1	1					51,172,046
Sewage Treatment Plant	1			1			61,792,356
Water Treatment Plant	1		1				
WAPA Tanks	1			1			
Pumping Station	1	1					

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

<u>TABLE 4.17</u> *Estimated Drought Exposure and Vulnerability, Critical Facilities and Infrastructure (St. Croix)*

Facility	# of Facilities in Class	Vulnerability Rating					Total Exposure
		Very Low	Low	Moderate	High	Very High	
Critical Facilities							
Police Stations	6	3	2		1		63,719,946
Fire Stations	5	3		2			9,269,808
Emergency Response	N/A						-
Hospital/ Medical Clinic	3	3					135,990,389
Government Buildings	12	6			2	4	121,046,648
Shelters/Special Needs	11	3			5	3	173,286,506
Transportation Infrastructure							
Marine Ports	5	5					9,922,078
Airport	1	1					57,686,500
Utilities							
Electrical Power Generating Plants	1	1					51,917,850
Sewage Pumps	14	9				5	110,067,300
Wastewater Treatment Plant	1	1					
Water Treatment Plant	1	1					
Water Pumps	8	1	4	3			

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

TABLE 4.18 ***Estimated Drought Exposure and Vulnerability, Critical Facilities and Infrastructure (St. John)***

Facility	# of Facilities in Class	Vulnerability Rating					Total Exposure
		Very Low	Low	Moderate	High	Very High	
Critical Facilities							
Police Stations	2	1		1		2	4,321,296
Fire Stations	2	1					4,845,666
Emergency Response	1						5,142,339
Hospital/ Medical Clinic	2			1		1	17,590,586
Government Buildings	3	3					13,159,486
Shelters/Special Needs	5	1		2		2	52,473,202
Transportation Infrastructure							-
Marine Ports	1	1					2,884,325
Airport	N/A						
Utilities							-
Electrical Power Generating Plants	1	1					15,575,355
WAPA Desalinization Plant	1	1					
WAPA Water Tank	1	1					
Sewage Treatment Plant	1	1					
Potable Water Tank	1	1					33,518,154

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

4.6.2 EARTHQUAKE

This section discusses the population and the proportion and value of buildings located in areas affected by an earthquake hazard. It also provides an estimate of proportion of assets located in earthquake hazard areas.

Social Impacts

Table 4.30 shows an estimate of the affected population and area (in square kilometers) as indicators of the social vulnerability of each island. Two special needs population segments are broken out by hazard areas: the number of people less than 18 years of age and the number of people over 65 years of age.

TABLE 4.19*Social Impacts (Earthquake)*

Island Jurisdiction	Total Population	Less than 18 Years of Age in Hazard Area	% Less than 18 Years of Age in Hazard Area	Over 65 Years of Age in Hazard Area	% Over 65 Years of Age in Hazard Area
St. Thomas	54,229	5,965	11%	1,627	3%
St. Croix	56,404	8,461	15%	1,692	3%
St. John	4,447	623	14%	178	4%

Physical and Economic Impacts

In this Plan Update, economic vulnerability relates to the extent of dollar exposure of its buildings. The findings of the vulnerability assessment for this Plan Update indicate that there was an increase of 558 residential properties exposed to this hazard on St. Thomas. On St. Croix, there was an increase of 405 residential properties exposed to this hazard, while on St. John the total number of residential properties exposed increased by 41. On St. Thomas there were 55 additional commercial properties exposed to this hazard. In St. Croix there was an increase of 18 commercial properties exposed to this hazard. On St. John there were 2 less commercial properties exposed to this hazard.

- On St. Thomas approximately 91% percent of the residential building stock and 96% of the commercial building stock is considered to be vulnerable to an earthquake event. Of this percentage, approximately 42% of the residential building stock is of high vulnerability and the remaining 58% is of very high vulnerability to an earthquake event. About 20% of the commercial building inventory is of high vulnerability to an earthquake and the remaining 80% of the inventory has a very high vulnerability to a seismic event.

- On St. Croix approximately 70% percent of the residential building stock and 84% of the commercial building stock is considered to be vulnerable to an earthquake event. Of this percentage, approximately 75% of the residential building stock is of medium vulnerability, 5% of the residential building stock is of high vulnerability, and the remaining 20% is of very high vulnerability to an earthquake event. About 84% of the commercial building inventory is of medium vulnerability, none has high vulnerability, and the remaining 27% of the inventory has a very high vulnerability to a seismic event.

- On St. John approximately 71% percent of the residential building stock and 85% of the commercial building stock is considered to be vulnerable to an earthquake event. Of this percentage, approximately 71% of the residential building stock is of medium vulnerability, 11% of the residential building stock is of high vulnerability, and the remaining 19% is of very high vulnerability to an earthquake event. About 32% of the commercial building inventory is of medium vulnerability to an earthquake, 20% of the stock is of high vulnerability, and the remaining 48% of the inventory has a very high vulnerability to a seismic event. St. John has construction on steep sloping ground, but most structures are more recent and better built due to economic reasons.

The tables below show potential dollar exposure to earthquake hazard on St. Thomas, St. Croix and St. John.

TABLE 4.20 *Estimated Earthquake Exposure and Vulnerability (St. Thomas)*

Occupancy Class	Total Number of Buildings/ Percentage	Number, Percentage and Value of Buildings by Vulnerability Rating				
		Very Low	Low	Moderate	High	Very high
% of Residential	91%	0.00	0.00	0.00	42%	58%
No. of Residential	21,262	0	0	0	9,807	13,558
Value of Residential	$5,848,955,616	$0	$0	$0	$2,697,864,850	$3,729,558,904
% of Commercial	96%	0.00	0.00	0.00	20%	80%
No. of Commercial	2,098	0	0	0	435	1,750
Value of Commercial	$1,747,859,317	$0	$0	$0	$362,197,527	$1,458,489,262

TABLE 4.21 ***Estimated Earthquake Exposure and Vulnerability (St. Croix)***

Occupancy Class	Total Number of Buildings/ Percentage	Number, Percentage and Value of Buildings by Vulnerability Rating				
		Very Low	Low	Moderate	High	Very high
% of Residential	70%	0%	0%	75%	5%	20%
No. of Residential	15,398	0	0	16,497	1,100	4,399
Value of Residential	4,057,013,200	0	0	3,042,759,900	202,850,660	811,402,640
% of Commercial	84%	0%	0%	73%	0%	27%
No. of Commercial	701	0	0	512	0	189
Value of Commercial	1,210,797,916	0	0	883,882,479	0	326,915,437

TABLE 4.22 ***Estimated Earthquake Exposure and Vulnerability (St. John)***

Occupancy Class	Total Number of Buildings/ Percentage	Number, Percentage and Value of Buildings by Vulnerability Rating				
		Very Low	Low	Moderate	High	Very high
% of Residential	71%	0	0	71%	11%	19%
No. of Residential	1,595	0	0	1,133	175	303
Value of Residential	583,125,398	0	0	414,019,033	64,143,794	110,793,826
% of Commercial	85%	0	0	32%	20%	48%
No. of Commercial	69	0	0	22	14	33
Value of Commercial	288,638,126	0	0	92,364,200	57,727,625	138,546,300

Critical Facilities

The tables below highlight the results of the vulnerability assessment of each state-owned or operated facility to the earthquake hazard. Results define the potential exposure to Territorial Facilities and Infrastructure for the island of St. Thomas, St. Croix and St. John.

TABLE 4.23 ***Estimated Earthquake Exposure and Vulnerability, Critical Facilities and Infrastructure (St. Thomas)***

Facility	# of Facilities in Class	Vulnerability Rating					Total Exposure
		Very Low	Low	Moderate	High	Very High	
Critical Facilities							
Police Stations	5	1			1	3	12,727,552
Fire Stations	5	1		1	1	2	7,792,547
Emergency Response				1			6,472,875
Hospital, Clinics, and special needs	5				4	1	95,838,253
Government Buildings	11			3		8	118,417,923
Shelters	5	1		1		3	123,556,219
Transportation Infrastructure							
Marine Ports	4	1		1		2	26,038,712
Airport	1	1					22,475,260
Utilities							
Electrical Power Plant						1	51,172,046
Sewage Treatment Plant	1				1		61,792,356
Water Treatment Plant	1				1		
WAPA Tanks	1					1	
Pumping Station	1				1		

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

TABLE 4.24 *Estimated Earthquake Exposure and Vulnerability, Critical Facilities and Infrastructure (St. Croix)*

Facility	# of Facilities in Class	Vulnerability Rating					Total Exposure
		Very Low	Low	Moderate	High	Very High	
Critical Facilities							
Police Stations	6	1		3	1	1	63,719,946
Fire Stations	5	1			1	3	9,269,808
Emergency Response	1			1			-
Hospital/ Medical Clinic	3			2		1	135,990,389
Government Buildings	12			6	2	4	121,046,648
Shelters/Special Needs	11		1	3	1	6	173,286,506
Transportation Infrastructure							
Marine Ports	5	5					9,922,078
Airport	1			1			57,686,500
Utilities							
Electrical Power Plant	1				1		51,917,850
Sewage Pumps	14	3	3	6	2		110,067,300
Wastewater Treatment Plant	1				1		
Water Treatment Plant	1	1					
Water Pumps	8			4	2	2	

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

TABLE 4.25 ***Estimated Earthquake Exposure and Vulnerability, Critical Facilities and Infrastructure (St. John)***

Facility	# of Facilities in Class	Vulnerability Rating					Total Exposure
		Very Low	Low	Moderate	High	Very High	
Critical Facilities							
Police Stations	2		1		1		4,321,296
Fire Stations	2			1		1	4,845,666
Emergency Response	1			1			5,142,339
Hospital/ Medical Clinic	2	1				1	17,590,586
Government Buildings	3		1			2	13,159,486
Shelters/Special Needs	5			1	1	3	52,473,202
Transportation Infrastructure							-
Marine Ports	1	1					2,884,325
Airport	N/A						--
Utilities							-
Electrical Power Plant	1				1		15,575,355
WAPA Desalinization Plant	1			1			
WAPA Water Tank	1				1		
Sewage Treatment Plant	1				1		
Potable Water Tank	1				1		
							33,518,154

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

4.6.3 Riverine Flooding

This section discusses the population and the proportion and value of buildings located in areas affected by a riverine flooding hazard. It also provides an estimate of proportion of assets located in riverine flooding hazard areas.

Social Impacts

Table 4.25 shows an estimate of the affected population and area (in square kilometers) as indicators of the social vulnerability of each island. Two special needs population segments are broken out by hazard areas: the number of people less than 18 years of age and the number of people over 65 years of age.

TABLE 4.26 ***Social Impacts (Riverine Flooding)***

Island Jurisdiction	Total Population	Less than 18 Years of Age in Hazard Area	% Less than 18 Years of Age in Hazard Area	Over 65 Years of Age in Hazard Area	% Over 65 Years of Age in Hazard Area
St. Thomas	54,229	3,796	7%	1,085	2%
St. Croix	56,404	4,512	8%	1,128	2%
St. John	4,447	267	6%	44	1%

Physical and Economic Impacts

In this Plan Update, economic vulnerability relates to the extent of dollar exposure of its buildings. The findings of the vulnerability assessment for this Plan Update indicate that there was an increase of 141 residential properties exposed to this hazard on St. Thomas. On St. Croix there was an increase of 70 residential properties exposed to this hazard, while on St. John the total number of residential properties exposed to this hazard increased by 14. On St. Thomas there were 21 more commercial properties exposed to this hazard. On St. Croix there were 2 more commercial properties exposed to this hazard. On St. John there were not any additional commercial properties exposed to this hazard.

- On St. Thomas approximately 23% percent of the residential building stock and 36% of the commercial building stock is considered to be vulnerable to river flooding. Of this percentage, approximately 47% of the residential building stock is of medium vulnerability and the remaining 53% is of high vulnerability to river flooding. About 36% of the commercial building inventory has a low vulnerability to river flooding, and the remaining 79% of the inventory has a high vulnerability to such flooding.

- On St. Croix approximately 12% percent of the residential building stock and 10% of the commercial building stock is considered to be vulnerable to river flooding. Of this percentage, approximately 68% of the residential building stock is of medium vulnerability and the remaining 32% is of high vulnerability to river flooding. About 51% of the commercial building inventory has a low vulnerability to river flooding, and the remaining 49% of the inventory has a high vulnerability to such flooding.

- On St. John approximately 12% percent of the residential building stock and 10% of the commercial building stock is considered to be vulnerable to river flooding. Of this percentage, approximately 81% of the residential building stock is of medium vulnerability and the remaining 19% is of high vulnerability to river flooding. About 51% of the commercial building inventory has a moderate vulnerability to river flooding, and the remaining 49% of the inventory has a high vulnerability to such flooding.

TABLE 4.27 ***Estimated Riverine Flooding Exposure and Vulnerability (St. Thomas)***

Occupancy Class	Total Number of Buildings/ Percentage	Number, Percentage and Value of Buildings by Vulnerability Rating				
		Very Low	Low	Moderate	High	Very high
% of Residential	23%	0.00	0.00	0.47	0.53	0.00
No. of Residential	5,374	0	0	2,519	2,855	0
Value of Residential	$1,478,307,463	$0.00	$0.00	$692,844,520	$785,462,943	$0.00
% of Commercial	36%	0.00	0.00	20	79	0.00
No. of Commercial	787	0	0	156	630	0
Value of Commercial	$655,447,244	$0	$0	$130,391,110	$525,056,134	0

TABLE 4.28 ***Estimated Riverine Flooding Exposure and Vulnerability (St. Croix)***

Occupancy Class	Total Number of Buildings/ Percentage	Number, Percentage and Value of Buildings by Vulnerability Rating				
		Very Low	Low	Moderate	High	Very high
% of Residential	12%	0%	0%	68%	32%	0%
No. of Residential	2,640	0	0	1,795	845	0
Value of Residential	695,487,977	0	0	472,931,824	222,556,153	0
% of Commercial	10%	0%	0%	51%	49%	0%
No. of Commercial	83	0	0	43	41	0
Value of Commercial	144,142,609	0	0	73,512,731	70,629,878	0

TABLE 4.29 ***Estimated Riverine Flooding Exposure and Vulnerability (St. John)***

Occupancy Class	Total Number of Buildings/ Percentage	Number, Percentage and Value of Buildings by Vulnerability Rating				
		Very Low	Low	Moderate	High	Very high
% of Residential	24%	0%	0%	81%	19%	0%
No. of Residential	539	0	0	437	102	0
Value of Residential	197,112,811	0	0	159,661,377	37,451,434	0
% of Commercial	15%	0%	0%	44%	48%	0%
No. of Commercial	12	0	0	5	6	0
Value of Commercial	50,936,140	0	0	22,411,902	24,449,347	0

It may be overly simplistic to determine flood vulnerability as a yes or no per the location of the structure in, or outside of, the floodplain. Flood vulnerability for this Plan Update was determined using the 100-year flood zone as an indicator of the overall hazard. The digital version of these maps was derived from updated DFIRMS. However, the updated DFIRMS did not have Base Flood Elevations (BFE) for all mapped riverine areas.

Therefore, BFEs were utilized where present and a terrain model was utilized to infer flood elevations where the BFE data was absent. The resulting analysis utilized a GIS to generate a Triangular Irregular Network (TIN) of the water surface elevation. Using GIS overlay techniques, the terrain were subtracted from TIN (an intersection of the flood polygon with the terrain model) to determine an estimated depth of flooding.

This method was found to be suitable for estimating zones experiencing different flood depths within the 100-year flood area. The depth intervals were broken out into five categories of different flood depths between 4 to 25 feet to define the flood hazard as very low, low, moderate, high and very high. Therefore, your highest areas of vulnerability would be found in the center of the 100-year floodplain, where the depths are the greatest. In this Plan Update, most of the residential and commercial structures in the Territory were found to be in moderate to high flood hazard intensity. This indicates that most the building stock estimated to be vulnerable to flooding were within the defined 100-year floodplain.

The flood hazard information in this Plan Update was used to integrate a Severe Repetitive Loss Strategy in the Mitigation Strategy. As in the 2011 Plan Update, general GIS maps that graphically show Special Flood Hazard Area (SFHA) were used to identify residential and commercial areas that experience repetitive flooding. Mapping of individual structures was not conducted during this Plan Update.

Critical Facilities

The following tables highlight the results of the vulnerability assessment of each state-owned or operated facility to the riverine flood hazard. Results define the potential exposure to Territorial Facilities and Infrastructure for the islands of St. Thomas, St. Croix and St. John.

The tables below show potential dollar exposure to Riverine flood hazard on St. Thomas, St. Croix and St. John.

TABLE 4.30 ***Estimated Riverine Flooding Exposure and Vulnerability, Critical Facilities and Infrastructure (St. Thomas)***

Facility	# of Facilities in Class	Vulnerability Rating					Total Exposure
		Very Low	Low	Moderate	High	Very High	
Critical Facilities							
Police Stations	5	2			1	2	12,727,552
Fire Stations	5	2		1		2	7,792,547
Emergency Response	1	1					6,472,875
Hospital, Clinics, and special needs	5	3	1			1	95,838,253
Government Buildings	11	3		1	2	5	118,417,923
Shelters	5	3		1	1		123,556,219
Transportation Infrastructure							
Marine Ports	4	3		1			26,038,712
Airport	1	1					22,475,260
Utilities							
Electrical Power Plant							51,172,046
Sewage Treatment Plant	1				1		61,792,356
Water Treatment Plant	1				1		
WAPA Tanks	1	1					
Pumping Station	1	1					

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

TABLE 4.31 ***Estimated Riverine Flooding Exposure and Vulnerability, Critical Facilities and Infrastructure (St. Croix)***

Facility	# of Facilities in Class	Vulnerability Rating					Total Exposure
		Very Low	Low	Moderate	High	Very High	
Critical Facilities							
Police Stations	6	6					63,719,946
Fire Stations	5	5					9,269,808
Emergency Response	1	1					-
Hospital/ Medical Clinic	3	3					135,990,389
Government Buildings	12	9		1	1		121,046,648
Shelters/Special Needs	11	11				1	173,286,506
Transportation Infrastructure							
Marine Ports	5	5					9,922,078
Airport	1	1					57,686,500
Utilities							
Electrical Power Plant	1		1				51,917,850
Sewage Pumps	14	**12**	2				110,067,300
Wastewater Treatment Plant	1	**1**					
Water Treatment Plant	1		1				
Water Pumps	8	**6**	1	1			

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

TABLE 4.32 ***Estimated Riverine Flooding Exposure and Vulnerability, Critical Facilities and Infrastructure (St. John)***

Facility	# of Facilities in Class	Vulnerability Rating					Total Exposure
		Very Low	Low	Moderate	High	Very High	
Critical Facilities							
Police Stations	2	1			1		4,321,296
Fire Stations	2	2					4,845,666
Emergency Response	1	1					5,142,339
Hospital/ Medical Clinic	2	2					17,590,586
Government Buildings	3	2			1		13,159,486
Shelters/Special Needs	5	3				2	52,473,202
Transportation Infrastructure							-
Marine Ports	1						2,884,325
Airport	N/A						--
Utilities							-
Electrical Power Plant	1	1					15,575,355
WAPA Desalinization Plant	1	1					
WAPA Water Tank	1	1					
Sewage Treatment Plant	1				1		
Potable Water Tank	1	1					33,518,154

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

4.6.4 COASTAL FLOODING

This section discusses the population and the proportion and value of buildings located in areas affected by a coastal flood hazard. It also provides an estimate of proportion of assets located in coastal flood hazard areas.

Social Impacts

Table 4.33 shows an estimate of the affected population and area (in square kilometers) as indicators of the social vulnerability of each island. Two special needs population segments are broken out by hazard areas: the number of people less than 18 years of age and the number of people over 65 years of age.

TABLE 4.33 ***Social Impacts (Coastal Flooding)***

Island Jurisdiction	Total Population	Less than 18 Years of Age in Hazard Area	% Less than 18 Years of Age in Hazard Area	Over 65 Years of Age in Hazard Area	% Over 65 Years of Age in Hazard Area
St. Thomas	54,229	1,085	2%	16	0.03%
St. Croix	56,404	1,128	2%	23	0.04%
St. John	4,447	89	2%	2	0.04%

Physical and Economic Impacts

In this Plan update economic vulnerability relates to the extent of dollar exposure of its buildings. The findings of the vulnerability assessment for this Plan Update indicate that there was an increase of 43 residential properties exposed to this hazard on St. Thomas. On St. Croix there was an increase 29 residential properties, while on St. John the total number of residential properties exposed increased by 6. On St. Thomas the total number of commercial properties increased by 2. On St. Croix there were 1 more commercial property exposed to this hazard and on St. John, there was no change.

- On St. Thomas approximately 7% percent of the residential building stock and 4% of the commercial building stock is considered to be vulnerable to coastal flooding. Of this percentage, approximately 2% of the residential building stock is of medium vulnerability, 45% of the residential building stock is of high vulnerability, and the remaining 53% is of very high vulnerability to coastal flooding. About 1% of the commercial building inventory is of medium vulnerability to coastal flooding, 19% of the stock is of high vulnerability, and the remaining 80% of the inventory has a very high vulnerability to such flooding.

- On St. Croix approximately 5% percent of the residential building stock and 2% of the commercial building stock is considered to be vulnerable to coastal flooding. Of this percentage, approximately 1% of the residential building stock is of medium vulnerability, 76% of the residential building stock is of high vulnerability, and the remaining 24% is of very high vulnerability to coastal flooding. About 4% of the commercial building inventory is of medium vulnerability to coastal flooding, 67% of the stock is of high vulnerability, and the remaining 29% of the inventory has a very high vulnerability to such flooding.

- On St. John approximately 10% percent of the residential and commercial building stock are considered to be vulnerable to coastal flooding. Of this percentage, approximately 1% of the residential building stock is of medium vulnerability, 76% of the residential building stock is of high vulnerability, and the remaining 23% is of very high vulnerability to coastal flooding. About 4% of the commercial building inventory is of medium vulnerability to coastal flooding, 47% of the stock is of high vulnerability, and the remaining 49% of the inventory has a very high vulnerability to such flooding.

The tables below show potential dollar exposure to the coastal flooding hazard on St. Thomas, St. Croix and St. John.

***TABLE 4.34* Estimated Coastal Flooding Exposure and Vulnerability (St. Thomas)**

Occupancy Class	Total Number of Buildings/ Percentage	Number, Percentage and Value of Buildings by Vulnerability Rating				
		Very Low	Low	Moderate	High	Very high
% of Residential	7%	0.00	0.00	0.02	0.45	0.53
No. of Residential	1,636	0	0	29	738	869
Value of Residential	$449,919,663	0	0	7,936,939	202,928,784	239,053,939
% of Commercial	4%	0.00	0.00	0.01	0.19	0.80
No. of Commercial	87	0	0	1	16	70
Value of Commercial	$72,827,472	$0	$0	$929,427	$13,558,474	$58,339,570

TABLE 4.35 ***Estimated Coastal Flooding Exposure and Vulnerability (St. Croix)***

Occupancy Class	Total Number of Buildings/ Percentage	Number, Percentage and Value of Buildings by Vulnerability Rating				
		Very Low	Low	Moderate	High	Very high
% of Residential	5%	0%	0%	1%	76%	24%
No. of Residential	1,100	0	0	11	836	264
Value of Residential	289,786,657	0	0	2,897,867	220,237,859	69,548,798
% of Commercial	2%	0	0	4%	67%	29%
No. of Commercial	17	0	0	3	54	23
Value of Commercial	28,828,522	0	0	57,657,044	965,755,481	418,013,566

TABLE 4.36 ***Estimated Coastal Flooding Exposure and Vulnerability (St. John)***

Occupancy Class	Total Number of Buildings/ Percentage	Number, Percentage and Value of Buildings by Vulnerability Rating				
		Very Low	Low	Moderate	High	Very high
% of Residential	10%	0%	0%	1%	76%	23%
No. of Residential	225	0	0	2	171	52
Value of Residential	82,130,338	0	0	821,303	62,419,057	18,889,978
% of Commercial	10%	0	0	4%	47%	49%
No. of Commercial	8	0	0	0	4	4
Value of Commercial	33,957,427	0	0	1,358,297	15,959,990	16,639,139

Critical Facilities

The following tables highlight the results of the vulnerability assessment of each state-owned or operated facility to the coastal flood hazard. Results define the potential exposure to Territorial Facilities and Infrastructure for the island of St. Thomas, St. Croix and St. John.

TABLE 4.37 ***Estimated Coastal Flooding Exposure and Vulnerability, Critical Facilities and Infrastructure (St. Thomas)***

Facility	# of Facilities in Class	Vulnerability Rating					Total Exposure
		Very Low	Low	Moderate	High	Very High	
Critical Facilities							
Police Stations	5	5					12,727,552
Fire Stations	5	5					7,792,547
Emergency Response	1	1					6,472,875
Hospital, Clinics, and special needs	5	5					95,838,253
Government Buildings	11	11					118,417,923
Shelters	5	5					123,556,219
Transportation Infrastructure							
Marine Ports	4	4					26,038,712
Airport	1	1					22,475,260
Utilities							
Electrical Power Plant	1	1					51,172,046
Sewage Treatment Plant	1	1					61,792,356
Water Treatment Plant	1	1					
WAPA Tanks	1	1					
Pumping Station	1	1					

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

TABLE 4.38 ***Estimated Coastal Flooding Exposure and Vulnerability, Critical Facilities and Infrastructure (St. Croix)***

Facility	# of Facilities in Class	Vulnerability Rating					Total Exposure
		Very Low	Low	Moderate	High	Very High	
Critical Facilities							
Police Stations	6	6					63,719,946
Fire Stations	5	5					9,269,808
Emergency Response	1	1					-
Hospital/ Medical Clinic	3	3					135,990,389
Government Buildings	12	11				1	121,046,648
Shelters/Special Needs	11	11					173,286,506
Transportation Infrastructure							
Marine Ports	5	5					9,922,078
Airport	1	1					57,686,500
Utilities							
Electrical Power Plant	1	1					51,917,850
Sewage Pumps	14	14					110,067,300
Wastewater Treatment Plant	1	1					
Water Treatment Plant	1	1					
Water Pumps	8	8					

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

TABLE 4.39 ***Estimated Coastal Flooding Exposure and Vulnerability, Critical Facilities and Infrastructure (St. John)***

Facility	# of Facilities in Class	Vulnerability Rating					Total Exposure
		Very Low	Low	Moderate	High	Very High	
Critical Facilities							
Police Stations	2	2					4,321,296
Fire Stations	2	2					4,845,666
Emergency Response	1	1					5,142,339
Hospital/ Medical Clinic	2	2					17,590,586
Government Buildings	3	2				1	13,159,486
Shelters/Special Needs	5	5					52,473,202
Transportation Infrastructure							-
Marine Ports	1	1					2,884,325
Airport	N/A						--
Utilities							-
Electrical Power Plant	1					1	15,575,355
WAPA Desalinization Plant	1	1					
WAPA Water Tank	1					1	
Sewage Treatment Plant	1					1	
Potable Water Tank	1	1					33,518,154

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

4.6.5 HURRICANE WINDS

This section discusses the population and the proportion and value of buildings located in areas affected by a Hurricane Winds hazard. It also provides an estimate of proportion of assets located in Hurricane Winds hazard areas.

Although there no areas of the US Virgin Islands that are totally free from hurricane force winds, the vulnerability of each islands building inventory is quite different. The tables above indicate that the vulnerability of each island's building stock differs. Since vulnerability refers to the potential of the built environment to be damaged or destroyed, the number of certain model buildings types that found throughout each island, e.g., single-family wood-frame buildings, may experience particular states of damage to the hurricane wind hazard (ranging from Very Low, Low, Moderate, High, to Very High).

Social Impacts

Table 4.40 shows an estimate of the affected population and area (in square kilometers) as indicators of the social vulnerability of each island. Two special needs population segments are broken out by hazard areas: the number of people less than 18 years of age and the number of people over 65 years of age.

TABLE 4.40 ***Social Impacts (Hurricane Winds)***

Island Jurisdiction	Total Population	Less than 18 Years of Age in Hazard Area	% Less than 18 Years of Age in Hazard Area	Over 65 Years of Age in Hazard Area	% Over 65 Years of Age in Hazard Area
St. Thomas	54,229	11,388	21%	2,711	5%
St. Croix	56,404	14,101	25%	2,820	5%
St. John	4,447	1,067	24%	267	6%

Physical and Economic Impacts

In this Plan update, economic vulnerability relates to the extent of dollar exposure of its buildings. The findings of the vulnerability assessment for this Plan Update indicate that there was an increase of 331 residential properties exposed to this hazard on St. Thomas. On St. Croix, there were 9239 residential properties exposed to the hazard, which represented an increase of 243 properties. On St. John, there were 786 residential properties, which represented an increase of 2 structures that are exposed high winds. On St. Thomas, there were 41 more commercial properties exposed to this hazard. While in St. Croix, there were 31 more commercial properties and no increase in commercial properties on St. John.

- On St. Thomas, approximately 54% percent of the residential building stock and 70% of the commercial building stock is considered to be vulnerable to hurricane winds. Of this percentage, 1% of the residential building stock is of low vulnerability to hurricane force winds, 94% is of medium vulnerability, and the remaining 5% is of high vulnerability to such winds. Nearly 1% of the commercial building inventory has a low vulnerability to hurricane force winds, and the remaining 99% of commercial building inventory has a medium vulnerability to such winds.

- On St. Croix, approximately 42% percent of the residential building stock and 58% of the commercial building stock is considered to be vulnerable to hurricane winds. Of this percentage, 83% of the residential building stock is of low vulnerability to hurricane force winds, 12% is of medium vulnerability, and the remaining 5% is of high vulnerability to such winds. Nearly 69% of the commercial building inventory has a low vulnerability to hurricane force winds, and the remaining 31% of the inventory has a medium vulnerability to such winds.

- On St. John, approximately 35% percent of the residential and commercial building stock are is considered to be vulnerable to hurricane winds. Of this percentage, 86% of the residential building stock is of low vulnerability to hurricane force winds, 9% is of medium vulnerability, and the remaining 5% is of high vulnerability to such winds. Nearly 73% of the commercial building inventory has a low vulnerability to hurricane force winds, and the remaining 27% of the inventory has a medium vulnerability to such winds.

The tables below show potential dollar exposure to the hurricane hazard on St. Thomas, St. Croix and St. John.

TABLE 4.41 ***Estimated Hurricane Exposure and Vulnerability (St. Thomas)***

Occupancy Class	Total Number of Buildings/ Percentage	Number, Percentage and Value of Buildings by Vulnerability Rating				
		Very Low	Low	Moderate	High	Very high
% of Residential	54%	0%	1%	94%	5%	0%
No. of Residential	12,617	0	126	11860	631	0
Value of Residential	$3,470,808,827	$0	$34,708,088	$3,262,560,297	$173,540,441	$0
% of Commercial	70%	0%	1%	99%	0%	0%
No. of Commercial	1530	0	28	2157	0	0
Value of Commercial	$1,274,480,752	$0	$23,235,666	$1,797,451,122	$0	$0

TABLE 4.42 ***Estimated Hurricane Exposure and Vulnerability (St. Croix)***

Occupancy Class	Total Number of Buildings/ Percentage	Number, Percentage and Value of Buildings by Vulnerability Rating				
		Very Low	Low	Moderate	High	Very high
% of Residential	42%	0%	83%	12%	5%	0%
No. of Residential	9,239	0	7,668	1,109	462	0
Value of Residential	2,434,207,920	0	2,020,392,573	292,104,950	121,710,396	0
% of Commercial	58%	0%	69%	31%	0%	0%
No. of Commercial	484	0	334	150	0	0
Value of Commercial	1,441,426,090	0	994,584,002	446,842,088	0	0

TABLE 4.43 ***Estimated Hurricane Exposure and Vulnerability (St. John)***

Occupancy Class	Total Number of Buildings/ Percentage	Number, Percentage and Value of Buildings by Vulnerability Rating				
		Very Low	Low	Moderate	High	Very high
% of Residential	35%	0	0.86	0.09	0.05	0
No. of Residential	786	0	676	71	39	0
Value of Residential	287,456,182	0	247,212,317	25,871,056	14,372,809	0
% of Commercial	35%	0	0.73	0.27	0	0
No. of Commercial	28	0	21	8	0	0
Value of Commercial	118,850,993	0	86,761,225	32,089,768	0	0

Critical Facilities and Infrastructure

The following tables highlight the results of the vulnerability assessment of each state-owned or operated facility to the Hurricane Wind hazard. Results define the potential exposure to Territorial Facilities and Infrastructure for the island of St. Thomas, St. Croix and St. John.

TABLE 4.44 ***Estimated Hurricane Exposure and Vulnerability, Critical Facilities and Infrastructure (St. Thomas)***

Facility	# of Facilities in Class	Vulnerability Rating					Total Exposure
		Very Low	Low	Moderate	High	Very High	
Critical Facilities							
Police Stations	5			3	1		12,727,552
Fire Stations	5		1	2	2		7,792,547
Emergency Response	1		1				6,472,875
Hospital, Clinics, and special needs	5		1	2	2		95,838,253
Government Buildings	11		2	1	6	2	118,417,923
Shelters	5			1	4		123,556,219
Transportation Infrastructure							
Marine Ports	4	1	1	1	1		26,038,712
Airport	1		1				22,475,260
Utilities							
Electric Power Plant	1		1				51,172,046
Sewage Treatment Plant	1		1				
Water Treatment Plant	1		1				
WAPA Tanks	1		1				61,792,356
Pumping Station	1		1				

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

TABLE 4.45 ***Estimated Hurricane Exposure and Vulnerability, Critical Facilities and Infrastructure (St. Croix)***

Facility	# of Facilities in Class	Vulnerability Rating					Total Exposure
		Very Low	Low	Moderate	High	Very High	
Critical Facilities							
Police Stations	6		4	2			63,719,946
Fire Stations	5	1			1	3	9,269,808
Emergency Response	1		1				-
Hospital/ Medical Clinic	3			2		1	135,990,389
Government Buildings	12			6	2	4	121,046,648
Shelters/Special Needs	11		1	3	1	6	173,286,506
Transportation Infrastructure							
Marine Ports	5	4	1				9,922,078
Airport	1			1			57,686,500
Utilities							
Electrical Power Plant	1		1				51,917,850
Sewage Pumps	14	3	2	3	4	2	
Wastewater Treatment Plant	1		1				
Water Treatment Plant	1		1				110,067,300
Water Pumps	8		8				
Water Tanks	12	2	3	3	4		

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

TABLE 4.46 *Estimated Hurricane Exposure and Vulnerability, Critical Facilities and Infrastructure (St. John)*

Facility	# of Facilities in Class	Vulnerability Rating					Total Exposure
		Very Low	Low	Moderate	High	Very High	
Critical Facilities							
Police Stations	2		1		1		4,321,296
Fire Stations	2		1		1		4,845,666
Emergency Response	1		1				5,142,339
Hospital/ Medical Clinic	2		1			1	17,590,586
Government Buildings	3		2		1		13,159,486
Shelters/Special Needs	5			2	3		52,473,202
Transportation Infrastructure							-
Marine Ports	1		1				2,884,325
Airport	N/A						
Utilities							-
Electrical Power Plant	1		1				15,575,355
WAPA Desalinization Plant	1		1				
WAPA Water Tank	1		1				
Sewage Treatment Plant	1		1				
Potable Water Tank	1	1					33,518,154

4.6.6 RAIN-INDUCED LANDSLIDES

This section discusses the population and the proportion and value of buildings located in areas affected by a rain-induced landslides. It also provides an estimate of proportion of assets located in areas that are susceptible to rain-induced landslides

Social Impacts

Table 4.48 shows an estimate of the affected population and area (in square kilometers) as indicators of the social vulnerability of each island. Two special needs population segments are broken out by hazard areas: the number of people less than 18 years of age and the number of people over 65 years of age.

TABLE 4.48 ***Social Impacts (Rain-induced Landslide)***

Island Jurisdiction	Total Population	Less than 18 Years of Age in Hazard Area	% Less than 18 Years of Age in Hazard Area	Over 65 Years of Age in Hazard Area	% Over 65 Years of Age in Hazard Area
St. Thomas	54,229	9,246	17%	2,278	4%
St. Croix	56,404	3,462	6%	853	2%
St. John	4,447	1,516	34%	146	3%

Physical and Economic Impacts

In this Plan Update, economic vulnerability relates to the extent of dollar exposure of its buildings that are susceptible to this hazard. The findings of the vulnerability assessment for this Plan Update indicate that there are 11,682 residential structures and 830 commercial structures exposed to this hazard on St. Thomas. On St. Croix there are 3,959 residential structures and 150 commercial structures exposed to this hazard on St. Thomas. On St. John there are 876 residential structures and 30 commercial structures exposed to this hazard.

- On St. Thomas approximately 50% percent of the residential building stock and 38% of the commercial building stock is considered to be vulnerable rain-induced landslides. Of this percentage, approximately 13% of the residential building stock is of high vulnerability and the remaining 27% is of very high vulnerability to rain-induced landslide event. Commercial structures are considered to be less vulnerable to rain–induced landslide with the majority of structures falling into the very low and low susceptibility categories.

- On St. Croix approximately 18% percent of the residential building stock susceptible to landslide hazards. Of this percentage, approximately 17% of the residential building stock is of medium vulnerability, 13% of the residential building stock is of high vulnerability, and the remaining 5% is of very high vulnerability to rain-induced landslide. None of the commercial building inventory falls into the medium, high or very high vulnerability hazard rating for a rain-induced landslide.

- On St. John approximately 39% percent of the residential building stock and 37% of the commercial building stock is considered to be vulnerable to a rain-induced landslide. Of this percentage, approximately 24% of the residential building stock is of medium vulnerability, 27% of the residential building stock is of high vulnerability, and the remaining 12% is of very high vulnerability to a rain-induced landslide event. None of the commercial building inventory is of medium high or very high vulnerability rating to a rain-induced landslide event.

The tables below show potential dollar exposure to earthquake hazard on St. Thomas, St. Croix and St. John.

TABLE 4.49 *Estimated Rain-Induced Landslide Exposure and Vulnerability (St. Thomas)*

Occupancy Class	Total Number of Buildings/ Percentage	Number, Percentage and Value of Buildings by Vulnerability Rating				
		Very Low	Low	Moderate	High	Very high
% of Residential	50%	5%	33%	22%	13%	27%
No. of Residential	11,682	629	3,834	2,546	1,463	3,211
Value of Residential	$3,213,711,877	$173,052,574	$1,054,598,986	$700,405,281	$402,405,769	$883,249,267
% of Commercial	38%	13%	87%	0	0	0
No. of Commercial	830	109	721	0	0	0
Value of Commercial	$691,860,980	$91,034,339	$600,826,640	$0	$0	$0

TABLE 4.50 ***Estimated Rain-Induced Landslide Exposure and Vulnerability (St. Croix)***

Occupancy Class	Total Number of Buildings/ Percentage	Number, Percentage and Value of Buildings by Vulnerability Rating				
		Very Low	Low	Moderate	High	Very high
% of Residential	18%	46%	20%	17%	13%	5%
No. of Residential	3959	1,805	790	654	504	207
Value of Residential	$1,043,231,966	475,623,664	208,168,636	172,259,816	132,684,653	54,495,197
% of Commercial	18%	70%	30%	0	0	0
No. of Commercial	150	105	46	0	0	0
Value of Commercial	$259,456,696	180,833,455	78,623,241	0	0	0

TABLE 4.51 ***Estimated Rain-Induced Landslide Exposure and Vulnerability (St. John)***

Occupancy Class	Total Number of Buildings/ Percentage	Number, Percentage and Value of Buildings by Vulnerability Rating				
		Very Low	Low	Moderate	High	Very high
% of Residential	39%	15%	22%	24%	27%	12%
No. of Residential	876	130	197	206	236	107
Value of Residential	$320,308,317	47,473,212	71,913,125	75,445,644	86,187,058	39,289,278
% of Commercial	37%	41%	59%			
No. of Commercial	30	12	18	0	0	0
Value of Commercial	$125,642,478	50,936,140	74,706,338	0	0	0

Critical Facilities

The tables below highlight the results of the vulnerability assessment of each state-owned or operated facility to the earthquake hazard. Results define the potential exposure to Territorial Facilities and Infrastructure for the island of St. Thomas, St. Croix and St. John.

TABLE 4.52 ***Estimated Rain-Induced Landslide Exposure and Vulnerability, Critical Facilities and Infrastructure (St. Thomas)***

Facility	# of Facilities in Class	Vulnerability Rating					Total Exposure
		Very Low	Low	Moderate	High	Very High	
Critical Facilities							
Police Stations	5	3	2				12,727,552
Fire Stations	5	3	2				7,792,547
Emergency Response	1	1					6,472,875
Hospital, Clinics, and special needs	5	4	1				95,838,253
Government Buildings	11	10	1				118,417,923
Shelters	5	2	1	1	1		123,556,219
Transportation Infrastructure							
Marine Ports	4	4					26,038,712
Airport	1	1					22,475,260
Utilities							
Electrical Power Generating Plants	1	1					51,172,046
Sewage Treatment Plant	1		1				61,792,356
Water Treatment Plant	1		1				
WAPA Tanks	1	1					
Pumping Station	1		1				

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

TABLE 4.53 ***Estimated Rain-Induced Landslide Exposure and Vulnerability, Critical Facilities and Infrastructure (St. Croix)***

Facility	# of Facilities in Class	Vulnerability Rating					Total Exposure
		Very Low	Low	Moderate	High	Very High	
Critical Facilities							
Police Stations	6	6					63,719,946
Fire Stations	5	5					9,269,808
Emergency Response	N/A						-
Hospital/ Medical Clinic	3	3					135,990,389
Government Buildings	12	11	1				121,046,648
Shelters/Special Needs	11	11					173,286,506
Transportation Infrastructure							
Marine Ports	5	5					9,922,078
Airport	1	1					57,686,500
Utilities							
Electrical Power Generating Plants	1	1					51,917,850
Sewage Pumps	14	14					110,067,300
Wastewater Treatment Plant	1	1					
Water Treatment Plant	1	1					
Water Pumps	8	5	3				

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

TABLE 4.54 ***Estimated Rain-Induced Landslide Exposure and Vulnerability, Critical Facilities and Infrastructure (St. John)***

Facility	# of Facilities in Class	Vulnerability Rating					Total Exposure
		Very Low	Low	Moderate	High	Very High	
Critical Facilities							
Police Stations	2	1	1				4,321,296
Fire Stations	2	1	1				4,845,666
Emergency Response	1	1					5,142,339
Hospital/ Medical Clinic	2	1	1				17,590,586
Government Buildings	3	2	1				13,159,486
Shelters/Special Needs	5	3	2				52,473,202
Transportation Infrastructure							-
Marine Ports	1	1					2,884,325
Airport	N/A						--
Utilities							-
Electrical Power Generating Plants	1	1					15,575,355
WAPA Desalinization Plant	1	1					
WAPA Water Tank	1	1					
Sewage Treatment Plant	1	1					
Potable Water Tank	1	1					33,518,154

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

4.6.7 TSUNAMI

This section discusses the population and the proportion and value of buildings located in areas affected by a tsunami hazard. It also provides an estimate of proportion of assets located in tsunami hazard areas.

Social Impacts

Table 4.55 shows an estimate of the affected population and area (in square kilometers) as indicators of the social vulnerability of each island. Two special needs population segments are broken out by hazard areas: the number of people less than 18 years of age and the number of people over 65 years of age.

TABLE 4.55 ***Social Impacts (Tsunami)***

Island Jurisdiction	Total Population	Less than 18 Years of Age in Hazard Area	% Less than 18 Years of Age in Hazard Area	Over 65 Years of Age in Hazard Area	% Over 65 Years of Age in Hazard Area
St. Thomas	54,229	2,440	5%	813	2%
St. Croix	56,404	2,758	5%	919	2%
St. John	4,447	141	3%	71	2%

Physical and Economic Impacts

In this Plan Update, economic vulnerability relates to the extent of dollar exposure of its buildings. The findings of the vulnerability assessment for this Plan Update indicate that there was an increase of 1,476 residential properties exposed to this hazard on St. Thomas. For St. Croix there were 1011 less residential properties exposed to this hazard, while on St. John the total number of residential properties exposed decreased by 111. On St. Thomas there were 253 more commercial properties exposed to this hazard. On St. Croix, there were 17 more commercial properties, while on St. John there was an increase of 4 commercial properties exposed to this hazard.

- All building types are equally vulnerable to a tsunami. No regular building structure can be built to withstand a tsunami, as it would not be economically or realistically feasible to do so, given the rare and random nature of this hazard. Of all buildings exposed to this hazard, approximately 40% of the residential building stock is of high vulnerability and the remaining 60% is of very high vulnerability to a tsunami event. The commercial buildings 20% are of high vulnerability and 80% fall in the very high category.

- Tsunamis can devastate development along coastlines, causing widespread property damage and loss of life. Both residential and commercial structures are considered to be equally vulnerable to the tsunami hazard. Tsunamis can cause significant loss of life, especially in low-lying harbors of Charlotte Amalie, Christiansted and Frederiksted.

- Tsunamis have the potential to have an enormous impact of the tourist industry. Cruise ships and their passengers are particularly exposed to this hazard, especially while in harbor.

The tables below show potential dollar exposure to earthquake hazard on St. Thomas, St. Croix and St. John.

TABLE 4.56 ***Estimated Tsunami Exposure and Vulnerability (St. Thomas)***

Occupancy Class	Total Number of Buildings/ Percentage	Number, Percentage and Value of Buildings by Vulnerability Rating				
		Very Low	Low	Moderate	High	Very high
% of Residential	18%	0	0	0	40%	60%
No. of Residential	4,206	0	0	0	1,682	2,523
Value of Residential	$1,156,936,276	$0	$0	$0	$462,774,510	$694,161,765
% of Commercial	33%	0	0	0	20%	80%
No. of Commercial	721	0	0	0	144	577
Value of Commercial	$ 600,826,640	$ 0 -	$ 0 -	$ 0 -	$ 120,165,328	$ 480,661,312

TABLE 4.57 ***Estimated Tsunami Exposure and Vulnerability (St. Croix)***

Occupancy Class	Total Number of Buildings/ Percentage	Number, Percentage and Value of Buildings by Vulnerability Rating				
		Very Low	Low	Moderate	High	Very high
% of Residential	11%	0	0	0	40%	60%
No. of Residential	2,510	0	0	0	1,004	1,506
Value of Residential	661,293,152	0	0	0	264,517,261	396,775,891
% of Commercial	5%	0	0	0	20%	80%
No. of Commercial	41	0	0	0	8	33
Value of Commercial	70,485,736	0	0	0	14,097,147	56,388,589

TABLE 4.58 ***Estimated Tsunami Exposure and Vulnerability (St. John)***

Occupancy Class	Total Number of Buildings/ Percentage	Number, Percentage and Value of Buildings by Vulnerability Rating				
		Very Low	Low	Moderate	High	Very high
% of Residential	13%	0	0	0	40%	60%
No. of Residential	286	0	0	0	114	171
Value of Residential	104,469,790	0	0	0	41,787,916	62,681,874
% of Commercial	13%	0	0	0	20%	80%
No. of Commercial	10	0	0	0	2	8
Value of Commercial	43,193,847	0	0	0	8,638,769	34,555,077

Critical Facilities

Tables 4.59 through 4.61 highlights the results of the vulnerability assessment of each state-owned or operated facility to the Tsunami hazard. Results define the potential exposure to Territorial Facilities and Infrastructure for the island of St. Thomas, St. Croix and St. John.

TABLE 4.59 ***Estimated Tsunami Exposure and Vulnerability, Critical Facilities and Infrastructure (St. Thomas)***

Facility	# of Facilities in Class	Vulnerability Rating					Total Exposure
		Very Low	Low	Moderate	High	Very High	
Critical Facilities							
Police Stations	5	4				1	12,727,552
Fire Stations	5	3				2	7,792,547
Emergency Response	1	1					6,472,875
Hospital, Clinics, and special needs	5	4				1	95,838,253
Government Buildings	11	4				7	118,417,923
Shelters	5	5					123,556,219
Transportation Infrastructure							
Marine Ports	4	1				3	26,038,712
Airport	1	1					22,475,260
Utilities							
Electrical Power Plant	1					1	51,172,046
Sewage Treatment Plant	1		1				61,792,356
Water Treatment Plant	1		1				
WAPA Tanks	1		1				
Pumping Station	1		1				

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

TABLE 4.60 ***Estimated Tsunami Exposure and Vulnerability, Critical Facilities and Infrastructure (St. Croix)***

Facility	# of Facilities in Class	Vulnerability Rating					Total Exposure
		Very Low	Low	Moderate	High	Very High	
Critical Facilities							
Police Stations	6	6					63,719,946
Fire Stations	5	5					9,269,808
Emergency Response	1	1					-
Hospital/ Medical Clinic	3	2				1	135,990,389
Government Buildings	12	11				1	121,046,648
Shelters/Special Needs	11	11					173,286,506
Transportation Infrastructure							
Marine Ports	5	1				4	9,922,078
Airport	1					1	57,686,500
Utilities							
Electrical Power Plant	1	1					51,917,850
Sewage Pumps	14	14					110,067,300
Wastewater Treatment Plant	1					1	
Water Treatment Plant	1	1					
Water Pumps	8	7					

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

TABLE 4.61 ***Estimated Tsunami Exposure and Vulnerability, Critical Facilities and Infrastructure (St. John)***

Facility	# of Facilities in Class	Vulnerability Rating					Total Exposure
		Very Low	Low	Moderate	High	Very High	
Critical Facilities							
Police Stations	2	1				1	4,321,296
Fire Stations	2	1				1	4,845,666
Emergency Response	1	1					5,142,339
Hospital/ Medical Clinic	2	2					17,590,586
Government Buildings	3	3					13,159,486
Shelters/Special Needs	5	1				1	52,473,202
Transportation Infrastructure							-
Marine Ports	1					1	2,884,325
Airport	N/A						
Utilities							-
Electrical Power Plant	1					1	15,575,355
WAPA Desalinization Plant	1					1	
WAPA Water Tank	1					1	
Sewage Treatment Plant	1	1					
Potable Water Tank	1	1					
							33,518,154

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

4.6.8 WILDFIRE

This section discusses the population and the proportion and value of buildings located in areas affected by a rain-induced landslides. It also provides an estimate of proportion of assets located in areas that are susceptible to rain-induced landslides

Social Impacts

Table 4.62 shows an estimate of the affected population and area (in square kilometers) as indicators of the social vulnerability of each island. Two special needs population segments are broken out by hazard areas: the number of people less than 18 years of age and the number of people over 65 years of age.

TABLE 4.62 ***Social Impacts (Wildfire)***

Island Jurisdiction	Total Population	Less than 18 Years of Age in Hazard Area	% Less than 18 Years of Age in Hazard Area	Over 65 Years of Age in Hazard Area	% Over 65 Years of Age in Hazard Area
St. Thomas	54,229	7,767	14%	1,913	3.53%
St. Croix	56,404	7,111	13%	1,752	3.11%
St. John	4,447	421	9%	104	2.33%

Physical and Economic Impacts

In this Plan Update, economic vulnerability relates to the extent of dollar exposure of its buildings that are susceptible to this hazard. The findings of the vulnerability assessment for this Plan Update indicate that there are 10,067 residential structures and 219 commercial structures exposed to this hazard on St. Thomas. On St. Croix, there are 10,067 residential structures and 575 commercial structures exposed to this hazard on St. Thomas. On St. John, there are 831 residential structures and 35 commercial structures exposed to this hazard.

- On St. Thomas approximately 42% percent of the residential building stock and 35% of the commercial building stock is considered to be vulnerable wildfires. Of this percentage, approximately 32% of the residential building stock is of high vulnerability and the remaining 11% is of very high vulnerability to wildfires. Commercial structures are considered to be less vulnerable to wildfires with the majority of structures falling into the very low and low susceptibility categories.

- On St. Croix approximately 47% percent of the residential building stock susceptible to wildfire hazards. Of this percentage, approximately 26% of the residential building stock is of medium vulnerability, 30% of the residential building stock is of high vulnerability, and the remaining 16% is of very high vulnerability to wildfires. None of the commercial building inventory falls into the medium, high or very high vulnerability hazard rating for a rain-induced landslide.

- On St. John approximately 38% percent of the residential building stock and 44% of the commercial building stock is considered to be vulnerable to a wildfire. Of this percentage, approximately 18% of the residential building stock is of medium vulnerability, 30% of the residential building stock is of high vulnerability, and the remaining 8% is of very high vulnerability to wildfire hazard. None of the commercial building inventory is of medium high or very high vulnerability rating to a rain-induced landslide event.

The tables below show potential dollar exposure to earthquake hazard on St. Thomas, St. Croix and St. John.

TABLE 4.63 ***Estimated Wildfire Exposure and Vulnerability (St. Thomas)***

Occupancy Class	Total Number of Buildings/ Percentage	Number, Percentage and Value of Buildings by Vulnerability Rating				
		Very Low	Low	Moderate	High	Very high
% of Residential	42%	18%	17%	22%	32%	11%
No. of Residential	9813	1781	1694	2178	3099	1061
Value of Residential	$2,699,517,976	$489,938,678	$466,103,823	$599,108,197	$852,463,874	$291,903,404
% of Commercial	35%	51%	49%	0	0	0
No. of Commercial	774	398	376	0	0	0
Value of Commercial	$644,801,763	$331,612,335	$313,189,428	$0	$0	$0

TABLE 4.64 ***Estimated Wildfire Exposure and Vulnerability (St. Croix)***

Occupancy Class	Total Number of Buildings/ Percentage	Number, Percentage and Value of Buildings by Vulnerability Rating				
		Very Low	Low	Moderate	High	Very high
% of Residential	47%	10%	17%	26%	30%	16%
No. of Residential	10067	1,051	176	46	14	2
Value of Residential	$2,723,994,577	284,286,019	47,720,282	12,397,796	3,762,452	618,913
% of Commercial	27%	37%	63%	0	0	0
No. of Commercial	590	219	138	0	0	0
Value of Commercial	$389,185,044	144,142,609	90,756,458	0	0	0

TABLE 4.65 ***Estimated Wildfire Exposure and Vulnerability (St. John)***

Occupancy Class	Total Number of Buildings/ Percentage	Number, Percentage and Value of Buildings by Vulnerability Rating				
		Very Low	Low	Moderate	High	Very high
% of Residential	38%	26%	18%	18%	30%	8%
No. of Residential	854	223	154	153	259	65
Value of Residential	$312,095,283	81,626,575	56,353,525	55,923,345	94,585,735	23,606,104
% of Commercial	44%	59%	41%	0	0	0
No. of Commercial	36	21	15	0	0	0
Value of Commercial	$150,128,802	88,712,474	61,416,328	0	0	0

Critical Facilities

The tables below highlight the results of the vulnerability assessment of each state-owned or operated facility to the earthquake hazard. Results define the potential exposure to Territorial Facilities and Infrastructure for the island of St. Thomas, St. Croix and St. John.

TABLE 4.66 *Estimated Wildfire Exposure and Vulnerability, Critical Facilities and Infrastructure (St. Thomas)*

<table>
<tr><th rowspan="2">Facility</th><th rowspan="2"># of Facilities in Class</th><th colspan="5">Vulnerability Rating</th><th rowspan="2">Total Exposure</th></tr>
<tr><th>Very Low</th><th>Low</th><th>Moderate</th><th>High</th><th>Very High</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Critical Facilities</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Police Stations</td><td>5</td><td>1</td><td></td><td></td><td>4</td><td></td><td>12,727,552</td></tr>
<tr><td>Fire Stations</td><td>5</td><td>1</td><td></td><td>2</td><td>4</td><td></td><td>7,792,547</td></tr>
<tr><td>Emergency Response</td><td>1</td><td>1</td><td></td><td></td><td></td><td></td><td>6,472,875</td></tr>
<tr><td>Hospital, Clinics, and special needs</td><td>5</td><td>4</td><td>1</td><td></td><td>1</td><td></td><td>95,838,253</td></tr>
<tr><td>Government Buildings</td><td>11</td><td>1</td><td></td><td>1</td><td>10</td><td></td><td>118,417,923</td></tr>
<tr><td>Shelters</td><td>5</td><td>4</td><td></td><td>3</td><td>1</td><td></td><td>123,556,219</td></tr>
<tr><td>Transportation Infrastructure</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Marine Ports</td><td>4</td><td></td><td></td><td></td><td>4</td><td></td><td>26,038,712</td></tr>
<tr><td>Airport</td><td>1</td><td></td><td></td><td></td><td>1</td><td></td><td>22,475,260</td></tr>
<tr><td>Utilities</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Electrical Power Generating Plants</td><td>1</td><td>1</td><td></td><td></td><td></td><td></td><td>51,172,046</td></tr>
<tr><td>Sewage Treatment Plant</td><td>1</td><td></td><td>1</td><td></td><td></td><td></td><td rowspan="4">61,792,356</td></tr>
<tr><td>Water Treatment Plant</td><td>1</td><td></td><td>1</td><td></td><td></td><td></td></tr>
<tr><td>WAPA Tanks</td><td>1</td><td>1</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Pumping Station</td><td>1</td><td></td><td>1</td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

TABLE 4.67 *Estimated Wildfire Exposure and Vulnerability, Critical Facilities and Infrastructure (St. Croix)*

Facility	# of Facilities in Class	Vulnerability Rating					Total Exposure
		Very Low	Low	Moderate	High	Very High	
Critical Facilities							
Police Stations	6	3		2	1		63,719,946
Fire Stations	5	1				4	9,269,808
Emergency Response	N/A						-
Hospital/ Medical Clinic	3	2		1		1	135,990,389
Government Buildings	12	7				5	121,046,648
Shelters/Special Needs	11	11		3	8		173,286,506
Transportation Infrastructure							
Marine Ports	5	5					9,922,078
Airport	1	1					57,686,500
Utilities							
Electrical Power Generating Plants	1	1					51,917,850
Sewage Pumps	14	9		3	2	3	110,067,300
Wastewater Treatment Plant	1	1				1	
Water Treatment Plant	1	1					
Water Pumps	8	3		3	2	3	

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

TABLE 4.68 ***Estimated Wildfire Exposure and Vulnerability, Critical Facilities and Infrastructure (St. John)***

Facility	# of Facilities in Class	Vulnerability Rating					Total Exposure
		Very Low	Low	Moderate	High	Very High	
Critical Facilities							
Police Stations	2				2		4,321,296
Fire Stations	2	1			1		4,845,666
Emergency Response	1	1					5,142,339
Hospital/ Medical Clinic	2	1					17,590,586
Government Buildings	3				3		13,159,486
Shelters/Special Needs	5	3			2		52,473,202
Transportation Infrastructure							-
Marine Ports	1	1					2,884,325
Airport	N/A						
Utilities							-
Electrical Power Generating Plants	1					1	15,575,355
WAPA Desalinization Plant	1					1	
WAPA Water Tank	1					1	
Sewage Treatment Plant	1					1	
Potable Water Tank	1					1	33,518,154

Appendix E provides detailed Vulnerability and Loss Estimate calculations for each facility.

4.7 LOSS ESTIMATES

This section of the Plan Update presents the "estimate of losses," including: exposure, damage, and loss estimates analyzed on a hazard-by-hazard basis. The findings support local and regional planners' understanding of the potential impacts of each hazard and enable a comparison of hazards by quantifying potential exposures impacts.

The loss estimates provided in this section were developed using available data, and the methodologies applied have resulted in an approximation of risk. These estimates should be used to understand relative risk from hazards and potential losses.

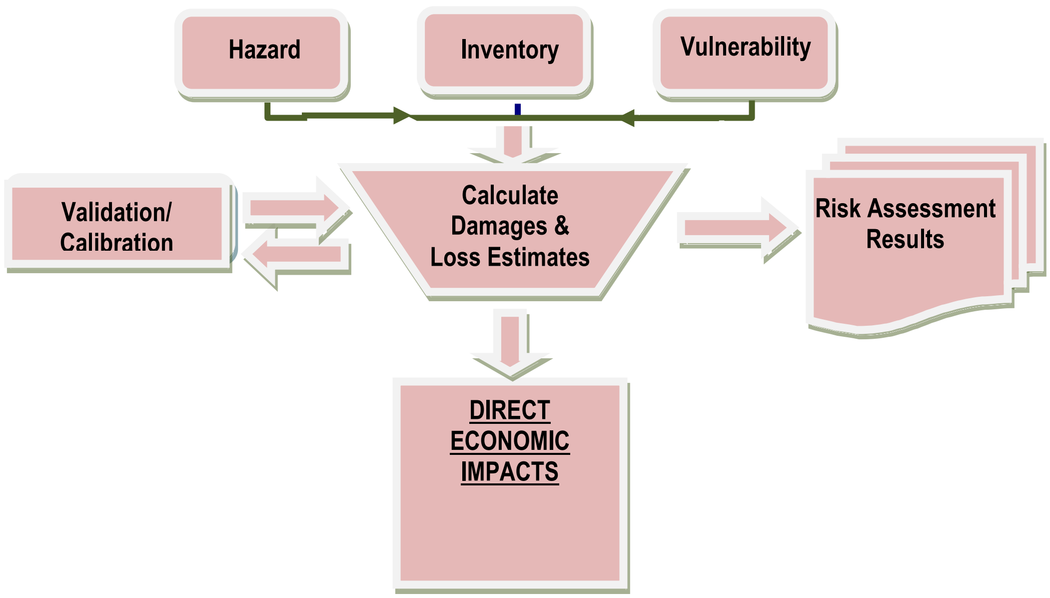
However, it is important to understand that uncertainties are inherent in any loss estimation methodology, arising in part from incomplete scientific knowledge concerning natural hazards and their effects on the built environment. Uncertainties also result from approximations and simplifications that are necessary for a comprehensive analysis.

The risk assessment utilized for this Plan Update was parametric. The risk analyses are based on a comprehensive methodology that incorporates approaches for:

- Characterizing Hazards, understanding the nature of the hazards (i.e. level of ground shaking, wind speed, depth of flooding);
- Categorization of the built environment, understanding number, distribution, and value of assets (i.e. general buildings & critical facilities),
- Vulnerability Analysis, understanding the damage and loss characteristics of identified buildings, and
- Estimating damage and losses to buildings and critical facilities.

Figure 4.26 illustrates a conceptual model of the loss estimation methodology as applied for the US Virgin Islands Mitigation Plan.

FIGURE 4.26 ***Conceptual Model of Risk Assessment Methodology***



For each of the hazards (Earthquake, Riverine Flooding, Coastal Flooding, Hurricane Winds, and Tsunami) estimates were derived from calculating the number of buildings exposed to the hazard and the potential economic losses. The economic loss ratio is also provided, which is the percentage of the losses against the total value of all the structures within the Territory for a particular hazard.

Loss estimates associated with drought were not analyzed using a risk assessment methodology based on the same principals as described above. Instead, available historical data for each hazard are used and statistical evaluations are performed using manual calculations. The general steps used in this methodology are summarized below:

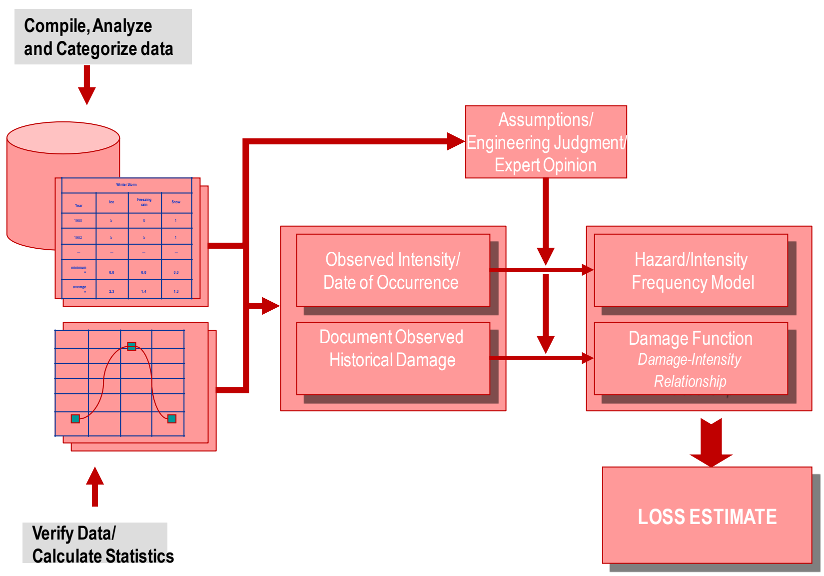
- Compile and analyze available data from national and local sources
- Verify data and conduct statistical analysis to relate historical patterns within the data to existing hazard models
- Develop model parameters based on data analysis, existing hazard models, and risk engineering judgment

The paucity of historic information that was available for these hazards necessitated the CIPA consultant team to try to ascertain the following:

- Analysis of frequency of hazard occurrence
- Analysis of intensity and/or damages parameters associated with hazard occurrence (for example, one drought event = $ in estimated damages)
- Development of frequency curves expected damages
- Estimate losses

Figure 4.27 illustrates a conceptual model of the statistical risk assessment methodology as applied to the US Virgin Islands.

FIGURE 4.27: ***Conceptual Model of Statistical Risk Assessment Methodology***



The risk assessment methodologies used in the Plan Update are standardized, meaning they have been applied to each island in the same way. Impacts presented in this study include only direct social economic losses because of data limitations and time constraints on the project; however these results represent the key impacts faced by US Virgin Islands.

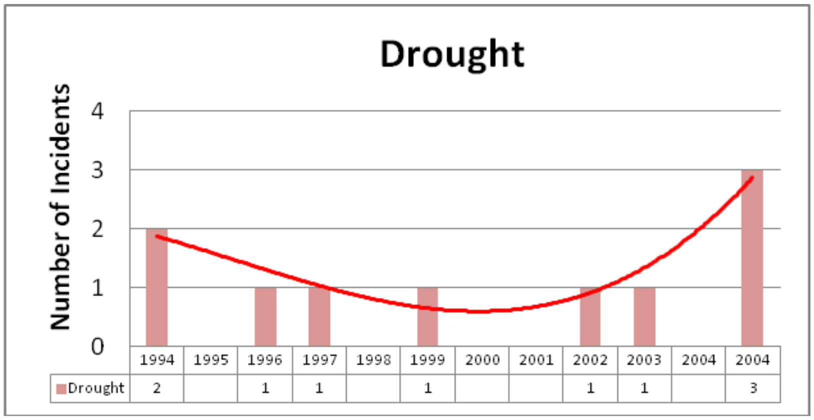
4.7.1 DROUGHT

This subsection of the risk assessment presents the "estimate of losses for drought hazard.

Estimated Losses: Economic Impact

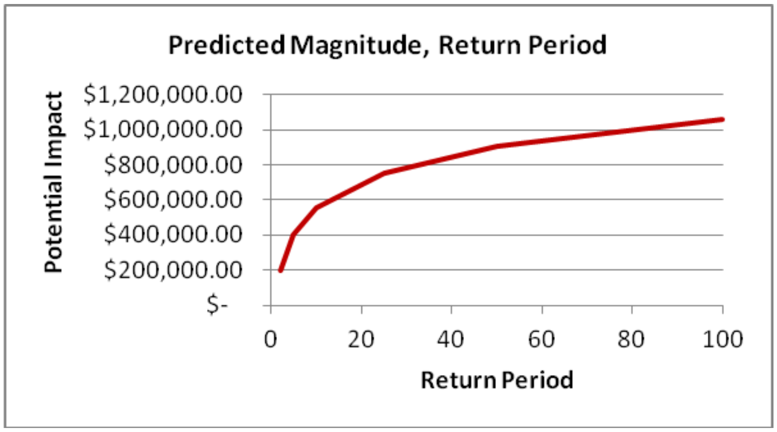
Estimated losses for drought were aggregated for primary economic impacts that could impact the US Virgin Islands through regional economic loss. The primary economic impact was assumed to be increased costs associated with feeding cattle.

FIGURE 4.28 ***Historical Droughts in US Virgin Islands, 2003-2007***



This figure was based regional historic drought data for Puerto Rico and the US Virgin Islands. Based on the available data and the assumptions provided above, the predicted impact of a drought with a 50% probability of occurrence is $200,000.

FIGURE 4.29 ***Historical Droughts in US Virgin Islands, 2003-2007***



The expected impact of a drought for a 100 year return period is approximately 1.058M. Damage parameters from only two (2) historic events in the US Virgin Islands were used to develop this estimate.

4.7.2 EARTHQUAKE

This subsection of the risk assessment presents the "estimate of losses," including: exposure, damage, and loss estimates analyzed for the earthquake hazard.

Estimated Losses: General Building Stock

Damages and losses were estimated based on a 1000-year probabilistic ground shaking scenario. Property damage is summarized by general occupancy classes. The total damage for a 1000-year event was estimated to be $6 billion for St. Thomas, $4.3 billion for St. Croix and $463 million for St. John. This represents a $419 billion increase in estimated losses for on St. Thomas since the 2011 Plan. Estimated losses for St. Croix have increased by 11M and 9.7 M on St. John.

TABLE 4.69 ***Estimated Losses: General Building Stock for Earthquake Hazard***

Occupancy	No of Affected Buildings	Expected Losses	% Value
St. Thomas			
Residential	21,679	$ 4,641,269,145	72%
Commercial	981	$ 1,384,710,463	86%
Total	22,660	$ 6,025,979,608	
St. Croix			
Residential	18,082	$ 3,645,930,917	56%
Commercial	670	$ 746,489,600	53%
Total	18,753	$ 4,392,420,517	
St. John			
Residential	1,431	$ 386,386,207	0.54
Commercial	70	$ 76,830,370	0.65
Total	1,501	$ 463,216,578	

Estimated Losses: Critical Facilities and Infrastructure

Critical facilities and infrastructure losses for St. Thomas, St. Croix and St. John are highlighted in Table 4.70.

TABLE 4.70 ***Estimated Losses: Critical Facilities and Infrastructure for Earthquake Hazard***

Facility	St. Thomas	St. Croix	St. John
Critical Facilities			
Police Stations	$13,804,002	$42,949,130	$2,373,142
Fire Stations	$32,370,825	$7,431,814	$3,321,795
Emergency Response	$6,331,171	$2,476,394	$3,367,056
Hospital/ Medical Clinic	$71,272,393	$106,217,486	$9,393,598
Government Buildings	$103,612,740	$109,157,907	$8,777,514
Shelters/Special Needs	$123,062,681	$128,181,063	$54,803,795
Transportation Infrastructure			
Marine Ports	$6,844,012	$364,105	$33,953
Airport	$26,632	$30,627,988	$0
Utilities			
Electrical Power Generating Plants	$30,892,492	$43,768,184	$14,094,331
Water Treatment Plants	$44,509,147	$15,989,798	$2,096,480
Wastewater Treatment Plants	$910,804	$16,707,348	$20,768,378
Pumps	$295,361	$16,476,882	--
Tanks	$8,080,947	$8,451,850	$1,090,889

Detailed information on critical facilities identified to be high risk structures is included in Appendix E. These are defined as those expected to sustain damages exceeding 60% for any of the hazards considered.

4.7.3 RIVERINE FLOODING

This subsection of the risk assessment presents the “estimate of losses,” including: exposure, damage, and loss estimates analyzed for the riverine flooding hazard.

Estimated Losses: General Building Stock

Property damage due to the riverine hazard is summarized in Table 4.71 by occupancy class. The total expected loss for a 100-year MRP is approximately $1B million for St. Thomas, $768 million for St. Croix and $17million for St. John. This represents a significant increase for the Territory.

TABLE 4.71 ***Estimated Losses: General Building Stock for Riverine Flooding Hazard***

Occupancy	No of Affected Buildings	Expected Losses	% Value
St. Thomas			
Residential	11,390	$ 752,430,862	0.12
Commercial	742	$ 292,639,745	0.18
Total	12,133	$ 1,045,070,607	
St. Croix			
Residential	4,648	$ 618,081,641	0.09
Commercial	349	$ 150,076,139	0.11
Total	4,996	$ 768,157,780	
St. John			
Residential	309	$ 15,718,980	0.02
Commercial	9	$ 1,570,220	0.01
Total	318	$ 17,289,200	

The estimated loss values are based on the count of buildings damaged as presented in the table above. Building counts are based on a geographic distribution of structures by occupancy class across estate boundaries.

Estimated Losses: Critical Facilities and Infrastructure

Critical facilities and infrastructure losses for St. Thomas, St. Croix and St. John are highlighted in Table 4.72.

TABLE 4.72 ***Estimated Losses: Critical Facilities and Infrastructure for Riverine Flooding Hazard***

Facility	St. Thomas	St. Croix	St. John
Critical Facilities			
Police Stations	$2,208,247	$846,102	$2,450,885
Fire Stations	$32,635,564	$0	$0
Emergency Response	$0	$0	$0
Hospital/ Medical Clinic	$4,495,220	$0	$0
Government Buildings	$81,303,611	$41,134,403	$6,613,182
Shelters/Special Needs	$55,258,961	$8,146,920	$24,107,203
Transportation Infrastructure	$0	$0	$0
Marine Ports	$2,143,620	$0	$34,183
Airport	$0	$0	$0
Utilities	$0	$0	$0
Electrical Power Generating Plants	$0	$0	$2,768,783
Water Treatment Plants	$44,437,250	$9,229,275	$0
Wastewater Treatment Plants	$937,800	$0	$22,218,625
Pumps	$0	$1,525,473	--
Tanks	$0	$517,334	$0

Detailed information on critical facilities identified to be high risk structures is included in Appendix E. These are defined as those expected to sustain damages exceeding 60% for any of the hazards considered.

4.7.4 Coastal Flooding

This subsection of the risk assessment presents the "estimate of losses," including: exposure, damage, and loss estimates analyzed for the coastal flooding hazard.

Estimated Losses: General Building Stock

The total estimated property damages and losses for a Category 5 Storm Surge event is $171 million for St. Thomas, $78.5 million for St. Croix and $26.6 million for St. John. Table 4.48 presents these results by occupancy class. This represents a $439 million increase in estimated losses for the Territory since the 2011 Plan.

TABLE 4.73 ***Estimated Losses: General Building Stock for Coastal Flooding Hazard***

Occupancy	No of Affected Buildings	Expected Losses	% Value
St. Thomas			
Residential	1,511	$ 115,105,946	0.02
Commercial	236	$ 56,606,106	0.04
Total	1,747	$ 171,712,053	
St. Croix			
Residential	3,425	$ 52,319,194	0.01
Commercial	334	$ 26,256,719	0.02
Total	3,760	$ 78,575,913	
St. John			
Residential	386	$ 22,500,497	0.03
Commercial	3	$ 4,123,048	0.03
Total	389	$ 26,623,544	

The estimated loss values are based on the count of buildings damaged as presented in the table above. Building counts are based on a geographic distribution of structures by occupancy class across estate boundaries.

Estimated Losses: Critical Facilities and Infrastructure

Critical facilities and infrastructure losses for St. Thomas, St. Croix and St. John are highlighted in Table 4.74.

TABLE 4.74 ***Estimated Losses: Critical Facilities and Infrastructure For Coastal Flooding Hazard***

Facility	St. Thomas	St. Croix	St. John
Critical Facilities			
Police Stations	$133,178	$0	$0
Fire Stations	$13,900,517	$0	$0
Emergency Response	$0	$0	$0
Hospital/ Medical Clinic	$3,196,231	$0	$0
Government Buildings	$6,455,387	$3,987,047	$9,113,250
Shelters/Special Needs	$0	$0	$0
Transportation Infrastructure	$0	$0	$0
Marine Ports	$2,774,553	$2,871,330	$102,548
Airport	$0	$0	$0
Utilities	$0	$0	$0
Electrical Power Generating Plants	$13,317,856	$0	$14,766,840
Water Treatment Plants	$0	$9,844,560	$0
Wastewater Treatment Plants	$17,091,250	$0	$29,055,125
Pumps	$0	$379,623	--
Tanks	$0	$162,591	$1,296,013

Detailed information on critical facilities identified to be high risk structures is included in Appendix E. These are defined as those expected to sustain damages exceeding 60% for any of the hazards considered.

4.7.5 HURRICANE WIND

This subsection of the risk assessment presents the "estimate of losses," including: exposure, damage, and loss estimates analyzed for the hurricane wind hazard.

Estimated Losses: General Building Stock

Property damage due to the wind-hurricane hazard is summarized in Table 4.73 by occupancy class. The total expected for a loss for a hurricane event with a 50 year MRP is approximately $3.6 billion for St. Thomas, $1.8 billion for St. Croix and $190 million for St. John. This represents an increase of $2.3 billion in the Territory since the 2011 Plan.

TABLE 4.75 ***Estimated Losses: General Building Stock for Hurricane Wind Hazard***

Occupancy	No of Affected Buildings	Expected Losses	% Value
St. Thomas			
Residential	14,184	$ 3,097,521,815	0.48
Commercial	856	$ 571,109,732	0.36
Total	15,041	$ 3,668,631,547	
St. Croix			
Residential	12,986	$ 1,508,195,711	0.23
Commercial	555	$ 307,082,553	0.22
Total	13,542	$ 1,815,278,264	
St. John			
Residential	745	$ 163,596,725	0.23
Commercial	32	$ 26,457,092	0.22
Total	777	$ 190,053,817	

Because of differences in building construction, residential structures are more susceptible to wind damage. In using the damage counts for buildings, the number of buildings impacted should be interpreted loosely. Damage to a specific building can range from slight damage to total destruction; the total dollar damage estimates the overall impact to individual buildings at an aggregate level. The increase in construction cost, both commercial and residential, have increased the value of the building stock and thus estimated losses.

Estimated Losses: Critical Facilities and Infrastructure

Critical facilities and infrastructure losses for St. Thomas, St. Croix and St. John are highlighted in Table 4.76.

TABLE 4.76 ***Estimated Losses: Critical Facilities and Infrastructure for Hurricane Wind Hazard***

Facility	St. Thomas	St. Croix	St. John
Critical Facilities			
Police Stations	$8,455,970	$28,488,869	$1,783,516
Fire Stations	$30,035,180	$6,495,932	$2,481,830
Emergency Response	$3,402,979	$1,462,893	$1,899,208
Hospital/ Medical Clinic	$50,949,906	$94,355,181	$8,595,732
Government Buildings	$84,600,149	$80,955,418	$5,960,850
Shelters/Special Needs	$83,389,427	$102,857,136	$41,504,841
Transportation Infrastructure	$0	$0	$0
Marine Ports	$10,007,260	$750,907	$90,909
Airport	$9,924,923	$28,222,427	n/a
Utilities	$0	$0	$0
Electrical Power Generating Plants	$10,839,286	$23,936,125	$5,266,686
Water Treatment Plants	$19,565,950	$23,936,125	$1,287,957
Wastewater Treatment Plants	$364,269	$9,267,130	$9,494,825
Pumps	$110,851	$6,865,235	--
Tanks	$2,998,359	$2,084,234	$591,014

Detailed information on critical facilities identified to be high risk structures is included in Appendix E. These are defined as those expected to sustain damages exceeding 60% for any of the hazards considered.

4.7.6 RAIN-INDUCED LANDSLIDE

A deterministic approach was used to address the rain induced landslide hazard based on a worst-case scenario that assumed extensive to complete damage of structures during a landslide event.

Probability was not assigned to the rain-induced landslide hazard. Limited data and time needed to perform detailed mapping and statistical analysis go well beyond the scope of this study effort. The primary economic impact was assumed to be costs associated with infrastructure repair.

Based on the available data and the assumptions provided above, estimated impact of a rain-induced landslide is approximately $500,000. Damage parameters from historic events in the US Virgin Islands were used to develop this estimate.

Estimated Losses: General Building Stock

The physical damage that could occur as a result of rain-induced landslide is summarized in Table 4.77. Estimated property damages and losses for the landslide hazard were aggregated across occupancy classes and are estimated to be $76 million for St. Thomas, $20 million for St. Croix and $21 million for St. John.

TABLE 4.77 ***Estimated Losses: General Building Stock for Rain-Induced landslide Hazard***

Occupancy	No of Affected Buildings	Expected Losses	% Value
St. Thomas			
Residential	4,169	76,647,667	0.01
Commercial	0	$ -	0.00
Total	4,169	$ 76,647,667	
St. Croix			
Residential	1,209	$ 20,892,953	0.004
Commercial	0	$ -	0.00
Total	1,328	$ 20,892,953	
St. John			
Residential	455	$ 21,247,859	0.03
Commercial	0	$ -	0.00
Total	535	$ 21,247,859	

Estimated Losses: Critical Facilities and Infrastructure

Critical facilities and infrastructure losses for St. Thomas, St. Croix and St. John are highlighted in Table 4.78.

TABLE 4.78 ***Estimated Losses: Critical Facilities and Infrastructure for Rain-induced Landslide Hazard***

Facility	St. Thomas	St. Croix	St. John
Critical Facilities			
Police Stations	$0	$0	$0
Fire Stations	$0	$0	$0
Emergency Response	$0	$0	$0
Hospital/ Medical Clinic	$2,260,000	$0	$0
Government Buildings	$0	$0	$0
Shelters/Special Needs	$20,893,076	$0	$0
Transportation Infrastructure			
Marine Ports	$0	$0	$0
Airport	$0	$0	$0
Utilities			
Electrical Power Generating Plants	$0	$0	$0
Water Treatment Plants	$0	$0	$0
Wastewater Treatment Plants	$0	$0	$0
Pumps	$0	$0	--
Tanks	$0	$0	$0

4.7.7 TSUNAMI

Estimated Losses: General Building Stock

A deterministic approach was used to address the tsunami hazard based on a worst-case scenario that assumed extensive to complete damage within the Tsunami inundation area. Probability was not assigned to the tsunami hazard. Limited data and time needed to perform statistical analysis go well beyond the scope of this study effort. Therefore, while total damages were estimated, a return period is not applicable for the Tsunami hazard. The physical damage that could occur as a result of Tsunami is summarized in Table 4.76. Estimated property damages and losses for the tsunami hazard were aggregated across occupancy classes and are estimated to be $1.2 billion for St. Thomas, $786 million for St. Croix and $114 million for St. John. This represents a $234 million increase in estimated losses for on the Territory since the 2011 Plan.

TABLE 4.79 ***Estimated Losses: General Building Stock for Tsunami Hazard***

Hazard	No of Affected Buildings	Expected Losses	% Value
St. Thomas			
Residential	4,417	$ 808,769,974	0.19
Commercial	376	$ 402,633,004	0.38
Total	4,793	$ 1,211,402,978	
St. Croix			
Residential	2,961	$ 524,598,730	0.13
Commercial	258	$ 261,998,197	0.30
Total	3,218	$ 786,596,927	
St. John			
Residential	833	$ 96,449,264	0.19
Commercial	35	$ 18,284,842	0.21
Total	868	$ 114,734,106	

Estimated Losses: Critical Facilities and Infrastructure

Critical facilities and infrastructure losses for St. Thomas, St. Croix and St. John are highlighted in Table 4.80.

TABLE 4.80 ***Estimated Losses: Critical Facilities and Infrastructure for Tsunami Hazard***

Facility	St. Thomas	St. Croix	St. John
Critical Facilities			
Police Stations	$532,714	$0	$1,036,413
Fire Stations	$54,003,910	$0	$1,171,972
Emergency Response	$0	$0	$0
Hospital/ Medical Clinic	$11,762,331	$26,441,762	$0
Government Buildings	$98,704,238	$4,208,549	$15,003,849
Shelters/Special Needs	$0	$0	$13,348,261
Transportation Infrastructure			
Marine Ports	$11,098,214	$8,251,656	$290,551
Airport	$0	$61,528,500	$0
Utilities			
Electrical Power Generating Plants	$49,720,000	$50,850,000	$18,458,550
Water Treatment Plants	$68,365,000	$18,458,550	$3,586,232
Wastewater Treatment Plants	$1,442,768	$27,346,000	$0
Pumps	$0	$663,030	--
Tanks	$0	$258,667	$1,472,742

Detailed information on critical facilities identified to be high risk structures is included in Appendix E. These are defined as those expected to sustain damages exceeding 60% for any of the hazards considered.

4.7.8 WILDFIRE

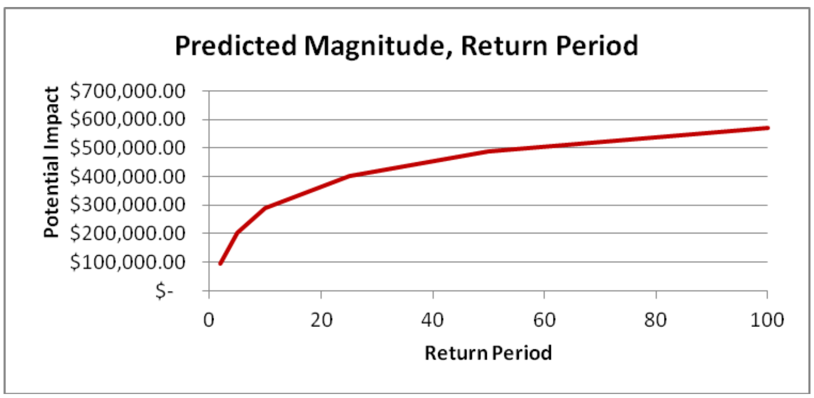
This subsection of the risk assessment presents the "estimate of losses for wildfires. Estimated losses for wildfires were aggregated for primary economic impacts that could impact the US Virgin Islands through economic loss.

Estimated Losses: Economic Impact

Estimated losses for drought were aggregated for primary economic impacts that could impact the US Virgin Islands through regional economic loss. The primary economic impact was assumed to be increased costs associated with feeding cattle.

This figure was based regional historic drought data for the US Virgin Islands. Based on the available data and the assumptions provided above, the predicted impact of a drought with a 50% probability of occurrence is $93,500,000 and a 1% occurrence of experiencing a wildfire event of $570,000.00.

FIGURE 4.29 ***Historical Wildfire in US Virgin Islands, 2000-2010***



The expected impact of a drought for a 100 year return period is approximately 570,000.00. Damage parameters from seventeen (17) events historic events in the US Virgin Islands were used to develop this estimate.

4.8 LOSS ESTIMATION SUMMARY AND HAZARD RANKING

This section of the Plan Update, presents a summary of the loss estimates similar to that included in the 2011 Plan. This section is used to evaluate the risk between hazards facing USVI. To do so, one must understand that the risk from a hazard is relative to its return period. For the purposes of risk assessment, a return period has been selected for each hazard analysis.

To assist in evaluating the results of this study, a simple ranking methodology has been developed based on a comparison of the losses per year (i.e. aggregate losses/ return period) and the expected period of recovery following the hazard events considered for this study. Table 4.81 represents hazards that are a more pressing concern to the territory. This ranking provides information on hazards that the territory should focus on (i.e. hazards that require aggressive correction of deficiencies with community funding). This ranking is based on an expected loss per year for each hazard, simply calculated as the total expected losses (critical facilities, commercial and residential) divided by the Return Period of the selected event, representing the amount of capital the territory would have to set aside to cover the damages for such an event.

TABLE 4.81 ***Hazard-by-Hazard Summary of Loss Estimates for US Virgin Islands***

Hazard	Return Period (Years)	Critical Facility Losses	Residential Losses	Commercial Losses	Total Loss	Loss/Year
St. Thomas						
Drought	100	N/A	N/A	N/A	$ 1,058,989.77	$ 10,590
Earthquake	1000	$ 442,013,206	$ 4,641,269,145	$ 1,384,710,463	$ 6,467,992,814	$ 6,467,993
Riverine Flooding	100	$ 223,420,272	$ 752,430,862	$ 292,639,745	$ 1,268,490,879	$ 12,684,909
Coastal Flooding	120	$ 56,868,971	$ 115,105,946	$ 56,606,106	$ 228,581,024	$ 1,904,842
Hurricane	50	$ 314,644,509	$ 3,097,521,815	$ 571,109,732	$ 3,983,276,056	$ 79,665,521
Rain-Induced Landslide	50	$ 23,153,076	$ 76,647,667	$ -	$ 99,800,743	$ 1,996,015
Tsunami	500	$ 295,629,176	$ 808,769,974	$ 402,633,004	$ 1,507,032,154	$ 3,014,064
Wildfire	10				$ 571,815	$ 57,181
St. Croix						
Drought	100	N/A	N/A	N/A	$ 1,058,989.77	$ 10,590
Earthquake	1000	$ 528,799,950	$ 3,645,930,917	$ 746,489,600	$ 4,921,220,467	$ 4,921,220
Riverine Flooding	100	$ 61,399,508	$ 618,081,641	$ 150,076,139	$ 829,557,287	$ 8,295,573
Coastal Flooding	120	$ 17,245,151	$ 52,319,194	$ 26,256,719	$ 95,821,063	$ 798,509
Hurricane	50	$ 409,677,613	$ 1,508,195,711	$ 307,082,553	$ 2,224,955,877	$ 44,499,118
Rain-Induced Landslide	50	$ -	$ 20,892,953	$ -	$ 20,892,953	$ 417,859
Tsunami	500	$ 198,006,714	$ 524,598,730	$ 261,998,197	$ 984,603,641	$ 1,969,207
Wildfire	10				$ 571,815	$ 57,181
St. John						
Drought	100	N/A	N/A	N/A	$ 1,058,989.77	$ 10,590
Earthquake	1000	$ 120,120,930	$ 444,103,045	$ 88,306,986	$ 652,530,961	$ 652,531
Riverine Flooding	100	$ 58,192,860	$ 18,067,019	$ 1,804,774	$ 78,064,652	$ 780,647
Coastal Flooding	120	$ 54,333,776	$ 25,861,531	$ 4,738,932	$ 84,934,239	$ 707,785
Hurricane	50	$ 78,957,369	$ 188,034,154	$ 30,409,148	$ 297,400,671	$ 5,948,013
Rain-Induced Landslide	50	$ -	$ 21,247,859	$ -	$ 21,247,859	$ 424,957
Tsunami	500	$ 54,368,571	$ 96,449,264	$ 18,284,842	$ 169,102,677	$ 338,205
Wildfire	10				$ 571,815	$ 57,181

This ranking mechanism allows not only a ranking for each hazard, but a weight factor for each hazard to compare the relative economic losses to the community The expected loss per year of Return Period can allow each jurisdiction individually to prioritize their hazards on an individual basis, and also allows the territory as a whole to determine which hazard most affects them as a whole.

The Recovery Ranking Table was not developed for this Plan Update. The paucity of data for certain hazards would lead to inclusive findings and would be misleading to gauge recovery efforts. Instead the potential dollar loss rankings are summarized in Table 4.82. It shows that the dollar loss for the VI as a whole is greatest for hurricanes and wildfires.

TABLE 4.82 ***Summary of Hazard Rankings for USVI***

Hazard	St. Thomas	St. Croix	St. John
Drought	8	8	8
Earthquake	3	3	4
Riverine Flooding	2	2	2
Coastal Flooding	5	5	3
Hurricane	1	1	1
Rain-Induced Landslide	6	6	5
Tsunami	4	4	6
Wildfire	7	7	7

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Section Five is divided into the following seven subsections:

- 5.1 IFR Requirement for Mitigation Strategy
- 5.2 Summary of the Risk and Capability Assessment
- 5.3 Analysis of Mitigation Strategy
- 5.4 Goals and Objectives
- 5.5 Identification of Mitigation Actions
- 5.6 Evaluation and Prioritization of Mitigation Actions
- 5.7 Implementation of Actions

5.1 IFR REQUIREMENT FOR MITIGATION STRATEGY

Section §201.4(c)(3) of the IFR states that "[to be effective, the plan must include] the State's blueprint for reducing the losses identified in the risk assessment."

The IFR includes three specific requirements that relate to the development of a Mitigation Strategy for the US Virgin Islands:

- **Hazard Mitigation Goals per Requirement §201.4(c)(3)(i):** "[The State shall include a] description of State goals to guide the selection of activities to mitigate and reduce potential losses."
- **Mitigation Actions** per **Requirement §201.4(c)(3)(iii):** **"**[State plans shall include an] identification, evaluation, and prioritization of cost-effective, environmentally sound, and technically feasible mitigation actions and activities the State is considering and an explanation of how each activity contributes to the overall mitigation strategy."
- **Funding Sources** per **Requirement §201.4(c)(3)(iv):** **"**[The State mitigation strategy shall include an] identification of current and potential sources of Federal, State, local, or private funding to implement mitigation activities."

5.2 SUMMARY OF THE RISK AND CAPABILITY ASSESSMENT

5.2.1 SUMMARY OF RISK ASSESSMENT

The overall risk assessment methodology utilized in this Plan Update is the same that as was utilized in the 2011 Plan. It is consistent with the process and steps presented in FEMA Publication 386-2, "State and Local Mitigation Planning How-To Guide, Understanding Your Risks—Identifying Hazards and Estimating Losses" (FEMA 2001) and utilizes a risk assessment methodology similar to HAZUS-MH.

The results of the hazard identification process and discussions with VITEMA, which held a series of meetings with the Island Hazard Mitigation Committees prior to the consultant team being contracted to develop the plan, indicated that there were not any new hazards that needed to be considered in this Plan Update. Therefore, the hazards addressed in the 2014 plan Update are the same that were addressed in the 2011 Plan. It should be noted that data sets for conducting vulnerability assessments for all of the hazards were not readily available (frequency of occurrence; magnitude and damages associated with historical events) so that the losses were estimated in a deterministic manner so as to arrive at the worst case scenario loss estimates for wildfire, landslide and drought.

Similar to the 2011 plan, the lack of accurate historical data prevented the CIPA consultant team from conducting a detailed and verifiable assessment for these hazards and necessitated using different estimation techniques. Hazard overlays were performed to identify the number of buildings in hazard susceptibility zones identified on newly created maps for these hazards. Hence, the vulnerability assessments for the new hazards provide only a rough estimate of the built environment that is exposed to these hazards.

A summary of the findings of the Risk Assessment for the 2014 Plan Update were presented to VITEMA at a meeting on May 13, 2014 and subsequently to the Island Hazard Mitigation Committees on May 13, 14, and 15, 2014. The risk assessment served as a foundation for the deliberations of the Committees in formulating a mitigation strategy for this Plan Update.

As a result of variation in values of Real Property over the past three years the Estimated Losses that would occur as a result of natural hazard events also fluctuated. To illustrate the impact that the reevaluation of the property values has upon the Loss Estimates the following matrix is provided. Table 5.1 demonstrates the differences in the Loss Estimates between the 2011 Plan and the 2014 Plan Update. A summary is provided for each major island in the Territory. The values presented in this matrix are painted in broad strokes with the intent to furnish a synopsis only of the changes in estimated losses included in this Plan Update.

TABLE 5.1 ***Hazard-by-Hazard Comparison of Loss Estimates of 2011 Plan and 2014 Plan Update***

	2011 Plan Update	2014 Plan Update	Difference (+ / -)
St. Thomas			
Drought	N/A	1.058M	1.058M
Earthquake	5.7B	6.4B	.7B
Riverine Flooding	1.1B	1.2B	419.1M
Coastal Flooding	203M	228M	25M
Hurricane	3.5B	3.9B	.4B
Rain-Induced Landslide	1.3B	1.9M	-1.2B
Tsunami	1.3B	1.5B	.2B
Wildfire	637M	.5M	-636M
St. Croix			
Drought	N/A	1.058M	1.058M
Earthquake	4.8B	4.9B	.1B
Riverine Flooding	818M	829M	11M
Coastal Flooding	92M	95M	3M
Hurricane	2.1B	2.2B	.1B
Rain-Induced Landslide	208M	20.9M	-187M
Tsunami	959M	984M	25M
Wildfire	146M	.5M	-145M
St. John			
Drought	N/A	1.058M	1.058M
Earthquake	562.4M	583M	21M

Riverine Flooding	65.3M	75M	9.7M
Coastal Flooding	71.5M	80M	8.5M
Hurricane	255.3M	269M	14M
Rain-Induced Landslide	123.2M	21M	-121M
Tsunami	144.7M	154.1M	6.4M
Wildfire	71M	.5M	-70M

The estimated losses presented above consider all vulnerable properties of the Territory, residential, commercial, and governmental critical facilities. The hazard mitigation strategy developed by the Island Mitigation Committees are congruent with the assessment of risk as detailed in Section Four of the this Plan Update. The Territorial Mitigation Strategy addresses the vulnerability of the building stock and critical facilities and infrastructure. The section of the Plan Update focuses on the potential risk of the Territory and presents a strategy for mitigating possible loss due to a hazard event as offered in the Risk Assessment providing a strong congruency between the two in this Plan Update.

5.2.2 Climate Change and Climate Variability

The implications of climate change variability on the small island states in the Caribbean will need to be thoroughly addressed in future Plan Updates. Some of those implications are discussed in a qualitative manner for specific hazards evaluated in Section 4 Risk Assessment. The challenge for the Territory is to integrate those findings into the hazard identification and risk assessment and make them relevant to the US Virgin Islands. Each island has its own climate, geology, topography, industries, and culture; particularly important are the differences between St. Thomas/St. John and the lower lying, less mountainous terrain on St. Croix. Still, some impacts of climate change could bring similar challenges to all three island communities of the USVI.

The vulnerability of the small island states in the Caribbean relate to their relative isolation, small land mass, concentrations of population and infrastructure in coastal areas and limited economic base with a reliance on tourism and natural resources. This vulnerability led to collaboration between regional academic and governmental institutions in 2004 with the creation of the Caribbean Community Climate Change (CCCCC) initiative. The research effort used global climate change models and down-scaled the analysis to create a regional climate change model for the Caribbean. The regional model (PRECIS) simulations suggest a significant reduction of mean annual rainfall (10 to 50 percent) by the end of the Century (Bulletin of the American Meteorological Society). Climate change will likely affect the availability of potable water on the Virgin Islands in the future. This finding will have implications not only for water availability but also to drought and wildfire hazards.

In the Caribbean, coral reefs provide annual benefits of more than $3 billon (USGCRP 2009). Coral reef systems already face serious impacts from sedimentation and water pollution; warmer, more acidic coastal waters would cause further stress to coral reefs. The loss and inundation of other coastal habitats from sea level rise and storm surge could endanger species that use these habitats for nesting, nursing, and feeding. Impacts to coastal resources would have serious implications to tourism, a key economic driver in the Virgin Islands. An analysis of the need to address global warming predicted that the cost of not taking action would reduce the GDP 6.7 percent by 2025 and 14.2 percent by 2050 (Stockholm Environment Institute 2008).

The most recent report of the Intergovernmental Panel on Climate Change focuses on mitigation and adaptation strategies to reduce the impacts of climate change (IPCC 2014). While recent efforts in the USVI to increase the use of solar energy are a positive step in mitigation, as a small island state, adaptation to climate change variability is the only realistic path for the Territory. Clearly, the USVI Territory will need to incorporate climate change adaptation in its long range public policy, land use planning, and infrastructure capital projects. With respect to hazard mitigation planning, the Mitigation Strategy acknowledges the need to incorporate climate change variability at both a programmatic level and in developing island-specific mitigation actions going forward.

5.2.3 SUMMARY OF THE CAPABILITY ASSESSMENT

Having experienced several devastating natural hazard events, the Government of the US Virgin Islands is cognizant of the magnitude of damage that can be inflicted on property and also the loss of life from natural hazards. It is, therefore, the desire of the Government and its agencies to prepare for, and mitigate, the potential damage that could be caused by these hazard events.

However, the Capability Assessment demonstrates that even though committed to hazard mitigation, the full implementation of the hazard mitigation strategy as presented in the 2011 Plan is not possible. Very few of the programmatic and island specific mitigation actions have been implemented over the past three years and a more realistic strategy will be required for the 2014 Plan Update.

Under the present and anticipated near term financial conditions for the US Virgin Islands Government, adequate operating budgets to implement hazard mitigation actions will be severely constrained. In the case of retrofitting critical facilities or undertaking structural mitigation projects, the financial reality over the next three years, implies a heavy reliance on Federal funding sources. VITEMA, DPNR and DPW are the key governmental agencies that have the primary responsibility for the implementation of Hazard Mitigation in the Territory. Each agency presently has numerous unfilled positions making full compliance with program mandates untenable. The lack of essential personnel and insufficient experience exacerbates compliance and enforcement of existing programs and regulatory requirements. Given the budgetary constraints of the Territorial government and the uncertainty of future general revenues, each of these agencies has a need for additional staffing to be able to address the range of goals, objectives and actions included in this Plan Update. In summary, both human resource capacity issues and limited funding for both programmatic and hazard mitigation projects over the next few years will severely constrain broad implementation of the Territorial hazard mitigation strategy.

Several important changes in FEMA's hazard mitigation guidance since the last Plan Update should be emphasized here, particularly given the uncertainty of future general revenues over the next 3 years:

- Implementing flood mitigation measures for severe repetitive loss properties would be funded by FEMA at 100 percent; and, funding for implementation of flood mitigation measures for repetitive loss properties would be funded at 90 percent. Prioritizing efforts to reduce repetitive losses should be emphasized wherever possible in the mitigation strategy.

- The Territory intends to request consideration from FEMA for the Advance Assistance option for expedited HMGP scoping and project development funding following a Presidential Declared Disaster. Staffing and capability issues anticipated in steady-state and immediately following disaster events argue that utilizing a percentage of HMGP funding to quickly analyze the situation post-disaster, to obtain data to prioritize, select, and develop complete HMGP applications.

- VITEMA intends to take full advantage of the Five Percent Initiative, whereby FEMA is willing to reserve up to 5 percent of the total HMGP funds that can be used by the Grantee to pay for a range of activities that are difficult to evaluate against traditional cost effectiveness criteria. This option is very important to the Territory because of the problems associated with the lack of a historical database of disaster-related damages, necessary to effectively conduct benefit/cost analysis for hard mitigation actions.

- VITEMA will pursue all opportunities with FEMA where the cost share can be minimized or eliminated, including planning and hard mitigation projects, and where the cost share could possibly be waived or justification provided as an extraordinary circumstances.

5.3 ANALYSIS OF MITIGATION STRATEGY IN 2011 PLAN

5.3.1 REVIEW OF GOALS AND OBJECTIVES

The process of reviewing Mitigation Goals and Objectives involved all members of the Hazard Mitigation Steering Committee and three Island Hazard Mitigation Committees. The review of the Goals and Objectives was made with a realistic understanding of the limited existing, and anticipated technical and financial capacity of VITEMA to implement the hazard mitigation strategy over the next Plan implementation cycle.

The Committees came to consensus that the Goals and Objectives of the 2011 Plan continued to be a viable overall framework for the Territory's mitigation strategy. The Committees revised Objective 1 of Goal 1 to **prioritize hazard mitigation actions that would lead to a reduction of repetitive loss properties throughout the Territory.** The emphasis on reducing repetitive properties is also reflected in a number of programmatic and island-specific actions in the 2014 Plan Update. In addition it has been revised and integrated into this Plan Update as a revised Appendix C Repetitive Loss Strategy.

5.3.2 REVIEW OF MITIGATION ACTIONS

The programmatic mitigation actions from the 2011 Plan Update were reviewed and then discussed at the May 13, 14, and 15, 2014 meetings held on St. Thomas, St. John and St. Croix with the respective Hazard Mitigation, Monitoring and Evaluation Committees. The consensus of the participants was to add 8 programmatic actions and to add 17 island specific actions for the Territory which are reflected in Section 5.5.3.1, 5.5.3.2, and 5.5.3.3.

As noted in Sections 5.3.1 and 5.2.2 above, the mitigation strategy reflects a realistic assessment by VITEMA and the islands Hazard Mitigation Committees limited technical and financial capacity as well as the findings of the risk assessment.

A more extensive process was followed for the development of island specific mitigation actions for this Plan. Recommendations for hazard mitigation actions was one of the important outcomes of public information workshops held on St. Thomas, St. John, St. Croix, on May 13, 14, and 15, 2014, respectively. These workshops provided valuable insight into the desires and concerns of the public relating to existing hazard mitigation actions which were identified previously by the island hazard mitigation committees.

VITEMA presented a prioritized listing of mitigation actions to the island Hazard Mitigation Committees via email correspondence on May 16, 2014 so that representatives of the three committees could concur on the priority of hazard mitigation action items. Committee members were asked to prioritize each mitigation action on the basis of the action's potential for loss reduction and to consider all the evaluation criteria included in the STAPLEE criteria. These considerations include:

- S for socially acceptable
- T for technically feasible
- A for administrative (having the capability and capacity to undertake the action)
- P for politically acceptable
- L for legal (having the legal authority to implement the action)
- E for economic (stressing adequate funding to implement the action)
- E for environment (understanding positive and adverse impacts of the action)

The resultant communication from the island hazard mitigation committees provided the basis for the consultant team, along with VITEMA, to review and evaluate actions and facilitated a final ranking process using a simple ranking protocol of high, moderate or low priority to rank each remaining or newly proposed mitigation action.

It is important to note that there has been some, albeit limited, progress in the implementation of past plan actions. Having public sector representation in all three Island Hazard Mitigation Committees was vital in determining which of the mitigation actions from the 2011 Plan had been fully or partially implemented. The major successes to report include:

- STT-2 -Pursue road reconstruction and drainage improvements to resolve recurrent flooding on Commandant Gade Gut (Garden Street) from Bunker Hill to Veterans Drive that affect businesses and emergency access.
- STT-3 -Pursue road reconstruction and drainage improvements to resolve recurrent shallow flooding on Radets Gade from Main Street to Veterans Drive that affect businesses.
- STT-4 -Pursue road reconstruction and drainage improvements to resolve recurrent shallow flooding on Storre Tvaer Gade from Main Street to Veterans Drive that affect businesses.
- STT-23 - Installation of High Impact Hurricane windows at the Department of Public Works (HMGP-1807).
- STT-22 - Installation of High Impact Hurricane windows at the Department of Property and Procurement (HMGP-1807).
- STT-24 - Installation of High Impact Hurricane windows at the Department of Education (HMGP-1807).
- STT-25 - Installation of High Impact Hurricane windows at the Department of Human Services (HMGP-1807).

- STT-11 - Pursue the acquisition of land for the relocation of the Downtown Fire Station that is susceptible to storm surges and tsunami.
- STX-17 - Install storm shutters at the American Red Cross (HMGP-1807).
- STX-18 - Install storm shutters Emile Henderson, Sr. Fire Station (HMGP-1807).
- STX-19 - Install Roll-Up Doors at the Rencelier I. Gibbs Fire Station (HMGP-1807). Note: roll-up windows were installed instead.
- STX 21 - Install Fabric Shutter system at Henry E. Rohlsen Airport (HMGP-1807).
- STJ-10 - Install Storm shutters at the DeCastro Health Clinic (HMGP 1807).
- STJ -12 - Clean Gut at Westin Hotel.

For further discussion as to specific actions that were completed, deleted or deferred, please refer to Section 6.6 of the Plan Update and to Appendix D. Appendix D presents a matrix that provides an overview of all mitigation actions included in the 2011 Plan that were either completed, removed or remain valid.

5.4 GOALS AND OBJECTIVES

The Mitigation Strategy includes a series of proposed mitigation actions based on goals and objectives established as part of an overarching hazard mitigation framework for the US Virgin Islands. As used in this Plan, these key terms are defined as follows:

- **Goals:** Broad policy statements, to be achieved through the implementation of specific objectives. They served as the framework for obtaining the desired results over the long-term planning horizon.

- **Objectives:** Specific steps to support, correspond and define a path on how to attain the desired goals and lead to their implementation.

- **Actions:** Efforts that seek to reduce or eliminate risk (see Appendix F). Actions can be grouped into two broad categories:

  - ✓ Programmatic or "soft" mitigation actions implemented through legislation, regulations or programs that operate on a Territory-wide level. One good example of programmatic actions is strengthening engineering specifications that address hazard risk reduction in the design and construction of public and private roads.

  - ✓ Projects that are designed and constructed to eliminate or reduce future disaster damages. Projects can include personal property and natural resource protection.

5.4.1 IDENTIFICATION OF GOALS AND OBJECTIVES

The Strategy for the Plan Update has not fundamentally changed since the 2005 and 2008 plans. In 2004 and 2005, VITEMA identified four (4) goals and several related objectives based on the risk assessment and capability assessment. Both the findings of the risk assessment and capability assessment have not changed significantly in the past three years. Therefore, it was not considered necessary to develop new goals and objectives.

It is important to note that the process of developing the goals and objectives in the previous Plan also involved a review of multi-hazard and hazard specific mitigation plans previously prepared for the US Virgin Islands, including:

- Phase 4 Report, Earthquake Hazards Reduction Plan, Geoscience Associates, for VITEMA, funded by FEMA grant EMA-K-86-0055 (1987);

- Natural Hazard Mitigation Plan for the US Virgin Islands, David Brower, Esq. and Timothy Beatley, Ph.D., for VITEMA (1988),

- Mitigating the Impacts of Natural Hazards in the US Virgin Islands, Island Resources Foundation, for VITEMA (1995);

- Mitigating the Impacts of Natural Hazards in the US Virgin Islands, Island Resources Foundation, for OMB (1999); and

- Virgin Islands Flood Hazard Mitigation Plan, Island Resources Foundation for VITEMA, funded by FEMA FMA grant (2000).

These plans provided, and continue to provide, a sound set of guiding principles for developing and implementing hazard mitigation actions in the US Virgin Islands.

GOAL 1: REDUCE THE NEGATIVE IMPACTS OF NATURAL HAZARDS ON RESIDENTS AND PROPERTY

Background

A fundamental guiding principle of the Territory that is indicated consistently in the past planning efforts is to eliminate or reduce human loss and suffering, and property losses resulting from natural disasters. This protection extends to both residents of, and visitors to, the Islands. As demonstrated in Section Four, much of the existing development in the US Virgin Islands is already at substantial risk to natural disasters:

- Developments are located in high-hazard prone areas;
- Structures have been constructed in natural drainage guts; and
- Many buildings have been constructed in hillside areas without adequate attention to the potential for severe earthquake damages.

However, development pressures in recent years have substantially damaged many important elements of the natural environment. This activity further threatens continued destruction in the future, particularly during hazard events. Preserving ecological integrity involves limiting the degradation of the environment and natural systems such as wetlands, floodplains, coral reefs, sea grass beds, and mangrove swamps. Protection of the natural environment of the US Virgin Islands is important and consistent with hazard mitigation.

So is the protection of properties, particularly those that are repetitive and severe repetitive loss properties. This goal is clearly consistent with FEMA's HMA grant program requirements. Specific actions in highlighted under Objective 1.1, focus on "hard" or "structural" actions that focus on minimizing repetitive losses, while the programmatic actions highlighted under Objective 1.2 and 1.3 focus on educational outreach in which the repetitive loss program is included.

Under this Goal and the pursuant objectives, the USVI has identified specific actions in the Plan Update for mitigating repetitive losses. These specific actions, as outlined in territory-wide and island-specific actions, contribute to the Territory's seeking an increased percentage of Federal grant funds.

Objectives

1.1 Protect existing development from future hazard events with the priority given to projects that would reduce the number of repetitive loss properties

1.2 Increase the awareness and understanding of residents and the private sector to the principles of hazard mitigation

1.3 Preserve, enhance, and restore features of the natural environment that have hazard mitigation benefits

GOAL 2: INTEGRATE HAZARD MITIGATION AND SUSTAINABLE DEVELOPMENT PRINCIPLES INTO ONGOING GOVERNMENT OPERATIONS AND LONG TERM PLANNING INITIATIVES TO REDUCE THE VULNERABILITY OF FUTURE DEVELOPMENT

Background

There is a direct correlation between hazardous development patterns and the post-disaster emergency and recovery expenses that must be assumed by the public sector. If buildings and infrastructure were not located in a hazardous area, there would be little or no need to expend public funds to rebuild and restore them. The expense of sheltering, rescue and other emergency response functions would be greatly reduced if people and development were kept out of harm's way in the first place. Future growth and development in the Islands is inevitable and may provide short term benefits for a localized economy, but it need not occur in ways that place people and property at risk and burden all the resources of the Territory. US Virgin Islands, like many of the small, island nations in the Lesser Antilles, must create a more sustainable future that addresses environmental, social and economic health.

Another of the guiding principles of the Territory is that the most cost effective way to implement hazard mitigation throughout the US Virgin Islands is to better integrate hazard mitigation in the subdivision and development review and the land use planning processes. The intent is that all new development be carefully managed and planned so that natural hazards are avoided – or where they cannot be avoided - their impacts are minimized. While it can be quite costly to correct past mistakes with respect to development in hazardous locations, there exists a broad range of opportunities to prevent future development from occurring in ways that make it vulnerable to natural hazards.

Environmentally sensitive areas are frequently subject to the effects of natural hazards. Thus, by limiting development in these locations, environmental protection and risk reduction objectives are achieved simultaneously. It is also important to note that tourism is a key element of the local economy. A healthy tourism economy cannot thrive and grow unless prospective tourists perceive the Islands as a safe place in which to visit and vacation. However, continued viability of the tourist economy also depends on the ability of the Territory to preserve the beauty and natural features that attract people in the first place. Obvious elements of this attraction include the beaches, green vegetated hills, the blue waters, and coral reefs.

No mitigation actions are being proposed for Goal 2 in the 2014 Plan Update owing to VITEMA's capacity issues, including both human and financial resources, to undertake actions that will require extensive inter-agency coordination over the next three years. However, the objectives listed below and the goal of integrating hazard mitigation into land and coastal zone planning to build a more sustainable future is valid and should be revisited during the next Update to determine whether Territorial resources are adequate to re-engage in this important initiative.

Objectives

2.1 Ensure that hazard mitigation principles are incorporated into the development review process

2.2 Include hazard mitigation as a key element in long range planning efforts that address comprehensive land use, natural resource management, and socio-economic issues

2.3 Ensure that hazard mitigation design criteria are incorporated into the planning and engineering design for future infrastructure improvements and major public sector investment projects

GOAL 3: RAPIDLY RESTORE ESSENTIAL INFRASTRUCTURE, WITH UNINTERRUPTED OPERATION OF CRITICAL FACILITIES AND CONTINUITY OF GOVERNMENT SERVICES FOLLOWING A NATURAL HAZARD EVENT

Background

Just as private development is subject to damage and destruction from natural hazards, so are public investments such as: schools, government buildings (whether owned or leased), public roads and streets, airports, port facilities, and other public infrastructure such as electrical power generation and distribution, and water and wastewater treatment plants.

These investments can be located, designed and constructed in ways that minimize their vulnerability. Public roads can be located outside of the floodplains, be designed to minimize impacts to the floodplain, or be elevated above predicted flood levels. Drainage systems can be designed to safely pass floodwaters downstream. Efforts can also be made to correct for past mistakes, for example, retrofitting critical public facilities so that they will better withstand high wind or earthquake events.

Objectives

3.1 Enhance capabilities of public agencies to ensure the continuity of government services following a natural hazard event

3.2 Reduce the vulnerability of essential infrastructure and critical facilities

GOAL 4: ENHANCE THE CAPABILITIES OF VITEMA AND THE GAR'S OFFICE TO EFFECTIVELY ADMINISTER FEMA MITIGATION PROGRAMS

Background

A broad range of enhancements are possible in terms of increasing the Territorial capabilities to address hazard mitigation. These recommendations have been cited in Section Three. The following objectives are based on these recommendations. However, recognizing that limited resources must be prioritized, these objectives focus on the areas where increased capabilities will have the most immediate effect during the three year horizon for this Plan.

Many of the programmatic actions in this Plan Update focus on developing capabilities of VITEMA. The identified actions focus on developing capabilities to gather data and implement management systems, particular as they relate to increasing a repository of hazard data and repetitive loss properties.

VITEMA already has access, through FEMA, to some information concerning repetitive loss properties. It also has access to information concerning property ownership and valuation. It is necessary to note that some data, which may be considered confidential or sensitive may prove critical for the effective implementation of actions that pertain to the implementation of actions that require substantial economic resources such as those identified for acquisition.

Specific actions that pertain to this goal and objectives focus on gathering information and building program capabilities that are consistent with the goals of FEMA's HMA grant programs and repetitive and severe repetitive loss claim data. The pursuant actions identified in this Plan Update contribute to meeting the USVI priority for reducing repetitive losses, development of action to implement the repetitive loss strategy, and reducing the cost share under HMA program criteria.

Objectives

4.1 Strengthen project implementation capabilities

4.2 Refine program administrative procedures

4.3 Demonstrate improvement in management of FEMA grants through application of established performance standards

5.5 IDENTIFICATION, EVALUATION AND PRIOROITIZATION OF MITIGATION ACTIONS

5.5.1 IDENTIFICATION OF MITIGATION ACTIONS

The mitigation actions focus on actions that VITEMA may take to reduce the impacts of natural hazards in the Territory. The challenge to implement the Plan Update is the lack of technical and financial resources within VITEMA to manage and coordinate the implementation of specific actions/projects – both "soft" projects (education, training, etc.) and 'hard" constructions projects (flood drainage, structural retrofit, etc.) – with a variety of government agencies. A particular priority of VITEMA is to address the significant impact of repetitive loss properties in the US Virgin Islands families, economy and property. A repetitive loss property is a property that is covered by the NFIP insurance policy and are defined as single or multifamily residential properties that have incurred flood –related damage for which four (4) or more claims payments of at least $5,000.00 have been made, and which the cumulative amount of such claims payments exceed $20,000.00. The Territory's repetitive loss strategy is discussed in more detail in Section 6 of this Plan Update.

An evaluation of the cost effectiveness of many of the mitigation actions identified in the Plan Update is difficult to demonstrate and may not be practical for such a "strategic plan". The quantification of costs associated with "soft" actions and/or projects normally require the calculation of the utilization of internal resources, either human and/or budgetary; while the quantification of benefits is more elusive. The identified "hard" actions or projects, on the other hand, specify locations for structural projects (i.e. flood drainage improvements in St. John) and may be quantified; however, the quantification of costs and benefits require an in-depth engineering assessment to be performed. A formal Benefit-Cost Analysis, including the calculation of a benefit/cost ratio, would be performed at a future date for any projects sent forward for funding consideration under Federal programs.

Nevertheless, the potential for risk reduction or the relative cost effectiveness, environmental soundness and technical feasibility and designation of action priorities for implementation were considered for this Plan Update and are highlighted in the Mitigation Action Plan (Appendix G).

The USVI Territorial Hazard Mitigation Plan includes four separate but related Action Plans presented in Appendix G. Below the Programmatic and Island specific mitigation actions are presented:

Programmatic mitigation actions applicable for the entire USVI Territory (numbered as USVI-#);

(1) Prioritized mitigation actions for St. Croix (numbered as STX-#);

(2) Prioritized mitigation actions for St. Thomas (numbered as STT-#);

(3) Prioritized mitigation actions for St. John (numbered as STJ-#).

5.5.2 EVALUATION AND PRIORITIZATION OF MITIGATION ACTIONS

Following the identification of each proposed programmatic and island-specific mitigation actions, VITEMA Steering Committee prepared a preliminary list of mitigation actions for consideration to each of the three Island Hazard Mitigation Committees. The programmatic and island specific committees were reviewed, evaluated and prioritized via email communication that was sent out on May 16, 2014. Each proposed mitigation action was reviewed and, where necessary, amended, deleted from consideration, and in several instances alternative mitigation actions were developed by Committee members.

Each island mitigation action was then further evaluated. Each action was reviewed based on the examination of the available resources versus the potential benefits of each action on reducing risks to the residents and property in the Territory. A simple ranking criterion was utilized for evaluating the potential for loss reduction.

Potential for Loss Reduction

- "H" which represents the highest relative potential for loss reduction;
- "M" which represents moderate relative potential for loss reduction; and
- "L" representing the lowest relative potential for loss reduction.

The programmatic and island specific actions were then prioritized using a simple voting technique. Each member of respective Committees voted on the priority of actions that should be included in the plan. The Voting procedure was based on consensus, which differed from the voting technique utilized in the 2008 Plan Update. The tables below reflect the evaluation of loss reduction potential as well as the prioritization of island specific hazard mitigation actions:

5.5.3 IDENTIFICATION, EVALUATION AND PRIORITIZATION OF PROGRAMMATIC MITIGATION ACTIONS

Following the evaluation and prioritization of island specific mitigation actions, the VITEMA Hazard Mitigation Steering Committee reviewed, evaluated and prioritized the programmatic mitigation actions for the entire Territory. The finalized list of programmatic actions was then discussed with the each Hazard Mitigation Committee via a teleconference meeting that was held on May 12, 13, and 14. Table 5.2 below highlights the results of the Hazard Mitigation Committee evaluation and prioritization.

The importance of the implications of climate change variability on hazard mitigation planning for the USVI was noted previously in the Mitigation Strategy. Several of the programmatic actions identified below acknowledge this need and the lack of empirical data to more effectively address those implications. Most important is USVI-9 which proposes to incorporate climate change in the Risk Assessment. Another programmatic mitigation action (USVI-7) proposes to develop a database to track past and future instances of drought, wildfires and landslides, which also has implications for integrating the impact of climate variability by associating occurrences with rainfall events in the case of landslide or lack of precipitation in the case of drought and wildfire. These three hazards were added in the 2011 Plan Update; however, the lack of empirical data limited the analysis of these hazards. All of these hazards will be affected by climate change variability in the future and a more complete database is necessary.

Some of the assumptions of climate change implications that merit further investigation include:

- Future increases in the intensity of rainfall events;
- Extended periods of drought on the islands and potential impacts on wildfires and availability of potable water supplies;
- Sea level rise and increase in storm surge levels, particularly important for St. Croix;

- Potential changes to Special Flood Hazard Areas (SFHA), if climate variability data is integrated into models used in the development of FEMA flood maps.

Action	Description	Goal/Objective	Potential for Loss Reduction	Existing (E) or New (N)	Priority
USVI-1	VITEMA collaborates with DPW to prioritize annual budget and action plans to remove built up sediment, debris and maintain natural guts, roadside ditches, drainage channels and storm drains in areas that are designated in this Plan as **Repetitive Loss Strategy (RLS**) designated areas.	Goal 1, Objective 1.1	H	E	1
USVI-2	Seek FMA funding for a planning study to map of **severe repetitive loss and repetitive loss properties**, conduct limited fieldwork, and evaluate hazard mitigation measures that would cost-effectively address clustered repetitive loss properties.	Goal 1, Objective 1.1	H	N	2
USVI-3	Strengthen partnerships with the Office of the Governor and media to disseminate information to the general public on hazard mitigation programs and importance of reducing number of **USVI repetitive loss properties.**	Goal 1, Objective 1.2	M	E	9
USVI-4	Conduct **watershed planning study** based on a hydrological and hydraulic (H&H) model that would provide the quantitative basis for assessing flood mitigation measures on basin and sub-basin level. The H&H modeling can be used to determine best management solutions for **RLS designated areas** and to build resilience in communities and reduce economic losses. This phased project would begin with St. Croix and take advantage of data developed from previous H&H studies.	Goal 1, Objective 1.1	H	N	3
USVI-5	VITEMA will establish relationships in the steady-state (pre-disaster) timeframe with **US HUD and US DOC** and other representatives of primary Federal agency partners of **NDRF Recovery Support Functions** that could facilitate recovery with technical assistance and potential funding in future post-disaster conditions.	Goal 4, Objective 4.2	L	N	4
USVI-6	Construct a database management program and develop procedures to collect information on and to track **repetitive loss** properties in the Territory.	Goal 4, Objective 4.1	M	E	5
USVI-7	Define and implement arrangements for the collection of data on **Landslides, Wildfire,**	Goal 4, Objective 4.1	M	E	6

Action	Description	Goal/Objective	Potential for Loss Reduction	Existing (E) or New (N)	Priority
	and Drought that can affect the Territory, including information on location (maps), history, and probability of hazard events.				
USVI-8	Construct a **database management program** and develop procedures to track mitigation project progress and effectiveness from project award to project completion so as to provide a record on the aggregate actual costs avoided of implemented mitigation projects in the territory.	Goal 4, Objective 4.2	M	E	10
USVI-9	Update the multi-hazard risk assessment to incorporate **climate change models** into the hazard and vulnerability analysis.	Goal 3, Objective 3.1	L	N	8
USVI-10	Develop or update Territorial **Debris Management Plan,** including identification of potential satellite locations for collecting and segregating building and woody debris, white goods, and hazardous materials.	Goal 4, Objective 4.1	L	N	7

5.5.4 Identification, Evaluation and Prioritization of Island Mitigation Actions

It is necessary to note that the effective implementation of mitigation actions is dependent upon: identifying appropriate agency or department roles, projected timeframes, necessary resources, and determining the prioritization for each action. Lead and supporting agency roles, projected timeframes, and potential funding sources were prepared for each action, along with an assessment of anticipated constraints and opportunities for their implementation.

A brief review of the Island Mitigation Actions for St. Thomas, St. Croix, and St. John reflects that many of mitigation actions proposed in the 2011 Plan Update (noted as E in the three tables below), have not been completed over the past three years. There are a number of reasons for this outcome; however, the major ones include:

- The economy of the USVI Territory has struggled over the past six years;
- The closure of the HOVENSA oil refinery on St. Croix in 2012 has had a severe impact on the Territorial unemployment and tax revenues over the past few years;
- The gap between Territorial revenues and annual budget expenditures has continued since 2011, despite efforts of the Government to constrain budgets for Territorial agencies, including VITEMA;

5.5.4.1 St. Thomas Mitigation Actions

Action	Description	Goal/Objective	Potential for Loss Reduction	Existing (E) or New (N)	Priority
STT-1	Construct drainage improvements on Turpentine Run (Brookman Road) to alleviate localized flooding.	Goal 1, Objective 1.1	H	E	5
STT-2	Construct drainage improvements to improve the capacity of the drainage system by Yvonne Bowsky Elementary School (Peace Corp) to alleviate localized flooding.	Goal 1, Objective 1.1	M	E	14
STT-3	Construct drainage improvements to improve the capacity, and clean, the storm water drainage system in Frydenhoj (next to and across from ball field) to alleviate localized flooding and damage of private property.	Goal 1, Objective 1.1	H	E	26
STT-4	Construct drainage improvements on Rt. 30 adjacent to Bolongo Bay to alleviate flooding to residential areas and beach erosion.	Goal 1, Objective 1.1	H	E	27
STT-5	Construct drainage improvements for major drainage channel that conveys flood waters from the surrounding Altona and Anna's Fancy areas to resolve recurrent flooding after heavy rainfall events.	Goal 1, Objective 1.1	H	E	1
STT-6	Construct Lindberg Estates, Phase IV Drainage Project north through Kirwin	Goal 1, Objective 1.1	H	E	16

Action	Description	Goal/Objective	Potential for Loss Reduction	Existing (E) or New (N)	Priority
	Terrace Public Housing Units.				
STT-7	Improve drainage infrastructure along Rt. 30 Estate Hope / Fortuna to eliminate flooding of nearby residences in Fortuna 3C Subdivision.	Goal 1, Objective 1.1	H	E	19
STT-8	Expand and reinforce communication infrastructure that is being implemented by BIT to mitigate damages from hurricanes to ensure rapid recovery and return to normal service.	Goal 3, Objective 3.1	H	E	13
STT-9	Replace and improve drainage infrastructure at Food Center in order to resolve flooding of roads, businesses, while addressing potential secondary impacts to wetlands.	Goal 3, Objective 3.2	H	E	15
STT-10	Conduct hydrologic study of the Smith Bay basin and implement drainage improvements to resolve the flooding problems at Coki Point and Smith Bay Roads, and, improvements to open channels draining through the resort complex into Water Bay to resolve localized flooding problems that periodically close roads, create traffic hazards, prevent emergency vehicle and public access, and cause damage to adjacent businesses and road pavement.	Goal 3, Objective 3.2	H	E	3
STT-11	Construct drainage improvements to secondary road that provides access to Caret Bay West. Improvements could include paving and/or providing proper roadside drainage and properly-sized culverts where appropriate to carry stormwater across the road to minimize erosion of the road surface.	Goal 3, Objective 3.2	M	E	18
STT-12	Complete installation of Hurricane Shutters at main police station in Charlotte Amalie.	Goal 3, Objective 3.2	M	E	20
STT-13	Improve drainage infrastructure along Hospital Gade from Antonio Jarvis School to the Police Station on Verteran's Drive, paying particular attention to the intersection of Hospital and Kongens Gade (Moravian Church and Zoras).	Goal 3, Objective 3.2	M	E	21
STT-14	Replace and improve drainage infrastructure along Rt. 33 (Estate Dorethea).	Goal 3, Objective 3.2	H	E	22
STT-15	Resolve flooding problems at Subbase Entrance. Pursue Phase II drainage improvements which include the installation of properly-sized culverts from	Goal 3, Objective 3.2	H	E	8

Action	Description	Goal/Objective	Potential for Loss Reduction	Existing (E) or New (N)	Priority
	Bellows across Veterans Drive to connect to Phase I drainage improvements.				
STT-16	Enlarge box culverts, stormdrains, and improvements to open channels from Veterans Drive to the Bay along the east edge of Frenchtown in southwest Charlotte Amalie (Frenchtown Drainage East), in order to resolve flooding, traffic access and business interruption.	Goal 3, Objective 3.2	H	E	10
STT-17	Harden WAPA Substations. Design and construction of hardened switchgear buildings at the East End and Tutu Substations	Goal 3, Objective 3.2	H	E	25
STT-18	Water Island Ferry Dock at "Philips Landing" experiences periodic flooding in the main turn around area. Periodic flooding caused by inadequate drainage at this facility impedes ferry traffic and emergency vehicles	Goal 3, Objective 3.2	M	N	8
STT-19	Honeymoon Beach at Druif Bay, western end of Water Island; flooding caused from inadequate drainage blocks vehicular passage and covers road with as much as 3 feet on the beach road and then takes as much as 3 weeks to drain. Economic impacts by blocking access to two commercial establishments and public health issue from mosquito breeding.	Goal 1, Objective 1.1	H	N	10
STT-20	Pearl and Larsen School structural retrofit of roof.	Goal 1, Objective 1.1	H	N	2
SST-21	Evelyn Williams School hurricane-strength wind mitigation retrofit of structural roof system and roof replacement.	Goal 1, Objective 1.1	H	N	6
SST-22	Resolve flooding problems at Abattoir Estate Nadir (race track) due to inadequate drainage.	Goal 1, Objective 1.1	M	N	23
SST-23	Address inadequate drainage at Tutu Fire Station	Goal 1, Objective 1.1	M	N	12
SST-24	Structural retrofit of following critical facilities used for sheltering (Lockhart School, Bertha Bochulte Middle School, and, Human Services Head Start building).	Goal 3, Objective 3.2	H	N	4
STT-25	Retrofit of electrical system at Blue Water Bible College to enable back-up power for all 3 main buildings from existing generator.	Goal 1, Objective 1.1	L	N	11
STT-26	Four WAPA power line projects to place feeder lines underground to eliminate damage from hurricane strength winds. They include feeder lines: 9A; 8E; 13; and,	Goal 3, Objective 3.2	H	N	9

Action	Description	Goal/Objective	Potential for Loss Reduction	Existing (E) or New (N)	Priority
	7E)				
STT-27	Rehabilitation of Water Storage Tank at Sara Hill to include seismic and wind retrofit. Complete rehabilitation and upgrade of the 105 MG Water Storage Tank. Work includes structural repairs and new wind girders and seismic joints.	Goal 3, Objective 3.2	H	N	7

5.5.4.2 St. Croix Mitigation Actions

Action	Description	Goal/Objective	Potential for Loss Reduction	Existing (E) or New (N)	Priority
STX-1	Resolve flooding problems and improve storm water drainage infrastructure in the "Grove at La Reine".	Goal 1, Objective 1.1	H	E	24
STX-2	Conduct a hydrological study of the St. Croix watersheds with particular attention given to the La Grange, Prosperity, Bethlehem and Salt River watershed basins. Attention should focus on upgrading inadequate drainage systems focused on reducing the impact of flooding (see USVI-4 Mitigation Action).	Goal 1, Objective 1.1	H	E	1
STX-3	Perform assessment of flooding problems within La Grande Princess Estate. Approximately 50 of 250 NFIP-insured losses in St. Croix (one in five repetitive losses) occur in La Grande Princess. Eighty two properties were identified as being in the 100 year flood plain and the potential for acquisition, structural solutions, and nonstructural control measures to reduce repetitive losses to residences should be assessed (see USVI-2 Mitigation Action).	Goal 1, Objective 1.1	H	E	2
STX-4	Improve drainage system to along Melvin H. Evans Highway in the area west of Williams Delight Stop Light and Carlton. Extend drainage system to connect with drainage improvements in Williams Delight Community.	Goal 1, Objective 1.1	M	E	10
STX-5	Conduct a hydrological study of the Christiansted watershed or catchment area with particular attention given to the sub-watersheds of Spring Gut and Water Gut to determine technically feasible and cost effective structural solutions to address the flooding problem in	Goal 1, Objective 1.1	H	E	12

Action	Description	Goal/Objective	Potential for Loss Reduction	Existing (E) or New (N)	Priority
	Christiansted.				
STX-6	Resolve flooding problems and improve stormwater drainage infrastructure for "Spring Gut" all the way to Gallows Bay.	Goal 1, Objective 1.1	H	E	13
STX-7	Resolve flooding problems and improve stormwater drainage infrastructure for Tide Village by implementing a low water crossing to divert surface run-off into the natural gut.	Goal 1, Objective 1.1	H	E	14
STX-8	Pursue Christiansted Gut USACE Section 205 Project. Preliminary feasibility phase currently underway by the Corps to determine whether technically feasible and cost effective solutions exist to reduce flood damages in residential and business areas adjacent to King Cross Street.	Goal 1, Objective 1.1	H	E	17
STX-9	Construct a retention pond at the property line of White Bay and the National Park Service reserve within the localized depression.	Goal 1, Objective 1.1	H	E	18
STX-10	Perform assessment of adjacent drainage basins that flow into Estate Williams Delight to identify alternate routing of surface runoff. Evaluate creation of stormwater detention pond below Blue Mountain	Goal 1, Objective 1.1	H	E	21
STX-11	Implement and improve storm water drainage infrastructure to relieve flooding at the Alfredo Andrews School and adjacent low-lying areas.	Goal 3, Objective 3.1	H	N	5
STX-12	Construct drainage improvements at the Ricardo Richards Elementary School at Estate Barren Spot near Melvin H. Evans Highway (Route 66).	Goal 3, Objective 3.1	H	E	19
STX-13	Improve Recovery Hill Water Storage Tanks. Install wind girders to reinforce against hurricane-strength winds.	Goal 3, Objective 3.2	M	E	9
STX-14	Implement and provide emergency power generator units for all wastewater pumping stations on St. Croix.	Goal 3, Objective 3.2.	M	E	11
STX-15	Pursue equipment anchoring program for the Richmond Electrical Generating Plant. Anchor critical equipment in the Plant to mitigate damages caused by earthquake, hurricane-strength winds, tsunami and storm surge.	Goal 3, Objective 3.2	H	E	15
STX-16	Improve Various Water Storage Tanks throughout the island. Install flexible connectors at multiple water storage tanks to permit pipe flexibility during earthquake events and ensure rapid recovery and	Goal 3, Objective 3.2	M	E	16

Action	Description	Goal/Objective	Potential for Loss Reduction	Existing (E) or New (N)	Priority
	normal service.				
STX-17	Lew Muckle School shutter project	Goal 1, Objective 1.1	H	N	23
STX-18	The 30” Coastal Interceptor transports sewage from the La Grande Princess area to the LBJ Pump Station in Christiansted. Shoreline erosion from coastal storms has left the interceptor submerged in the sea approximately 50’ from the shore. The mitigation action would reroute the pipeline inland, replacing approx. 1900’ of pipe, construct new lift station and associated improvements.	Goal 3, Objective 3.2	H	N	4
STX-19	FEMA Community Rating System (CRS). Initiate a planning project to have STX become a CRS Community by developing a strategy and action plan for improving the flood management program on the Island. The planning study would include an outreach strategy and series of community meetings on the NFIP Program, first living floor and base flood elevation determinations, LOMARS, and other flood insurance questions and concerns.	Goal 4, Objective 4.1	M	N	3
STX-20	LBJ Pump Station flood and storm surge protection. The pump station is located 215’ south of an existing gut and 125’ from the shoreline. Mitigation action involves improving conveyance from existing gut, regarding and rising existing roadway to site, fabrication of flood prevention brackets to provide protection from floodwaters and storm surge.	Goal 3, Objective 3.2	H	N	7
STX-21	Structural retrofits of Claude Markoe School and St. Croix Educational Complex critical facilities used for sheltering.	Goal 3, Objective 3.2	H	N	8
STX-22	Structural retrofits of Juan Luis Hospital for enhanced protection from hurricane-strength winds and earthquake hazards.	Goal 3, Objective 3.2	H	N	22
STX-23	Place Queen Street power lines in Christiansted underground to eliminate damage from hurricane-strength winds.	Goal 3, Objective 3.2	H	N	6
STX-24	Storm flows from Tropical Storm Otto collapsed a culvert and road crossing of Gut 5 in Enfield Green that connects the east and west sides of the Estate. Mitigation action involves replacing culvert with a larger diameter and implementing	Goal 3, Objective 3.2	M	N	20

Action	Description	Goal/Objective	Potential for Loss Reduction	Existing (E) or New (N)	Priority
	drainage improvements on Gut 5.				

5.5.4.3 St. John Mitigation Actions

Action	Description	Goal/Objective	Potential for Loss Reduction	Existing (E) or New (N)	Priority
STJ-1	Conduct a hydrological study of Coral Bay watershed to propose technically feasible and cost-effective solutions to flooding problems due to storm drain locations, undersized drainage, and lack of consideration of natural drainage guts.	Goal 1, Objective 1.1	M	E	2
STJ-2	Evaluate and construct drainage improvements to eliminate localized flooding at the lower end of "Carolina Gut" at Little Plantation where natural storm flows in the catchment area have been altered by construction and improper siting of structures.	Goal 1, Objective 1.1	H	E	6
ST-3	Construct drainage improvements to eliminate localized flooding at Pond Mouth at intersection of Rt. 102 and Rt. 105.	Goal 1, Objective 1.1	H	E	7
STJ-4	Implementing a slope stabilization program to reduce damage and blockage of roads during wind storm and flooding events. A program establishment of more stable and cut and fill slopes, removal of material that may be subject to landslide and rock fall events, re-vegetation, of disturbed slopes, etc.	Goal 1, Objective 1.1	H	E	8
STJ-5	Evaluate and construct drainage improvements to eliminate localized flooding along Route 20 southbound in Coral Bay (Estate Carolina).	Goal 1, Objective 1.1	H	E	11
STJ-6	Increase fuel capacity of the Myra Keating Health Clinic Emergency power generator unit.	Goal 3, Objective 3.1	H	E	5
STJ-7	Provide an alternate power generation substation for Coral Bay to ensure that there is adequate power source for all public services and critical facilities on the east end of the Island.	Goal 3, Objective 3.2	H	E	4
STJ-8	Construct underground feeders from the St. John substation to various termination points within Cruz Bay to mitigate damages to hurricane winds and ensure rapid recovery and return to normal service.	Goal 3, Objective 3.2	H	E	9
STJ-9	Improve drainage infrastructure (Box Culverts) at WAPA building and treatment plant, while addressing potential	Goal 3, Objective 3.2	H	E	10

Action	Description	Goal/Objective	Potential for Loss Reduction	Existing (E) or New (N)	Priority
	secondary impacts to wetlands.				
STJ-10	Coordinate with the National Park Service for the construction of appropriate drainage system improvements to eliminate localized flooding along Route Rt. 20 in Maho Bay.	Goal 3, Objective 3.2	H	E	12
STJ-11	Resolve flooding concerns from inadequate drainage at Cruz Bay Fire Station.	Goal 3, Objective 3.2	M	N	3
STJ-12	Functional replacement and relocation of the Fire Station in Coral Bay due to multiple coastal hazards and structural issues of this critical facility resulting from subsidence.	Goal 3, Objective 3.2	H	N	1

5.6 IMPLEMENTATION OF ACTIONS

The Hazard Mitigation Steering Committee considered the cost- effectiveness of all island specific and programmatic actions. The Hazard Mitigation Steering Committee further evaluated each of the identified mitigation actions by utilizing the STAPLEE criteria during meetings held on March 30, 2011.

The Hazard Mitigation Steering Committee was introduced to the STAPLEE process for evaluating both programmatic and island specific mitigation actions as recommended by FEMA guidance. The Hazard Mitigation Steering Committee agreed to use this method to further evaluate prioritized mitigation actions. The STAPLEE method provided the Hazard Mitigation Steering Committee with a systematic way of evaluating the opportunities and constraints of implementing particular mitigation actions that were rated for their loss reduction potential and prioritized through a simple voting technique.

The STAPLEE is an acronym for evaluating each action in terms of Social, Technical, Administrative, Political, Legal, Economic, and Environmental (STAPLEE) factors:

- **S** for Social; the mitigation strategy must be socially acceptable.
- **T** for Technical; the proposed action must be technically feasible.
- **A** for Administrative; the community must have the capability to implement the action (for example, the logical lead agency must be capable of carrying out oversight of the project).
- **P** for Political; mitigation actions must be politically acceptable.
- **L** for Legal; the community currently must have the authority to implement the proposed measure.
- **E** for Economic; economic considerations must include the present economic base, projected growth and opportunity costs.
- **E** for Environmental; the impact on the environment must be considered because of statutory considerations and the public's desire for sustainable and environmentally healthy communities.

Appendix G presents the programmatic and island-specific actions in a matrix format that depicts the prioritization and strategic planning conducted necessary to lead to effective implementation. A separate matrix is provided for each programmatic or island-specific action that includes the following information:

- Description of the mitigation action,
- Potential for Loss Reduction Rating,
- Priority ranking,
- The goal and objective that the action is intended to achieve,
- The specific hazard the action is intended to achieve (or all hazard),
- Responsible agency, department or division,
- Projected timeframe - Short term (1-2 years), Medium Term (3-5 years), and Long Term (5-10 years),
- Projected resources,
- Comments on rationale for action, contribution to goal, or other comment, and
- STAPLEE criteria evaluation, by individual criterion and total score.

Section Six consists of the following six subsections:

- 6.1 IFR Requirements for Plan Maintenance Process
- 6.2 Monitoring, Evaluating and Updating the Plan
- 6.3 Monitoring Implementation of Mitigation Actions
- 6.4 Reviewing Progress on Achieving Goals
- 6.5 Reviewing Progress on Activities and Projects in the Territorial Mitigation Strategy
- 6.6 Progress in Implementation of Past Plan Recommendations and Actions

6.1 IFR REQUIREMENTS FOR PLAN MAINTENANCE PROCESS

§201.4(c)(5)(i-iii) of the Interim Final Rule (IFR) requires the Territorial Hazard Mitigation Plan to include a section that describes the Plan Maintenance Process that the Territory will use to ensure that the Plan is current. The specific language in the IFR states that "*the Standard State Plan Maintenance Process" must include:*

- *An established method and schedule for monitoring, evaluating and updating the plan;*
- *A system for monitoring implementation of mitigation measures and project closeouts;*
- *A system for reviewing progress on achieving goals, as well as, activities and projects identified in the mitigation strategy."*

6.2 MONITORING, EVALUATING AND UPDATING THE PLAN

6.2.1 RESPONSIBLE PARTIES

The US Virgin Islands Territorial Emergency Management Agency (VITEMA) established a Hazard Mitigation Steering Committee for the 2014 Plan Update, and for implementation of actions identified in the Plan.

The newly appointed **Territory Hazard Mitigation Officer, Mr. Haldor Farquhar,** established the Hazard Mitigation Steering Committee, with the charge of overseeing the Plan Update process and for the provision of technical assistance to territorial agencies during the planning process. Mr. Farquhar will act as the chairperson the Hazard Mitigation Steering Committee. The members of the Hazard Mitigation Steering Committee have agreed to work on implementation of actions defined in the 2014 Plan Update. Members are highlighted in Table 6.1.

TABLE 6.1 ***Hazard Mitigation Steering Committee***

Name	Agency/ Department
Haldor Farquhar***	VITEMA
Austin Callwood	VITEMA
Joanne White	VITEMA
Malinda Vigilant	VITEMA
Renata Christian	VITEMA
Debra Henneman-Smith	VITEMA
Oliver Morton	VITEMA
*** Chairperson	

The Hazard Mitigation Steering Committee will be in charge and responsible for the implementation of the actions defined in Section Five of this Plan Update. It is necessary to note that this Committee consists of members of VITEMA staff, and it was decided that a smaller committee of emergency management staff, would be more effective in reviewing, monitoring, and evaluating progress in plan implementation.

This Committee will, therefore, be responsible for monitoring progress of the implementation of specific actions and ensuring that the overall goals and objectives of the Hazard Mitigation Plan are reached.

6.2.2 MONITORING AND EVALUATING THE PLAN

The Hazard Mitigation Steering Committee will meet once a year to monitor and evaluate progress in plan implementation. This process will include periodically validating underlying assumptions and identifying and securing updated information.

Specific issues that will be monitored and the appropriate procedures include:

1. Changes in information available to perform vulnerability and risk assessments. This will include the collection and update of hazard information, hazard profiles as well as inventory, especially critical facility information from the Department of Property and Procurement.
2. Changes in laws, policies, or regulations: The VITEMA Hazard Mitigation Steering Committee will keep abreast of changes in laws and regulations that have been passed. Particular attention will be given to pending laws as well to determine the potential impacts, if any, to hazard mitigation implementation.
3. Changes in territorial agencies or their procedures that will affect how mitigation programs or funds are administered. This will entail, liaising with Hazard Mitigation Committee members on all three islands and reviewing the different programs in key agencies, such as DPNR, DPW and WAPA. Review of these agencies must entail a determination to ascertain if any changes during the preceding 12 months would affect USVI hazard mitigation programs.
4. Changes in funding sources or capabilities: On an annual basis, VITEMA Hazard Mitigation Steering Committee members would formally convene to review federal funding opportunities

and the administration of grant programs. This will include an overview of project closeouts or new mitigation actions that the Territory is considering. This activity will result in the development report would include the tracking the status of Territorial and Federal funding for hazard mitigation projects.

5. The timing for the annual review should be made in anticipation of the FEMA HMA annual funding cycle so that the findings of the review can be considered prior to finalizing grant applications.

Based on this information, the VITEMA Hazard Mitigation Steering Committee will evaluate the plan annually. The Steering Committee will initiate the evaluations, by formally notifying FEMA Caribbean Area Division (CAD), and execute an action plan to gather information outlined above.

The VITEMA Steering Committee will contact the FEMA CAD and send out a series of letters to Territorial agencies to solicit information. A special session of the Hazard Mitigation Committee will be initiated through teleconference, in order to discuss progress, identify pending items and consider appropriate revisions for the next Plan Update.

VITEMA understands that the next Plan Update cycle may well be five years rather than the historical 3 year cycle.[1] This change will make the annual reviews even more important for monitoring and evaluation of plan progress.

In the first four (4) years of the next Plan Update cycle, VITEMA will make contact with agencies in November to solicit the required information, hold a meeting December (before the Christmas holidays and before December 15th) in order to consider any revisions for the next Plan Update. In the fifth (5th) year, solicitation of information should take place in August and the follow-up meeting should be in September, in anticipation of a complete revision of the Plan that will be submitted to FEMA for re-approval in April of the following year.   The evaluations will consider the information gathered as part of the monitoring process described above, and including:

1. Changes in hazard and vulnerability assessment information,
2. Changes in laws, policies, or regulations,
3. Changes in Territorial agencies or their procedures,
4. Changes in funding sources or capabilities, including status of FEMA project closeouts or new mitigation actions that the Territory is considering, and
5. Changes in VITEMA staffing, and/or composition of the Hazard Mitigation Monitoring Committee or island Hazard Mitigation Committees.

[1] April of 2014, FEMA promulgated a Final Rule that changed the frequency of Mitigation Plan Updates (44CRR Part 201). The Final Rule extends the Plan Update requirement for States and Territories from 3 to 5 years.

6.2.3 UPDATING THE PLAN

The Plan will be updated and re-submitted to FEMA for re-approval every five years, as required by law. VITEMA also has the prerogative to update the Plan at times other than those identified in this section, under the following general conditions.

1. After a major disaster declaration.
2. At the request of the Governor.
3. When significant new risks or vulnerabilities are identified during monitoring and evaluation procedures.

The VITEMA Hazard Mitigation Steering Committee will initiate and lead all Plan updates. The two sub-paragraphs below describe the procedures for interim and three-year updates, respectively.

6.2.3.1 Updates Resulting from Interim Evaluations

The nature of Plan updates will be determined by the evaluation process described above. In general, the VITEMA Steering Committee will notify the specific island Hazard Mitigation Monitoring and Evaluation Committees that the agency is initiating an interim plan update, and describe the circumstances that created the need for the update. VITEMA will consult the island Hazard Mitigation Committees regarding potential changes. If it is determined that the Hazard Mitigation Committees should be involved, the nature of the involvement will be at the discretion of VITEMA.

When interim updates are completed, VITEMA will advise all Hazard Mitigation Committee members via email that the Plan has been updated, and describe the nature of the update.

6.2.3.2 Updates Related to the Required Three-year Plan Review

As required by the Final Rule (44CFR Part 201), every five years the Plan will be updated for re-submission and re-approval by FEMA. In those years, the evaluation process will be more rigorous, and will examine all aspects of the Plan in detail. It is anticipated that several meetings of the Hazard Mitigation Committees will be required and that the Governor will formally re-approve the Plan prior to its submission to FEMA.

Based on the deadline established for the initial plan in the month of April, VITEMA anticipates that the submission date for the required update will be approximately April, 2019. Prior to that time, VITEMA will contact members of the Hazard Mitigation Monitoring and Evaluation Committee members and other appropriate agencies and organizations to determine a schedule for the Plan update.

The update process will entail a detailed and structured re-examination of all aspects of the Plan, followed by recommended updates. The recommendations will be presented to the VITEMA Director and the Hazard Mitigation Steering Committee, along with the Director, will take appropriate actions.

Scheduling Updates

- Monitoring activities by VITEMA should be done on at the final Hazard Mitigation Steering Committee meeting each year;
- The Plan Update, in view of the criteria set forth in Section 6.2.1 will be documented in a formal memorandum report that defines progress made during the yearly cycle;
- Notices and solicitation of information regarding annual evaluations should be sent out November of the first four years of the Plan and in August of the fifth year.
- The timetable for evaluations and updates for the first four years is expected to last one month, while the evaluation for the fifth year is expected to last three months and be documented for the Plan Update.

6.3 MONITORING IMPLEMENTATION OF MITIGATION ACTIONS

6.3.1 Monitoring Mitigation Projects

Mitigation projects are generally monitored as follows.

- Each mitigation project or activity (such as planning) has an established period of performance that VITEMA and FEMA monitor throughout the development and execution of the activity to whom quarterly reports are sent.
- VITEMA regularly meets with representatives from FEMA Region II Caribbean Area Division to coordinate project monitoring activities.
- Every calendar quarter, VITEMA send letters to all sub-grantees with open projects (i.e. ones that have been funded but are not completed), requesting a project progress update.
- Each of the sub-grantees responds to the VITEMA request by preparing a standard report that details progress on individual mitigation projects, and indicates the percentage complete.
- VITEMA compiles the sub-grantee progress reports, and produces a consolidated quarterly report that is sent to FEMA Region II Caribbean Area Division for review.

VITEMA as an agency does not provide separate funding for hazard mitigation projects and does not have any direct influence over the implementation process for projects funded by other Territorial agencies.

For mitigation projects that are funded by non-federal sources such as capital budgets of other territorial agencies, should be described. It will be the responsibility of VITEMA to describe the implementation status of mitigation project, unless otherwise specified at the Hazard Mitigation and Monitoring Committee meetings. The primary focus of these reports will be on providing the VITEMA Steering Committee with an understanding of which projects are progressing well toward meeting scheduled completion dates and which projects may be lagging behind their schedule, requiring intervention.

6.3.2 Monitoring Project Closeouts

Federally-funded mitigation project closeouts occur in the following sequence. These procedures were established in accordance with FEMA HMGP guidelines as set out in the HMGP Desk Reference and the Virgin Islands HMGP Administrative Plan.

- Sub-grantee indicates in a quarterly project progress report that a mitigation project is 100 percent complete.
- VITEMA reconciles FEMA SmartLink account for the project (by disaster).
- VITEMA initiates a comprehensive internal financial audit of the project.
- VITEMA resolves any issues discovered in the audit.

- VITEMA sends FEMA Region II Caribbean Area Division (CAD) a closeout letter that delineates the final eligible cost of the project, and delineates any de-obligations that are required, as well as any monies that will be recovered from the sub-grantee.

6.4 REVIEWING PROGRESS ON ACHIEVING GOALS

Subsection 201.4 (c)(5(iii) of the IFR states that the Territorial Hazard Mitigation Plan must include a system for reviewing progress on activities and projects that are included in the mitigation strategy.

In order to monitor progress on achieving the goals identified in this Plan, VITEMA will ensure that both the annual and five-year Plan evaluations include a detailed examination and analysis of the goals, and the various actions that are intended to achieve them. In future versions of the Plan, VITEMA will prepare tables to indicate the status of the various actions based on information from monitoring efforts detailed above, and a general indication of progress. A simple matrix was used during the 2014 Plan Update, which includes:

- Activity Number (delineated by island)
- Type: Existing or New Project
- Status: Implemented, Partially Implemented or Complete
- Description of Project:
- Priority: High, Medium and Low

It is necessary to note that for the Update of this Plan, there were no annual meetings or reports prepared for the specific purpose of updating the Plan. Therefore, the goals and underlying assumptions of the Plan were reviewed during the VITEMA Hazard Mitigation Steering Committee and Island Hazard Mitigation Monitoring and Evaluation Committee meetings that took place during the planning process for this Plan Update (2014).

6.5 REVIEWING PROGRESS ON ACTIVITIES AND PROJECTS IN THE TERRITORIAL MITIGATION STRATEGY

Subsection 201.4 (c)(5)(iii) of the IFR states that the Territorial Hazard Mitigation Plan must include a system for reviewing progress on activities and projects that are included in the mitigation strategy.

As part of the yearly and five-year evaluations and updates to this Plan, VITEMA will initiate a review of all activities and projects noted in the mitigation strategy. The review will take place in stages.

1. VITEMA will assemble a Steering Committee to undertake a preliminary review and analysis of progress on activities and projects that are listed in the mitigation strategy section.
2. The VITEMA Steering Committee will prepare a draft memorandum report that describes progress, remaining tasks and projected time to complete.

3. The draft memorandum report will be presented to the Director during its final annual meeting related to the yearly (and five-year) updates.
4. After Director's review, comment and approval, results of the progress review will be added as an addendum to Plan.
5. VITEMA will submit the summary memorandum report describing the results of the yearly program evaluations to FEMA Region II CAD.

Again, no formal documentation or annual reports were developed for the review or monitoring of mitigation projects identified in the 2011 Plan. The VITEMA Steering Committee agreed that the review procedures outlined in the 2011, required only slight modification, as outlined in the previous section of this Plan Section (Section 6). The VITEMA Steering Committee concurred that better documentation is required during the upcoming Plan Update cycle.

6.6 PROGRESS IN IMPLEMENTATION OF PAST PLAN ACTIONS

Despite severe staffing and funding constraints, it is important to note that there has been some, albeit limited, progress in the implementation of past plan actions since the preparation of the 2011 Plan Update. The Island Hazard Mitigation Monitoring and Evaluation Committees were vital in determining which of the mitigation actions from the 2011 Plan had been fully or partially implemented. The major successes to report include:

- STT-2 -Pursue road reconstruction and drainage improvements to resolve recurrent flooding on Commandant Gade Gut (Garden Street) from Bunker Hill to Veterans Drive that affect businesses and emergency access.
- STT-3 -Pursue road reconstruction and drainage improvements to resolve recurrent shallow flooding on Radets Gade from Main Street to Veterans Drive that affect businesses.
- STT-4 -Pursue road reconstruction and drainage improvements to resolve recurrent shallow flooding on Storre Tvaer Gade from Main Street to Veterans Drive that affect businesses.
- STT-23 - Installation of High Impact Hurricane windows at the Department of Public Works (HMGP-1807).
- STT-22 - Installation of High Impact Hurricane windows at the Department of Property and Procurement (HMGP-1807).
- STT-24 - Installation of High Impact Hurricane windows at the Department of Education (HMGP-1807).
- STT-25 - Installation of High Impact Hurricane windows at the Department of Human Services (HMGP-1807).
- STT-11 - Pursue the acquisition of land for the relocation of the Downtown Fire Station that is susceptible to storm surges and tsunami.
- STX-17 - Install storm shutters at the American Red Cross (HMGP-1807).

- STX-18 - Install storm shutters Emile Henderson, Sr. Fire Station (HMGP-1807).
- STX-19 - Install Roll-Up Doors at the Rencelier I. Gibbs Fire Station (HMGP-1807). Note: roll-up windows were installed instead.
- STX 21 - Install Fabric Shutter system at Henry E. Rohlsen Airport (HMGP-1807).
- STJ-10 - Install Storm shutters at the DeCastro Health Clinic (HMGP 1807).
- STJ -12 - Clean Gut at Westin Hotel.

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Virgin Islands Territorial Emergency Management Agency (VITEMA)

Hazard Mitigation Plan Update – Town Hall Meeting

Sign-In Roster

Venue: Gertrude's Restaurant – St. Croix

Date: Thursday, May 15, 2014

Time In: 5:30 pm **Time Out:** 7:00 pm

Name / E-mail	Agency	Telephone No.	Fax No.	Signature
Joanne White joanne.white@vitema.vi.gov	VITEMA	340/774-2244	340/715-6847	JWhite
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MARLA L. MATTHEW Marla L Matthew	ARC VI	340-778-5104	778-5104	Marla L Matthew
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talbany@viwma.org Tawana Nicholas	VIWMA	340-692-0505	—	Tawana Albany Nicholas
RICHARD E FAHIE efahie@hotmail.com		340-773-1083	—	[illegible]

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Virgin Islands Territorial Emergency Management Agency (VITEMA)

Hazard Mitigation Plan Update – Town Hall Meeting

Sign-In Roster

Venue: Julius Sprauve School – St. John

Date: Wednesday, May 14, 2014

Time In: 5:50pm **Time Out:** 6:40pm

Name / E-mail	Agency	Telephone No.	Fax No.	Signature
Joanne White joanne.white@vitema.vi.gov	VITEMA	340/774-2244	340/715-6847	[signature]
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Linda Williams linda.williams@vitema.vi.gov	VITEMA	340/776-2244	340/779-4260	[signature]
Jeffrey Eauwema	CIPA	340-7742288	—	[signature]
Pieter de Jong	CIPA	340.281.8282	—	[signature]

Virgin Islands Territorial Emergency Management Agency (VITEMA)

Hazard Mitigation Plan Update – Town Hall Meeting

Sign-In Roster

Venue: Julius Sprauve School – St. John **Date:** Wednesday, May 14, 2014

Name / E-mail	Agency	Telephone No.	Fax No.	Signature
Haldor Farquhar Haldor.farquhar@vitema.vi.gov	VITEMA	715-6802	715-6847	Haldor Farquhar

Virgin Islands Territorial Emergency Management Agency (VITEMA)

Hazard Mitigation Plan Update – Town Hall Meeting

Sign-In Roster

Venue: Emerald Beach Resort – St. Thomas **Date:** Tuesday, May 13, 2014

Time In: 5:40pm **Time Out:** 7:00pm

Name / E-mail	Agency	Telephone No.	Fax No.	Signature
Joanne White joanne.white@vitema.vi.gov	VITEMA	340/774-2244	340/715-6847	JWhite
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Roma Farquhar		340-774-7221	—	Roma Farquhar
John Gumbs		340-775-6900	-	John Gumbs

Virgin Islands Territorial Emergency Management Agency (VITEMA)

Hazard Mitigation Plan Update – Town Hall Meeting

Sign-In Roster

Venue: Emerald Beach Resort – St. Thomas **Date:** Tuesday, May 13, 2014

Name / E-mail	Agency	Telephone No.	Fax No.	Signature
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Rita C. Robles ritacrobles@vitema.vi.com	VITEMA	340 715 6812	340 775 6847	[illegible]
Debra Henneman-Smith debra.henneman-smith@vitema.vi.gov	VITEMA / Private Citizen	340 715-6804		Debra H Smith
NANA Baby Children's Home Beulah Wilson 7@hotmail	Private - Non-Profit	340-775-0044	Same	[illegible] B. Wilson
Cherie Wheatley 15-58 Frenchman Bay cwheatl@uvi.edu	Private Home	340 643 0566	340 693 1205	CWheatly

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Virgin Islands Territorial Emergency Management Agency (VITEMA)

Hazard Mitigation Plan Update – Town Hall Meeting

Sign-In Roster

Venue: VITEMA (STT) – EOC

Date: Thursday, April 3, 2014

Time In: 5:30p **Time Out:** 7:00p

Name / E-mail	Agency	Telephone No.	Fax No.	Signature
Joanne White joanne.white@vitema.vi.gov	VITEMA	340/774-2244	340/715-6847	JoWhite
Sharon Brown sharon.brown@vitema.vi.gov	Vitema	340 774-2244	340-715-6847	Sharon Brown
LEONARD Gumbs Leonard.Gumbs@FEMA.dhs.Gov	FEMA	340 201 8892	340 715 6847	Leonard Gumbs
Haldor Farquhar haldor.farquhar@vitema.vi.gov	VITEMA	340-715-6802	715-6847	Haldor Farquhar
RENATA CHRISTIAN RENATA.CHRISTIAN@VITEMA.VI.GOV	VITEMA	340 715 6819	340 715 6847	[illegible]
Debra Henneman-Smith ~~Stacy M~~	VITEMA	715-6804	"	Debra H Smith
Stacy M. George Smgeorge@doe.vi	Dept. of Ed.	(340) 774-0100 ext. 8068		SGeorge
Rita C Robles @vitema.vi.gov	VITEMA	x 6812		[illegible]

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Virgin Islands Territorial Emergency Management Agency (VITEMA)

Hazard Mitigation Plan Update – Town Hall Meeting

Sign-In Roster

Venue: VITEMA (STT) - EOC **Date:** Thursday, April 3, 2014

Name / E-mail	Agency	Telephone No.	Fax No.	Signature
Austin Callwood	VITEMA			[signature]
Jeffrey Euwema	CIPA			Jeff [signature]

ST. THOMAS SOURCE

Tuesday, May 13, 2014 Last Update 1:04am

Local government — St. Thomas

VITEMA Holds Public Workshops on Hazard Mitigation Plan

BY SOURCE STAFF — MAY 9, 2014

May 13 through 15, the Virgin Islands Territorial Emergency Management Agency (VITEMA) will hold a second round of public workshops to gather public input on updates to the territory's Hazard Mitigation Plan.

The public is invited to public workshops being held on:

• Tuesday, May 13 — 5:30 p.m., at the Emerald Beach Hotel, Lindbergh Bay, St. Thomas.

• Wednesday, May 14 — 5:30 p.m., at the Julius Sprauve School Auditorium, Cruz Bay, St. John.

• Thursday, May 15 — 5:30 p.m., at Gertrude's Restaurant, Castle Coakley, St. Croix.

SOURCE PICKS

Undercurrents: Stricter Water Standards Still Set for September

From more than 100 sites, territory residents regularly dump their waste into the surrounding ocean, threatening fragile coral beds and potentially putting at risk the fish populations that feed and shelter there.

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Community Calendar

St. John Tradewinds welcomes notices of community-oriented, not-for-profit events for inclusion in this weekly listing. Call 776-6496, e-mail editor@tradewinds.vi or fax 693-8885.

Wednesday, May 14

— The Virgin Islands Police Department will celebrate National Police Week with an open house at Leander Jurgen Command on Monday, May 12, from 12 to 3 p.m. in Cruz Bay.

Wednesday, May 14

— The Virgin Islands Territorial Emergency Management Agency (VITEMA) will have a second round of public workshops to gather public input on updates to the territory's Hazard Mitigation Plan. The St. John workshop is scheduled for Wednesday, May 14, at 5:30 p.m., at the Julius Sprauve School Cafeteria in Cruz Bay.

— The Virgin Islands Police Department will celebrate National Police Week with a fun day at Julius E. Sprauve School on Wednesday, May 14, from 8 a.m. to 3 p.m.

Thursday, May 15

— The Office of the Governor in partnership with the Departments of Education and Public Works announces a public scoping meeting to solicit recommendations for a new St. John School under consideration for the island of St. John. The meeting will be at the Julius E. Sprauve School cafeteria on Thursday, May 15, from 6 to 8 p.m. Preliminary educational program requirements and key milestones in the process to date will be outlined.

Saturday, May 17

— The Animal Care Center of St. John has rescheduled Wagapalooza, due to inclement weather, for Saturday, May 17, from 5 to 8 p.m. at the Winston Wells Ball Field in Cruz Bay.

— The University of the Virgin Islands will host its 2014 Commencement Ceremonies at 7 p.m. on Saturday, May 17, in the Sports and Fitness Center on the St. Thomas Campus

Sunday, May 24

— The 11th annual Beach-to-Beach Power Swim will be on Saturday, May 24. The event is set in the protected waters of Virgin Islands National Park along the north shore of St. John.

Monday, June 30

— Lt Gov. Gregory Francis is strongly encouraging and reminding corporate citizens to meet the June 30 deadline for franchise taxes and annual filing requirements. Failure to comply with the annual filing requirements will result in the assessment of penalties and interest, withdrawal of good standing status, or even administrative dissolution.

VITEMA Hosting Hazard Mitigation Plan Workshop on May 14

St. John Tradewinds

The Virgin Islands Territorial Emergency Management Agency (VITEMA) will have a second round of public workshops to gather public input on updates to the territory's Hazard Mitigation Plan.

The St. John workshop is scheduled for Wednesday, May 14, at 5:30 p.m., at the Julius Sprauve School Cafeteria in Cruz Bay.

The purpose of the USVI Hazard Mitigation Plan is to identify activities that can be undertaken by both the public and the private sectors to reduce property damage caused by hazards including floods, earthquakes, and hurricanes. While these hazards are acts of nature, the impacts on residents, public facilities, businesses, and private property can be diminished through hazard mitigation planning.

VITEMA is directing this territory-wide planning effort which is being funded by a grant from the Federal Emergency Management Agency (FEMA). The planning activities have been coordinated through a Hazard Mitigation Planning Committee created by VITEMA.

"A participatory planning process is vital for the development of a comprehensive mitigation plan as it is only through public participation that the priorities of the community are reflected," said Haldor Farquhar, VITEMA State Hazard Mitigation Officer. "In this regard, the public workshops are an important forum for understanding community concerns and incorporating feedback from government agencies, businesses and citizenry into the plan."

The Hazard Mitigation Plan will document information on the frequency of occurrence of natural hazard events, utilizing past disaster damages to understand the impact or vulnerability to natural hazards. A series of estimates will be used to understand the extent of hazards and potential property damages that may result from specific hazards. The resulting information will outline the full range of hazards the territory faces, from hurricanes to landslide —and potential social impacts, damages and economic losses.

"The territory's Hazard Mitigation Plan is an important tool for VITEMA and the government because it provides a comprehensive review of the natural hazards and their potential impacts to citizens and property," sad Elton Lewis, VITEMA Director. "By understanding the risks, we can outline and prioritize mitigation strategies that will help protect our communities."

Lewis added that community participation and feedback in the planning process is critical to the success of the plan because the local government, the private sector and non-profit stakeholders will ultimately be responsible for implementing the actions outlined in the mitigation plan. More importantly, the Virgin Islands will benefit from the federal grants for mitigation of hazards identified in the plan, he said.

For more information, contact Haldor Farquhar, VITEMA State Hazard Mitigation Officer, at 340-774-2244 or via email at haldor.farquhar@vitema.vi.gov.

US VIRGIN ISLANDS REPETITIVE LOSS PROPERTIES STRATEGY

The US Virgin Islands has formulated a strategy to effectively address the significant negative impact of Repetitive Loss properties on the Territory's families, economy and property. On June 30, 2004, the National Flood Insurance Act (42 U.S.C 4001 et seq) was amended to "introduce a mitigation plan requirement as a condition of receiving a reduced local cost share for the activities that mitigate severe repetitive loss properties under the Flood Mitigation Assistance and Severe Repetitive Loss grant programs. The October 31, 2007, interim final rule established this requirement under the 44 CFR § 201.4 (c)(3)(v) to allow a state to request the reduced costs share under the FMA and SRL programs if it has an approved State Mitigation Plan that also includes an approved Severe Repetitive Loss Strategy" (FEMA, Multi-Hazard Planning Guidance, 2008).

As noted in Section 2.4, the Biggert-Waters Flood Insurance Reform Act of 2012 eliminated the Repetitive Flood Claims and Severe Repetitive loss grant programs. To encourage efforts by states and local jurisdictions, FEMA has changed the cost-share requirements to allow more Federal funds for properties with repetitive flood claims and severe loss properties. Implementing flood mitigation measures for severe repetitive loss properties would be funded by FEMA at 100 percent; and, funding for implementation of flood mitigation measures for repetitive loss properties would be funded at 90 percent. Given the stark economic reality in the USVI, focusing the mitigation strategy on addressing repetitive losses is the best option for the USVI Territory.

A Repetitive Loss (RL) property is a structure covered by a contract for flood insurance made available under the NFIP that:

(a) Has incurred flood-related damage on 2 occasions, in which the cost of the repair, on the average, equaled or exceeded 25 percent of the market value of the structure at the time of each such flood event; and

(b) At the time of the second incidence of flood-related damage, the contract for flood insurance contains increased cost of compliance coverage.

A Severe Repetitive Loss (SRL) property is defined as a residential property that is covered under an NFIP flood insurance policy and:

(a) That has at least four NFIP claim payments (including building and contents) over $5,000 each, and the cumulative amount of such claims payments exceeds $20,000; or
(b) For which at least two separate claims payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building.
(c) For both (a) and (b) above, at least two of the referenced claims must have occurred within any ten-year period, and must be greater than 10 days apart.

Actions undertaken by the USVI Territorial Government include implementing a FMA grant to address three Repetitive Loss properties in Sugar Estate on St. Thomas. The three properties included the St. Andrews Episcopal Church and a 3-story, multi-family housing project. The hazard mitigation project was completed in 2009. The Territorial Government first formulated the Repetitive Loss Properties Strategy during the last Plan Update in 2011. Since that time, VITEMA has been working to implement the strategy through the full range of its hazard mitigation planning activities.

A major drainage improvement project has been completed in the Havensight area that has benefited surrounding residential and commercial areas including clusters of repetitive losses.

The primary objective of this strategy is to increase awareness of the negative impact of repetitive loss properties and the benefits of mitigation actions and to eliminate or reduce the total number of repetitive loss properties in the Territory.

Therefore, the Territory's approach is primarily focused on public education, data collection, and direct mitigation actions focused on minimizing repetitive losses. These are highlighted in the Plan Update in the following areas:

- Educational Outreach – where specific actions focus on developing an outreach program to provide the community with hazard mitigation educational materials include those on the NFIP, Community Rating System, as well as repetitive loss concerns. These outreach activities will educate citizens on the impact of repetitive loss properties in their communities and suggest ways to reduce flood insurance premiums. More specific programs will provide professionals and private sector guidance on retrofitting options and opportunities for repetitive loss properties (see programmatic Action 2 and 3).

- Data Collection – where specific action is taken by VITEMA to collect important information for the implementation of island specific actions focused on minimizing losses in high priority repetitive loss properties. Programmatic Actions #5 is specifically focused toward this program and will help with the implementation of the specific projects.

- Annual Reporting – the collection of data will also facilitate plan implementation and monitoring highlighted in Section Six. Better data collection by VITEMA will facilitate more accurate reporting on the total number of repetitive loss properties that are either targeted or retrofitted by the Territory.

- Targeted Actions – In meetings of the Hazard Mitigation Steering Committee leading up the 2014 Plan Update, a consensus was reached that mitigation actions proposed in the Plan should be prioritized with the actions reducing the number of repetitive loss properties having the highest priority. There are a number of specific mitigation actions that seek to minimize flood related losses associated with repetitive properties. Many of these projects involve drainage improvements but could also involve acquisitions, elevations, or other flood protection measures.

C.1 REPETITIVE LOSS PROPERTIES DATA

In preparation for this 2011 Plan Update, VITEMA requested data from FEMA regarding the identified Repetitive Loss (RL) and Severe Repetitive Loss (SRL) properties in the Territory. In March 2011, FEMA provided RL and SRL data as of November 2010, in the form of the RL and SRL assessment report completed for DR-1939. The table below shows the data received, which is the latest data available.

TABLE C.1 ***US Virgin Islands RL/SRL Property Statistics***

County	RLP Count	Percentage of RLP for USVI	SRLP Count	Insured Properties	Losses	Buildings Payment	Contents Payment	Total Paid	Percentage of Total USVI Payouts
ST. CROIX	133	53.85%	3	72	355	$ 7,902,668.53	$ 8,033,674.98	$ 15,936,343.51	47.69%
ST. JOHN	2	0.81%	0	1	4	$ 219,662.16	$ 48,361.70	$ 268,023.86	0.80%
ST. THOMAS	112	45.34%	0	37	311	$ 3,583,351.96	$ 13,629,364.55	$ 17,212,716.51	51.51%
WATER ISLAND	0	0.00%	0	0	0	$ -	$ -	$ -	0.00%
TOTAL	**247**	**100%**	**3**	**110**	**670**	**$ 11,705,682.65**	**$ 21,711,401.23**	**$ 33,417,083.88**	**100%**

As of November 2010 there were two hundred and fifty (250) RL properties identified in the NFIP BureauNet data system, with total claims paid of $33.4 million over the last 30 years. However, of those 250 structures, 21 were identified as duplicate entries. In addition, 3 structures were found to have been mitigated by a flood control project using funds from FMA, and 1 was a vacant lot. Therefore, as a result of the field verification process the total amount of RL structures in the USVI has been decreased from 250 to 225. The following table illustrates the results of this field inspection survey.

Table C.2 ***RL/SRL Validated Properties, as a Result of Field Inspection Summary***

CITY, STATE	RLP	SRLP	Insured	Located	Unable to Locate	Pending Inspections	Duplicated	Mitigated	# Reports	TOTAL (internal: minus DUP & MIT)
St. Croix, USVI	133	3	72	104	21	0	11	2	125	123
St. John, USVI	2	0	1	2	0	0	0	0	2	2
St. Thomas, USVI	112	0	37	73	27	2	10	2	102	100
	247	**3**	**110**	**179**	**48**	**2**	**21**	**4**	**229**	**225**

While the data provided by FEMA is illustrative of the number of NFIP-insured properties that meet the definition of Repetitive Loss or Severe Repetitive Loss, the information has limited uses in the development and implementation of the Territory's SRL Strategy. Without specific addresses, it is difficult to develop a targeted strategy to address RL and SRL structures throughout the Territory. In addition, the FEMA-provided data is limited to only those structures which are NFIP-insured, which likely does not account for the majority of repetitive loss structures in the Territory, as many are not insured through the NFIP.

As a supplement to the data received from FEMA data, and in an effort to develop a strategy that will target all properties known to suffer repetitive loss, VITEMA has included information on areas and neighborhoods known to be prone to repetitive flood loss. These areas and neighborhoods were identified by VITEMA and the Department of Permitting and Natural Resources, by staff with knowledge of the nature, frequency and effects of repetitive flooding in the areas. Those areas and neighborhoods are identified below, and are organized by island.

TABLE C.3 ***VITEMA-Identified Repetitive Loss Areas or Neighborhoods***

Island	Area or Neighborhood	Type of Development	Description of Known Flooding Issues
St. Thomas	Charlotte Amalie Main Street Area	Primarily commercial area with historic structures and drainage	Flooding primarily results from storm surge and exceptionally high tide events - Some flooding caused by storm water runoff and inadequate drainage
	Turpentine Run area	Primarily commercial	Flooding caused by storm water runoff and inadequate drainage
	Nadir area	Residential, single-family structures	Flooding caused by storm water runoff and inadequate drainage
	Bovoni Area (Thomasville Community)	Residential, single- and multi-family structures	Flooding caused by storm water runoff and inadequate drainage
	Bolongo Bay area	Residential, single-family structures	Flooding caused by storm water runoff and inadequate drainage
	Smith Bay area	Mixed use (residential and commercial)	Flooding caused by storm water runoff and inadequate drainage
	St. Peter area	Residential, single-family structures	Flooding caused by storm water runoff and inadequate drainage
St. Croix	Gallows Bay / Spring Valley area	Mixed use (residential and commercial)	Sheet flow flooding caused by storm water runoff and inadequate drainage
	La Grand Princess area	Mixed use (residential and hotel)	Flooding caused by storm surge, storm water runoff and inadequate drainage
	Sion Hill area	Mixed use (largely residential, come commercial)	Flooding caused by storm water runoff and inadequate drainage
	Estate Castle area	Mixed use (residential and commercial)	Flooding caused by storm water runoff and inadequate drainage
	Estate Barren Spots area (includes Strawberry Estate, Strawberry Hill, Estate La Reine)	Mixed use (residential and commercial)	Flooding caused by storm water runoff and inadequate drainage
	Mon Bijou area	Residential, single-family structures	Flooding caused by storm water runoff and inadequate drainage; significant erosion in the gut
	Lorraine Village Apartments area	Residential, single- and multi-family structures	Flooding caused by storm water runoff and inadequate drainage; significant erosion in the gut
	William's Delight area	Residential, single-family structures	Flooding caused by storm water runoff and inadequate drainage
	Fredericksted area	Mixed use (residential and commercial) with historic structures and drainage	Flooding caused by storm water runoff and inadequate drainage from upstream sources
St. John	Cruz Bay area	Mixed use (residential and commercial)	Flooding caused primarily by storm surge, with some storm water runoff issues

Island	Area or Neighborhood	Type of Development	Description of Known Flooding Issues
	Coral Bay area	Mixed use (residential and commercial)	Flooding caused primarily by storm surge, with some storm water runoff issues

This strategy will focus on these VITEMA-identified areas or neighborhoods, while remaining mindful of the two hundred and twenty-five NFIP-insured properties that provide a significant drain on the National Flood Insurance Fund.

C.2 REPETITIVE LOSS PROPERTIES MITIGATION PROJECT TYPES

A variety of project types exist that have the potential to mitigate repetitive flood losses. This sub-section provides a general discussion of these project types. Specific recommendations to address repetitive losses in specific areas can be found later in this section.

Public Education and Outreach
Insurance industry and emergency management research has demonstrated that awareness of hazards is not enough. People must know how to prepare for, respond to, and take preventive measures against threats from hazards. This research has also shown that a properly run local information program is more effective than national advertising or public campaigns.

Although Territorial efforts to inform the public exist, lives and properties continue to be threatened when segments of the population remain uninformed or chose to ignore the information available. Public education and outreach serves to assist communities with problems experienced from repetitive flooding. Educating the public of these life and property saving techniques should be a high priority task for all levels of government.

National Flood Insurance Program, Floodplain Management, and Building Codes
Improved floodplain management, including land use planning, zoning, and enforcement in the Territory can reduce flood related damages for both existing buildings and new development. The use of the NFIP is critical to the reduction of future, repetitive flood damage costs to the taxpayer.

All developments, regardless of the location, require a permit to include buildings, fill, and any other type development. The Territory has the authority to implement and enforce adopted ordinances related to floodplain management, building code and zoning compliance.

The NFIP requires that when the cost of reconstruction, rehabilitation, addition, or other improvements to a building equals or exceeds 50% of the fair market value, then the building must meet the same construction requirements as a new building. Substantially damaged buildings must be brought up to new construction standards. A residence or building damaged so that the cost of repairs equals or exceeds 50% of the structure's fair market value must also be elevated above the Base Flood Elevation (BFE) in flood zones where BFEs are established. This provision applies to the entire jurisdiction of the Territory.

The current, effective Flood Insurance Rate Maps for the Territory were issued on April 16, 2007. The Territory joined the NFIP on October 15, 1980, and is a member community in good standing with the Program.

Within floodplain management as a whole, the education process must play an important role. As noted above, an effective education program should be implemented to show citizens the importance of building codes and ordinances and how cost effective they could be in reducing future damages.

Established through the NFIP, the Community Rating System (CRS) is a program that participants can elect to join. Once a community has joined, policy holders in participating communities receive a discount on their flood insurance premiums. As a result of being part of the CRS, the Territory would have to actively pursue public outreach programs. One of the requirements of CRS is an annual outreach project, such as a Repetitive Loss Outreach Program. This program would focus on repetitive loss areas within the Territory and consists of three main components. The first is to advise the homeowners that they live in a repetitive loss area and could be subject to flooding. The second is to give the property owner appropriate property protection measure guidelines. The third is to make the homeowner aware of the basic facts about Flood Insurance. The Territory is not currently a member of the CRS, but could consider joining the program in the future.

Each community that is a participating community in the NFIP Program is required to have both a well trained municipal floodplain manager and construction code official. The Territory currently meets this requirement. To ensure adequate enforcement of both codes, each community in the NFIP should encourage additional training opportunities for all code enforcement personnel, to include its floodplain manager.

Floodplain management and building codes serve to assist the communities with problems experienced from floods, hurricanes, tornadoes, and thunderstorms/lightning/high winds as well as other lower priority hazards.

The Territory has adopted and currently enforces the International Building Code (IBC), 2009.

Flood Mitigation Actions
Retrofitting structures prone to periodic flooding can be an effective mitigation technique to reduce the flood loss of property. Techniques include the elevation of structures, property acquisition, dry flood-proofing, wet flood-proofing, and drainage improvements. Each of these project types is discussed below.

Elevation: involves raising a structure on a new foundation so that the lowest floor is above the BFE. Almost any type and size of structure can be elevated, though some types of construction lend themselves more easily to this technique.

A secondary type of elevation is known as a *second-story conversion.* In this type of elevation project, the first or ground floor of a structure is demolished, and a new floor is constructed above the BFE. In the case of an existing 2 story structure, for example, the ground story would be removed, and a new story would be constructed above or on top of the previous second story. This allows for the entire structure to be elevated above the BFE, without causing the structure the strain of traditional elevation.

Acquisition of Structures: the *buyout* option is the most effective mitigation technique to reduce the loss of property due to flooding. The owners of repetitive flood loss or flood damaged structures sell their structure and property to the community on a cost share basis for the fair market value of the structure prior to the last flood event. The structure is removed and/or demolished, and a deed restriction is placed on the property for perpetuity, thus removing the structure from future flood damage. This approach is most effective when flood prone structures located within the same vicinity are grouped together and acquired. The remaining property is converted to open space, and is subject to the building and development limitations outlined in the deed restriction. While the property may be re-developed, it may not be in any manner that impedes the floodplain or violates the terms of the deed restriction.

Dry Flood-proofing: is a mitigation technique designed to prevent floodwaters from penetrating the structure. Techniques include the building of floodwalls adjacent to existing walls, the installation of special doors to seal out floodwaters, and special backflow valves for water and sewer lines. Dry flood-proofing includes low cost mitigation measures such as raising air conditioners, cisterns, and water heaters on platforms above the BFE.

Wet Flood-proofing: is a mitigation technique designed to allow for the safe entry of floodwaters into a structure, thereby minimizing the flood damage to the structure. Generally, this includes properly anchoring the structure, using flood resistant materials below the BFE, protection of mechanical and utility equipment, and use of openings or breakaway walls. Application of wet flood-proofing as a flood protection technique under the NFIP is limited to enclosures below elevated residential and non-residential structures and to accessory and agricultural structures that have been issued variances by the community.

Drainage Improvements: Improving the drainage capacity around roads and low-lying areas is a time-tested technique to mitigate flood damage. Maintenance of drainage canals, swales, ditches, culverts and laterals is essential to maximize their efficiency and continued long term effectiveness. General actions to reduce the effects of flooding include: widening and deepening the canals, cleaning of existing ditches, replacing existing culverts, upgrading pumps, installing check valves and inverts in certain culverts. Maintaining and improving drainage serves to assist the communities with problems experienced from floods, high winds, and severe storms.

Erosion Mitigation Actions
With a clear understanding of the erosion hazard, communities can work towards preventing future damages. Some mitigating measures are:

- **Educational Outreach:** develop and conduct educational outreach programs on the effects of coastal erosion as well as on how to minimize future erosion.

- **Erosion Zone Studies**: conduct detailed studies to identify erosion hazard zones and provide direction for future coastal development.

- **Erosion Control / Bank Stabilization:** detailed studies of eroded or erosion-prone areas can provide direction for ways to slow down erosion rates or to otherwise provide for bank stabilization.

- **Beach Restoration** projects can also be undertaken as a means to mitigate this hazard, when erosion occurs in shoreline or beachfront areas.

C.3 POTENTIAL FUNDING SOURCES

The Federal Emergency Management Agency (FEMA) administers the National Flood Insurance Program (NFIP), and the Unified Hazard Mitigation Assistance (UHMA) grant program. The UHMA includes the Flood Mitigation Assistance Program (FMA), the Hazard Mitigation Grant Program (HMGP), the Pre-Disaster Mitigation Program (PDM), Repetitive Flood Claims (RFC) and the Severe Repetitive Loss (SRL) grants. All of these programs are administered by VITEMA.

The following is a tabular summary, followed by a more detailed description of programs that are the primary source of federal funding of hazard mitigation projects and activities in the USVI. All of the programs listed below are current or potential sources funding for mitigation projects to address Severe Repetitive Loss properties and concerns.

TABLE C.4 ***Federally Funded Mitigation Programs***

Program	Type of Assistance	Availability	Funding Source
National Flood Insurance Program (NFIP)	Pre-disaster flood insurance	Any time (pre and post disaster)	National Flood Insurance Program
Flood Mitigation Assistance Program (FMA)	Cost share grants for pre-disaster planning and flood projects	Annual pre-disaster grant program	FEMA
Hazard Mitigation Grant Program (HMGP)	Post-disaster cost share grants	Post disaster grant program	FEMA
Pre-Disaster Mitigation Program (PDM)	Pre disaster mitigation grants	Annual pre-disaster grant program	FEMA
Public Assistance	Post-disaster aid to state and local governments	Post disaster	FEMA
Community Development Block Grant- Disaster Recovery Funding (CDBG-DR)	Post disaster aid to state and local governments	Post disaster	U.S. Department of Housing and Urban Development

The following paragraphs provide additional details regarding these Federal mitigation funding opportunities. Each of these programs is a potential funding source for projects to advance VITEMA's SRL strategy.

National Flood Insurance Program

The National Flood Insurance Program (NFIP), established by Congress in 1968, provides flood insurance to property owners in participating communities. This program is a direct agreement between the federal government and the Territory that flood insurance will be made available to residents in exchange for community compliance with minimum floodplain management requirements. Since the typical property insurance policy does not cover flooding, the Territory's participation in the NFIP is vital to protecting property in the floodplain as well as ensuring that federally backed mortgages and loans can be used to finance property within the floodplain.

Pursuant to the Flood Disaster Protection Act of 1973, many forms of federal financial assistance, including disaster assistance and federally regulated loans, related to structures located in the Special Flood Hazard Area (SFHA) are contingent on the purchase of flood insurance. Such federal assistance includes not only direct aid from agencies, but also from federally insured lending institutions. In order for property owners to be eligible for purchasing flood insurance through the federal government, their respective community must be participating in good standing in the NFIP.

Communities participating in the NFIP must:

. Adopt the Flood Insurance Rate Maps as an overlay regulatory district or through another enforceable measure.
. Require that all new construction or substantial improvements to existing structures in the flood hazard area will be compliant with the construction standards of the NFIP and adopted building code.
. Require additional design techniques to minimize flood damage for structures being built in high hazard areas, such as floodways or velocity zones.

Flood Mitigation Assistance Program (FMA)

Authorized by the National Flood Insurance Reform Act of 1994 (42 USC 4101, the Flood Mitigation Assistance (FMA) program was created with the goal of reducing or eliminating claims under the National Flood Insurance Program (NFIP).

FEMA provides FMA funds in the form of a grant to assist the Territory in the implementation of measures that reduce or eliminate the long-term risk of damage to buildings and structures insured under the NFIP. Three types of grants are available to the Territory:

- **Planning Grants** to prepare Flood Mitigation Plans. Only NFIP-participating communities with approved Flood Mitigation Plans can apply for FMA Project grants
- **Project Grants** to implement measures to reduce flood losses, such as elevation, acquisition, or relocation of NFIP-insured structures. Applicants are encouraged to prioritize FMA funds for applications that include repetitive loss properties; these include structures with 2 or more losses each with a claim of at least $1,000 within any ten-year period since 1978.
- **Management Cost Grants** for the Territory to help administer the FMA program and activities. Up to ten percent (10%) of Project grants may be awarded for Management Cost Grants

Flood hazard mitigation plans, approved by the Territory and FEMA, are a pre-requisite for receiving FMA project grants. FEMA provides a federal share of up to 75% of the cost of the plan or project while the remaining 25% must come from a non-federal funding source.

FMA is funded through an annual federal appropriation. In Fiscal Year 2010 (FY-10), approximately $32,308,500 was allocated to FMA nationwide. . Previous fiscal years have seen FMA allocations ranging from $28,000,000 to $35,700.000 nationwide.

Some statutory limits exist on the amount of FMA funding a State may receive[1]:

- The total amount of FMA funds provided during any 5-year period shall not exceed $10 million to any State agency or $3.3 million to any community.
- The total amount of FMA funds provided to any State, including all communities located in the State, shall not exceed $20 million during any 5-year period.
- Individual planning grants using FMA funds shall not exceed $150,000 to any Applicant or $50,000 to any sub-applicant. FMA funds only can be used for the flood hazard component of a hazard mitigation plan that meets the planning criteria outlined in 44 CFR Part 201.
- The total planning grant using FMA funds made in any fiscal year to any State and the communities located within the State shall not exceed $300,000.
- No more than 7.5 percent of FMA funds shall be used for planning in any fiscal year.
- A planning grant shall not be awarded to an applicant or sub-applicant more than once every 5 years.

Applicants for FMA funding must submit their applications through the e-Grants system during the application window, as established by the *HMA Unified Guidance.* For FMA, FEMA will conduct a National Technical Review, for all project sub-applications that are forwarded from the initial FEMA review, for the following:

- Cost effectiveness;
- Engineering feasibility and effectiveness; and
- Environmental and Historic Preservation compliance.

Hazard Mitigation Grant Program (HMGP)

Unlike the other HMA programs, HMGP is not a nationwide competitive program. Established pursuant to Section 404 of the Stafford Disaster Relief and Emergency Relief Act (PL 100-707), this program provides matching grants (75% Federal, 25% non Federal) for FEMA-approved hazard mitigation projects following a Presidential Disaster Declaration. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from

[1] Note: FEMA may waive the above limits when a major flood-related disaster or emergency is declared pursuant to the Stafford Act.

a disaster. Eligible State, Territorial, local and tribal governments, as well as some non-profit organizations, may apply for the funding. Individual citizens are not eligible to apply, though eligible entities may apply on their behalf.

HMGP is not funded annually. The amount of funding available varies from disaster to disaster. The formula is based on the estimated aggregate grant funding under the Stafford Act assistance programs (Public Assistance, Individual Assistance, and Disaster Unemployment Assistance). The Territory is allocated a percentage of the estimated funding for use as HMGP funds. States and Territories with Standard Mitigation Plans, such as Rhode Island, are allocated the following:

15 % of the first $2,000,000,000
10% of the next $10,000,000,000
7.5% of any amount over $10,000,000,000

For States and Territories with a Standard Mitigation Plan, the total allocation for HMGP cannot exceed $35,333,000,000.

States and Territories with an Enhanced Mitigation Plan are eligible to receive an amount not to exceed 20% of the estimated aggregate grant funding.

The grants are specifically directed toward reducing future hazard losses, and can be used for projects protecting property and other resources against the damaging effects of floods, hurricanes, earthquakes, high winds, and other natural hazards.

Since the creation of the HMA program, significant changes have been made to the program guidance that guides the HMGP. The following illustrates the program guidance for HMGP in recent years:

- For disasters declared prior to 06-01-09, the 1999 *HMGP Desk Reference* is the applicable guidance.
- For disasters declared on or after 06-01-09 and prior to 06-01-10, the *FY-10 HMA Unified Guidance* is the applicable guidance.
- For disasters declared on or after 06-01-10, the *FY-11 HMA Unified Guidance* is the applicable guidance.

In addition to these changes, FEMA also implemented guidance specific to property acquisition projects. FEMA codified Part 80, *Property Acquisition and Relocation for Open Space,* into 44 CFR; the new part became effective for all disasters declared on or after 12-03-07.

Pre-Disaster Mitigation Competitive (PDM) Program

The Pre-Disaster Mitigation (PDM) Program was authorized by §203 of the Robert T. Stafford Disaster Assistance and Emergency Relief Act (Stafford Act), 42 US.C. Chapter 68, as amended by § 1 02 of the Disaster Mitigation Act of 2000. Funding for the program is provided by annual appropriation through the

National Pre-Disaster Mitigation Fund to assist States, Territories, Indian Tribal Governments, communities and universities in implementing cost effective hazard mitigation activities that complement a comprehensive mitigation program. All applicants must be participating and in good standing in the National Flood Insurance Program (NFIP) if they have been identified through the NFIP as having a Special Flood Hazard Area.

44 CFR Part 201, *Hazard Mitigation Planning*, establishes criteria for State, Territorial and local hazard mitigation planning authorized by §322 of the Stafford Act, as amended by §104 of the DMA 2000. After November 1, 2004, states and territories are required to have an approved mitigation plan in order to receive PDM funds for State or Territorial mitigation projects. Therefore, the development and maintenance of State or Territorial mitigation plans is critical to maintaining eligibility for future PDM funding.

Funding these plans and projects reduces overall risks to the population and structures, while also reducing reliance on funding from actual disaster declarations. PDM grants are awarded on a competitive basis and without reference to state allocations, quotas, or other formula-based allocation of funds.

PDM is a part of FEMA HMA Program, and is guided by the *HMA Unified Guidance* for the applicable fiscal year.

The State or Territory (also called the Applicant) submits the prioritized applications to their FEMA Regional Office. Applications will be initially reviewed by FEMA to ensure all minimum requirements are met for the PDM program. FEMA provides additional ranking points for all eligible mitigation planning and project sub-applications on the basis of predetermined, objective, quantitative factors to calculate a final National Ranking Score for each sub-application.
The table below provides the 2011 National Ranking Factors.

National Ranking Factors and Point Values	**Plans**	**Projects**
The priority given to the sub-application by the Applicant in their PDM grant application.	40%	40%
Assessment of frequency and severity of hazards.	20%	NA
Whether the Applicant has a FEMA-approved Enhanced State / Tribal Mitigation Plan by the application deadline.	20%	20%
Community mitigation factors such as Community Rating System class, Cooperating Technical Partner, participation as a FireWise Community, and adoption and enforcement of codes including the International Code Series and National fire Protection Association 5000 Code, as measured by the Building Code Effectiveness Grading Schedule.	10%	10%
The percent of the population benefitting, which equals the number of individuals directly benefiting divided by the community population.	NA	10%
Whether the project protects critical facilities.	NA	10%
Status of the local sub-applicant as a small and impoverished community.	10%	10%
TOTAL POINT VALUES	100%	100%

Project and plan applications that are selected for further review are sent for final review by the National Evaluation Panel. These are panels composed of representatives from FEMA, State, Territories, local governments, federally recognized Indian Tribal governments, and other Federal agencies who peer evaluate project and planning sub-applications on the basis of qualitative factors. (Note: Project applications and Plan applications have differing factors, which can be found here: http://www.fema.gov/government/grant/pdm/index.shtm.)

PDM, unlike other HMA programs, is a nationwide, competitive program. While there is no set limit on how much funding a single State, Territory or community may receive, there are restrictions in place, which are as follows:

- Up to $800,000 Federal share may be requested in a sub-application for a planning grant to develop a new hazard mitigation plan.
- Up to $400,000 Federal share may be requested in a sub-application for a planning grant to update a hazard mitigation plan.
- Up to $3 million Federal share may be requested in a sub-application to implement a mitigation project.
- The cumulative Federal award for sub-applications awarded during a single application cycle to any one Applicant shall not exceed 15 percent of the total appropriated PDM program funds for that application cycle.

The amount of funding allocated for PDM fluctuates from year to year:

FY-10	$100,000,000
FY-09	$ 90,000,000
FY-08	$114,000,000
FY-07	$100,000,000
FY-06	$ 50,000,000

Public Assistance Program (Section 406 Mitigation)

The objective of the Federal Emergency Management Agency's (FEMA) Public Assistance (PA) Grant Program is to provide assistance to State, Territorial, Tribal and local governments, and certain types of private non-profit organizations so that communities can quickly respond to and recover from major disasters or emergencies declared by the President.

Through the PA Program, FEMA provides supplemental Federal disaster grant assistance for debris removal, emergency protective measures, and the repair, replacement, or restoration of disaster-damaged, publicly owned facilities and the facilities of certain private non-profit (PNP) organizations. The PA Program also encourages protection of these damaged facilities from future events by providing assistance for hazard mitigation measures during the recovery process.

The Federal share of assistance is not less than 75% of the eligible cost for emergency measures and permanent restoration. The grantee (usually the Territory) determines how the non-Federal share (up to 25%) is split with the sub-grantees (eligible applicants).

After a natural or man-made event that causes extensive damage, FEMA coordinates with the Territory to implement the Public Assistance Grant Program. The funding process consists of the following steps:

- Preliminary Damage Assessment (PDA)
- Presidential Disaster Declaration
- Applicants' Briefing by Grantee
- Submission of Request for Public Assistance by Applicant
- Kick-off Meeting with Public Assistance Coordinator (PAC)
- Project Formulation and Cost Estimating
- Project Review and Validation
- Obligation of Federal Funds and Disbursement to Sub-grantees
- Appeals and Closeout

The Public Assistance (PA) Program is administered through a coordinated effort between the Federal Emergency Management Agency (FEMA), the Territory (grantee), and the applicants (sub-grantees).

The Robert T. Stafford Disaster Relief and Emergency Assistance Act provides FEMA the authority to fund the restoration of eligible facilities that have sustained damage due to a Presidentially declared disaster. Commonly called Section 406 Mitigation, this program provides some mitigation funding within the context of the Public Assistance Program.

Section 406 Mitigation provides discretionary authority to fund mitigation measures in conjunction with the repair of the disaster-damaged facilities. These opportunities usually present themselves during the repair efforts. The mitigation measures must be related to eligible disaster-related damages and must directly reduce the potential of future, similar disaster damages to the eligible facility. Normally, this work is performed on the parts of the facility that were actually damaged by the disaster. In some instances, an eligible mitigation measure may not be an integral part of the damaged facility.

There is no pre-set limit to the amount of Section 406 funds a community may receive. Section 406 Mitigation measures must be determined to be cost effective. Any one of the following means may be used to determine cost-effectiveness:

1. Mitigation measures may amount to up to 15% of the total eligible cost of the eligible repair work on a particular project.
2. Certain mitigation measures have been determined to be cost effective, as long as the mitigation measure does not exceed 100% of the eligible cost of the eligible repair work on the project.
3. For measures that exceed the above costs, the Grantee or sub-grantee must demonstrate through an acceptable benefit/cost analysis methodology that the measure is cost effective.

C.4 REPETITIVE LOSS PROPERTIES MITIGATION STRATEGIES

This sub-section provides specific mitigation strategy recommendations and suggestions for the VITEMA- and DPNR-identified repetitive loss areas throughout the Territory. A discussion of the area suffering repetitive flood damage is included, to provide a basis for the recommendations and suggestions.

In lieu of property-specific information from FEMA, this strategy was prepared based on local knowledge regarding areas of repetitive flood loss. Staff members from the Department of Permitting and Natural Resources (DPNR) Permitting Department and VITEMA were consulted, and a list of areas or neighborhoods known to be affected by repetitive flood loss was prepared. Each of these areas was then visited and assessed, in preparation for the development of this strategy.

It must be noted that the following strategies are recommendations only. No site-specific engineering or design has been conducted, nor has a detailed hydrology and hydraulic study been prepared. Prior to implementation of any of these recommendations, detailed engineering and analysis must occur.

For an overview of the areas designated as repetitive loss through this methodology, please refer to Table D-3.

Area-Specific Repetitive Loss Mitigation Strategies – St. Thomas

Charlotte Amalie: Main Street Area
This area is located in the heart of Charlotte Amalie, and is primarily comprised of commercial structures. Many of these structures are historic. The primary source of flooding is storm surge, though storm water runoff issues do exist. The runoff issues result from debris and/or inadequate drainage, in the form of undersized guts. The area has also been known to flood during exceptionally high tide events. During storm surge events, the flooding occurs, on average, inland as far as two streets back from the waterfront. The buildings in the area are predominantly slab on grade construction with little structure elevation for flood protection.

To mitigate this repetitive loss area, the following strategies (individually or in conjunction with one another) are recommended for consideration:

- Public education, outreach, and technical assistance to residents and builders, to develop and implement sound water management practices
- Wet flood-proofing of existing structures
- Dry flood-proofing of historic structures
- Drainage improvements

Turpentine Run Area
This mostly commercial area is located outside of Charlotte Amalie. Flooding occurs due to inadequate drainage from storm water runoff, usually from overtopping of a large gut along the roadway. When the gut overflows, the road and businesses suffer flood damage. The structures in the area date mostly to 1990s; none are considered historically significant. While other access points to the area do exist, the road that floods is the main thoroughfare.

To mitigate this repetitive loss area, the following strategies (individually or in conjunction with one another) are recommended for consideration:

- Public education, outreach, and technical assistance to residents and builders, to develop and implement sound water management practices

- Elevation of existing structures
- Wet flood-proofing of existing structures
- Drainage improvements

Nadir Area

This residential area is home to 70-80 single family structures, primarily consisting of slab on grade construction. Shallow, roadside guts provide the only drainage for storm water runoff, which is the source of flooding in this area.

To mitigate this repetitive loss area, the following strategies (individually or in conjunction with one another) are recommended for consideration:

- Public education, outreach, and technical assistance to residents and builders, to develop and implement sound water management practices
- Acquisition and relocation/demolition of existing structures, and conversion of the property to open space
- Elevation of existing structures
- Wet flood-proofing of existing structures
- Drainage improvements

Bovoni Area

The residential community of Thomasville, in the Bovoni area, has storm water runoff issues similar to those found in the Nadir area. Though the Bovoni/Thomasville area is a bit hillier, the same inadequate drainage – comprised of shallow, roadside guts – is found in this neighborhood of 50-60 single family structures and an apartment community. Though the apartment community has been known to experience flooding, the single family structures were identified as the repetitive loss area.

To mitigate this repetitive loss area, the following strategies (individually or in conjunction with one another) are recommended for consideration:

- Public education, outreach, and technical assistance to residents and builders, to develop and implement sound water management practices
- Acquisition and relocation/demolition of existing structures, and conversion of the property to open space
- Elevation of existing structures
- Wet flood-proofing of existing structures
- Drainage improvements

Bolongo Bay Area

This residential area is found in rather hilly terrain. The source of flooding for this area is storm water runoff, which results in frequent flooding of the roadway. One single family residential structure, located close to the road, is especially prone to flooding. Storm water runoff flows down the hill and along the road, resulting in too great of a flow for the small gut along the roadway to effectively contain.

To mitigate this repetitive loss area, the following strategies (individually or in conjunction with one another) are recommended for consideration:

- Public education, outreach, and technical assistance to residents and builders, to develop and implement sound water management practices

- Acquisition and relocation/demolition of existing structures, and conversion of the property to open space
- Elevation of existing structures
- Wet flood-proofing of existing structures
- Drainage improvements

Smith Bay Area

This area is comprised of mixed use structures, with the primary flooding concern being for the residential structures. The entire area is flood-prone, as the small, inconsistent gut along the roadway provides insufficient drainage for storm water runoff, resulting in channeling of runoff along the roadway. The structures of particular concern are the 10-15 houses that are sited lower than the roadway, and are especially prone to flooding.

To mitigate this repetitive loss area, the following strategies (individually or in conjunction with one another) are recommended for consideration:

- Public education, outreach, and technical assistance to residents and builders, to develop and implement sound water management practices
- Acquisition and relocation/demolition of existing structures, and conversion of the property to open space
- Elevation of existing structures
- Wet flood-proofing of existing structures
- Drainage improvements

St. Peter/Northside Village Area:

In this hilly, residential area, there is a single family structure that is known to have suffered repetitive flood losses. A small gut along the road provides only drainage for storm water runoff, and is inadequate to contain the flow of water. Floodwaters spill out of the gut and cross the road, rushing over/under the guardrail and inundating the structure.

To mitigate this repetitive loss area, the following strategies (individually or in conjunction with one another) are recommended for consideration:

- Public education, outreach, and technical assistance to residents and builders, to develop and implement sound water management practices
- Acquisition and relocation/demolition of existing structures, and conversion of the property to open space
- Wet flood-proofing of existing structures
- Drainage improvements

Area-Specific Repetitive Loss Mitigation Strategies – St. Croix

Gallows Bay/Spring Valley Area

This mixed use area is comprised of residential structures on top of the hills and commercial properties below the houses. The source of flooding in the area is storm water runoff, with sheet flow occurring down the hill. The flow typically channels through the street, and often enters the open sewer system under the street, leading to contamination issues. Due to the relative flatness of the road, flood waters typically stand for a day, disrupting passage and access to the ferry. In addition, new bypass highway is being constructed; this new highway will also use the existing drainage system.

To mitigate this repetitive loss area, the following strategy is recommended for consideration:

- Public education, outreach, and technical assistance to residents and builders, to develop and implement sound water management practices
- Drainage improvements

La Grand Princess Area

This residential area has long-standing flooding issues, dating back more than 30 years. Development of the 200-300 affected homes this area was completed prior to the development of many areas upstream. Many of the structures in the area are of slab on grade construction, though some have been elevated for flood protection. Due to inadequate drainage for storm water runoff, flood waters funnel down the road to the beach. Throughout the area, structures bear visible signs of repetitive high water, with evident high water marks on structures. Many of the homes were built on filled foundations. In particular, one structure, located next to a gut, has experienced repetitive flooding so often that the house now has evident structural issues, including cracking of walls and foundation.

In addition, the area experiences storm surge flooding during tropical storm and hurricane events. In particular, the Hibiscus Hotel, a beachfront property, has made several insurance claims in the last few years, with damages resulting from storm surge. It should be noted that there are no dunes on the beach to provide flood protection, though a small sea wall (approximately 6' high) was constructed at edge of property.

To mitigate this repetitive loss area, the following strategies (individually or in conjunction with one another) are recommended for consideration:

- Public education, outreach, and technical assistance to residents and builders, to develop and implement sound water management practices
- Acquisition and relocation/demolition of existing structures, and conversion of the property to open space
- Elevation of existing structures
- Wet flood-proofing of existing structures
- Drainage improvements

Sion Hill Area

This area is mixed use, but is largely comprised of residential structures. A major gut exists in the area, which provides drainage for storm water runoff. The road is higher than the gut, which results in flooding of the gut. Previous attempts to correct the issue have resulted in increased flooding. Some residents have erected small flood barriers around their property (often attached to fences around the property), causing increased flooding downstream. In previous flood events, water has moved throughout the area with enough force to dislodge a septic system.

To mitigate this repetitive loss area, the following strategies (individually or in conjunction with one another) are recommended for consideration:

- Public education, outreach, and technical assistance to residents and builders, to develop and implement sound water management practices
- Acquisition and relocation/demolition of existing structures, and conversion of the property to open space
- Elevation of existing structures
- Wet flood-proofing of existing structures

- Drainage improvements

Estate Castle Area

This residential area experiences major flooding from a development upstream, and is often saturated with storm water runoff. Many of the approximately 100 homes in the area were constructed below grade. The area is prone to standing water in the road, as evidenced by the large and numerous potholes. Just to the east of the area are several acres of impervious surface, which results in a fast moving sheet flow of flood waters. Property owners and residents have been trapped in their houses and/or had no access to egress. A retention pond was placed in the area to alleviate some of the drainage issues, but – due to poor maintenance - it was eventually filled in with sediment and is now a small animal farm. Residents of the area have indicated previously that they wanted the drainage issues in the area resolved, but that they were unwilling to give up any private property to easements for drainage improvements.

To mitigate this repetitive loss area, the following strategies (individually or in conjunction with one another) are recommended for consideration:

- Public education, outreach, and technical assistance to residents and builders, to develop and implement sound water management practices
- Acquisition and relocation/demolition of existing structures, and conversion of the property to open space
- Elevation of existing structures
- Wet flood-proofing of existing structures
- Drainage improvements

Estate Barron Spots Area (including Strawberry Estate, Strawberry Hill, and Estate La Reine)

This large residential area, which is home to several hundred houses in each development, experiences significant storm water runoff flooding from multiple channels upstream, which are compressed into a single channel downstream, leading to sheet flow and fast moving water in the area. A single culvert exists downstream, which is obviously undersized. It must be noted that more permits are issued in this general area than anywhere else on the island, and that the primary foundation type in the area is slab on grade. Many structures in the area bear evidence of repeated flooding via visible high water marks.

To mitigate this repetitive loss area, the following strategies (individually or in conjunction with one another) are recommended for consideration:

- Public education, outreach, and technical assistance to residents and builders, to develop and implement sound water management practices
- Acquisition and relocation/demolition of existing structures, and conversion of the property to open space
- Elevation of existing structures
- Wet flood-proofing of existing structures
- Drainage improvements

Mon Bijou Area

This residential area experiences significant flooding resulting from channelization of storm water runoff into the natural gut, which routinely results in flows that exceed the capacity of the natural gut. This has led to serious erosion of the gut, and resulted in severe foundation damage and drifting of structural elements of the residential structures that are in the area. Visible evidence exists of shifted or destabilized retaining walls and concrete driveways. As the erosion progresses, the damage to structures will likely continue. Approximately 8-10 homes are affected and most are believed to be uninsured.

To mitigate this repetitive loss area, the following strategies (individually or in conjunction with one another) are recommended for consideration:

- Public education, outreach, and technical assistance to residents and builders, to develop and implement sound water management practices
- Acquisition and relocation/demolition of existing structures, and conversion of the property to open space
- Erosion control /Bank stabilization of the gut
- Drainage improvements

Lorraine Village Apartments Area

This residential housing complex consists of apartment homes of a split level design and some single family residences. Flood waters have entered several units throughout the complex. A drainage gut runs through the complex, crossing paved areas, and often overflows due to inadequate drainage and capacity. This overflowing has resulted in significant erosion of the area around the gut; one single family structure is in jeopardy of eventually falling into the gut due to foundation destabilization.

To mitigate this repetitive loss area, the following strategies (individually or in conjunction with one another) are recommended for consideration:

- Public education, outreach, and technical assistance to residents and builders, to develop and implement sound water management practices
- Acquisition and relocation/demolition of existing structures, and conversion of the property to open space
- Wet flood-proofing of existing structures
- Erosion control /Bank stabilization of the gut
- Drainage improvements

William's Delight Area

This large residential area is home to more than 300 single family structures, and has experienced significant flooding for many years. The primary cause of flooding is undersized or inadequate drainage of storm water runoff in the area. A significant drainage project has been underway in the area for several years. The project seeks to install underground drainage piping to direct storm water runoff to the gut; the project has been partially completed. As a part of the project, the roadway surfaces were removed, leaving unpaved roads throughout the neighborhood. Funding is currently being sought to repave the roadways and to finish the drainage project.

To mitigate this repetitive loss area, the following strategies (individually or in conjunction with one another) are recommended for consideration:

- Public education, outreach, and technical assistance to residents and builders, to develop and implement sound water management practices
- Acquisition and relocation/demolition of existing structures, and conversion of the property to open space
- Wet flood-proofing of existing structures
- Elevation of existing structures
- Drainage improvements

Frederiksted Area

This historical, mixed use district contains buildings and drainage dating to the 1700s. Most buildings are elevated, windows to modern base flood elevations, and have been so since their original construction. The existing storm water and surge drainage system (which is also original to the area) would be sufficient for the area if not for impervious surfaces and increased runoff from upstream. Improvements to drainage upstream would likely alleviate storm water runoff flooding in the area.

To mitigate this repetitive loss area, the following strategies (individually or in conjunction with one another) are recommended for consideration:

- Public education, outreach, and technical assistance to residents and builders, to develop and implement sound water management practices
- Drainage improvements (upstream)

Area-Specific Repetitive Loss Mitigation Strategies – St. John

Cruz Bay / Enighed Pond Area

This mixed use area is located in an area subject primarily to storm surge inundation, though some storm water runoff issues do exist. Repetitive flooding of a critical facility (electrical substation) has occurred, as well as repetitive flooding of roads and recreation areas.

To mitigate this repetitive loss area, the following strategies (individually or in conjunction with one another) are recommended for consideration:

- Public education, outreach, and technical assistance to residents and builders, to develop and implement sound water management practices
- Acquisition and relocation/demolition of existing structures, and conversion of the property to open space
- Wet flood-proofing of existing structures
- Elevation of existing structures
- Drainage improvements

Coral Bay Area

This mixed use area is located in an area subject primarily to storm surge inundation, though some storm water runoff issues do exist. The area is prone to debris and washouts from flooding, and experiences significant runoff and erosion as a result of insufficient storm water management.

To mitigate this repetitive loss area, the following strategies (individually or in conjunction with one another) are recommended for consideration:

- Public education, outreach, and technical assistance to residents and builders, to develop and implement sound water management practices
- Acquisition and relocation/demolition of existing structures, and conversion of the property to open space
- Wet flood-proofing of existing structures
- Elevation of existing structures
- Drainage improvements

C.5 SUMMARY OF REPETITIVE LOSS PROPERTIES MITIGATION STRATEGY

Two primary sources of flooding exist in the US Virgin Islands – storm surge inundation and inland flooding. As an island territory, storm surge inundation will continue to be a flooding source for the built environment on all three islands. Mitigation of storm surge inundation should be considered in terms of both individual structures and area drainage systems. Flooding includes both coastal flooding and inland flooding; the later often associated with inadequate storm drain systems.

Any drainage improvements should take careful consideration of both the upstream and downstream effects, and should incorporate the natural drainage and floodplain patterns of the island wherever possible. Significant drainage improvements in the identified areas would have the potential to alleviate a significant portion of the existing storm water runoff and storm surge inundation flooding concerns.

Changes to FEMA hazard mitigation grant program since the last Plan Update include the elimination of the Severe Repetitive and Repetitive Loss Claim grant programs. To encourage efforts by states and local jurisdictions to reduce repetitive loss damages, FEMA has reduced the cost share requirement for HMA grant funding if the action directly reduces repetitive losses. In this Plan Update, VITEMA has emphasized administrative, planning, and hazard mitigation actions that will help achieve a reduction of repetitive losses throughout the Territory.

Although the Flood Mitigation Assistance (FMA) grant program is the most closely related to reducing the number of repetitive loss properties, the Repetitive Loss Strategy presents a number of FEMA and other funding sources that should be considered to provide hazard mitigation funds. There are very few severe repetitive loss properties in the USVI; hence, the major effort should be focused on repetitive loss properties, currently estimated at 225 properties.

APPENDIX D MITIGATION ACTION ASSESSMENT MATRIX: REVIEW OF 2011 MITIGATION ACTIONS

REVIEW OF 2011 PROGRAMMATIC ACTIONS

Action	Description	Action Completed	Action Removed	Action Remains Valid	Comment
USVI-1	VITEMA to work with DPW to focus annual budget and priorities to remove built up sediment, debris and maintain natural guts, roadside ditches, drainage channels and storm drains in areas that are designated in this Plan as Repetitive Loss Mitigation Strategy (RLMS area).			X	
USVI-2	Publicize the availability of print material on hazard data and hazard mitigation tools to professional associations, interest groups, and the private sector.		X		VITEMA staff reductions and resource constraints necessitate removing this action over the next Plan Update cycle
USVI-3	Strengthen partnerships with the Office of the Governor and media to disseminate information to the general public on hazard mitigation programs and importance of reducing number of USVI repetitive loss properties			X	
USVI-3	Distribute and require the use of maps that were developed as part of the flood insurance study that delineate natural drainageways (guts) that exceed a specified cross-section or flow in cubic feet per second to appropriate DPNR and DPW staff responsible for development review or engineering design of flood drainage improvement works to prevent encroachment of new development or alteration of natural guts unless necessary for the correction of existing flooding problems.			X	
USVI-6	Construct a database management program and develop procedures to collect information on and to track **repetitive loss** properties in the Territory.			X	
USVI-7	Define and implement arrangements for the collection of data on **Landslides** that can affect the Territory, including information on location (maps), history, and probability of			X	USVI-7, USVI-8, and USVI-9 were combined into one programmatic action in the 2014 Plan Update

Action	Description	Action Completed	Action Removed	Action Remains Valid	Comment
	hazard events.				
USVI-8	Define and implement arrangements for the collection of data on the **Wildfire** that can affect the Territory, including information on location (maps), history, and probability of hazard events.		X		See above
USVI-10	Define and implement arrangements for the collection of data on **Drought** that can affect the Territory, including information on location (maps), history, and probability of hazard events.		X		See above
USVI-11	Construct a database management program and develop procedures to track mitigation project progress and effectiveness from project award to project completion so as to provide a record on the aggregate actual costs avoided of implemented mitigation projects in the territory.			X	
USVI-12	Conduct follow-up activities to engage members of hazard mitigation committees in an annual review of planning and implementation activities under their agency's responsibility		X		Removed because this action was considered in the 2014 Plan Update as a necessary part of program implementation, not requiring a specific mitigation action (see discussion in Section 6 Plan Maintenance).
USVI-5	Develop conceptual retrofit or relocation mitigation projects, including preliminary cost estimates, for retrofitting or relocating essential infrastructure and critical facilities that can be undertaken following a future disaster event (primarily hazard mitigation funding sources – PDMC, HMGP,etc.).		X		Removed in the 2014 Plan Update due to VITEMA staff and resource constraints.
USVI-4	Develop worksheets for Government agency facility managers to gather relevant information necessary to support applications to seek federal hazard mitigation funding where appropriate.		X		Mitigation action removed because considered standard operating procedure for VITEMA not requiring a specific mitigation action.

REVIEW OF 2011 ISLAND SPECIFIC ACTIONS, ST. THOMAS

Action	Description	Action Completed	Action Removed	Action Remains Valid	Comment
STT-23	Installation of High Impact Hurricane windows at the Department of Public Works (HMGP-1807).	X			
STT-22	Installation of High Impact Hurricane windows at the Department of Property and Procurement (HMGP-1807).	X			
STT-24	Installation of High Impact Hurricane windows at the Department of Education (HMGP-1807).	X			
STT-25	Installation of High Impact Hurricane windows at the Department of Human Services (HMGP-1807).	X			
STT-8	Construct drainage improvements on Turpentine Run (Brookman Road) to alleviate localized flooding.			X	
STT-9	Construct drainage improvements to improve the capacity of the drainage system by Yvonne Bowsky Elementary School (Peace Corp) to alleviate localized flooding.			X	
STT-10	Construct drainage improvements to improve the capacity, and clean, the storm water drainage system in Frydenhoj (next to and across from ball field) to alleviate localized flooding and damage of private property.			X	
STT-17	Resolve flooding problems at Subbase Entrance. Pursue Phase II drainage improvements which include the installation of properly-sized culverts from Bellows across Veterans Drive to connect to Phase I drainage improvements.			X	

STT-6	Construct drainage improvements on Rt. 30 adjacent to Bolongo Bay to alleviate flooding to residential areas and beach erosion.			X	
STT-13	Enlarge box culverts, stormdrains, and improvements to open channels from Veterans Drive to the Bay along the east edge of Frenchtown in southwest Charlotte Amalie (Frenchtown Drainage East), in order to resolve flooding, traffic access and business interruption, by providing 100-year flood protection.	X			
STT-11	Pursue the acquisition of land for the relocation of the Downtown Fire Station that is susceptible to storm surges and tsunami.		X		Current USVI Territory financial issues necessitate removing this action for the upcoming Plan Update cycle.
STT-7	Construct drainage improvements for major drainage channel that conveys flood waters from the surrounding Altona and Anna's Fancy areas to resolve recurrent flooding after heavy rainfall events.			X	
STT-12	Expand and reinforce communication infrastructure that is being implemented by BIT to mitigate damages from hurricanes to ensure rapid recovery and return to normal service.			X	
STT-21	Replace and improve drainage infrastructure at Food Center in order to resolve flooding of roads, businesses, while addressing potential secondary impacts to wetlands.			X	
STT-3	Pursue road reconstruction and drainage improvements to resolve recurrent shallow flooding on Radets Gade from Main Street to Veterans Drive that affect businesses.	X			
STT-1	Construct Lindberg Estates, Phase IV Drainage Project north through Kirwin Terrace Public Housing Units.			X	

STT-14	Implement drainage improvements to resolve the flooding problems at Coki Point and Smith Bay Roads, and, improvements to open channels draining through the Resort Complex into Water Bay (Smith Bay Basin) to resolve localized flooding problems that periodically close roads, create traffic hazards, prevent emergency vehicle and public access, and cause damage to adjacent businesses and road pavement.			X	Modified in the 2014 Plan Update to include a hydrological study to identify potential sub-basin mitigation measures.
STT-15	Construct drainage improvements to secondary road that provides access to Caret Bay West. Improvements could include paving and/or providing proper roadside drainage and properly-sized culverts where appropriate to carry stormwater across the road to minimize erosion of the road surface.			X	
STT-5	Improve drainage infrastructure along Rt. 30 Estate Hope / Fortuna to eliminate flooding of nearby residences in Fortuna 3C Subdivision.			X	
STT-18	Complete Installation of Hurricane Shutters at main police station in Charlotte Amalie.			X	
STT-19	Improve drainage infrastructure along Hospital Gade from Antonio Jarvis School to the Police Station on Verteran's Drive, paying particular attention to the intersection of Hospital and Kongens Gade (Moravian Church and Zoras).			X	
STT-20	Replace and improve drainage infrastructure along Rt. 33 (Estate Dorethea).			X	
STT-2	Pursue road reconstruction and drainage improvements to resolve recurrent flooding on Commandant Gade Gut (Garden Street) from Bunker Hill to Veterans Drive that affect businesses and emergency access.			X	

STT-4	Pursue road reconstruction and drainage improvements to resolve recurrent shallow flooding on Storre Tvaer Gade from Main Street to Veterans Drive that affect businesses.	X			
STT-16	Harden WAPA Substations. Design and construction of hardened switchgear buildings at the East End and Tutu Substations.			X	

REVIEW OF 2011 ISLAND SPECIFIC ACTIONS, ST. CROIX

Action	Description	Action Completed	Action Removed	Action Remains Valid	Comment
STX-17	Install storm shutters at the American Red Cross (HMGP-1807).	X			
STX-18	Install storm shutters Emile Henderson, Sr. Fire Station (HMGP-1807).	X			
STX-19	Install Roll-Up Doors at the Rencelier I. Gibbs Fire Station (HMGP-1807).	X			
STX 21	Install Fabric Shutter system at Henry E. Rohlsen Airport (HMGP-1807).	X			
STX-20	Implement and improve storm water drainage infrastructure to relieve flooding at the Alfredo Andrews School and adjacent low-lying areas.			X	
STX-10	Resolve flooding problems and improve storm water drainage infrastructure in the "Grove at La Reine".			X	
STX-9	Conduct a hydrological study of the St. Croix watersheds with particular attention given to the La Grange, Prosperity, Bethlehem and Salt River watershed basins. Attention should focus on upgrading inadequate drainage systems focused on reducing the impact of flooding.			X	
STX-3	Perform assessment of flooding problems within La Grande Princess Estate. Approximately 50 of 250 NFIP-insured losses in St. Croix (one in five repetitive losses) occur in La Grande Princess. Eighty two properties were identified as being in the 100 year flood plain and the potential for acquisition, structural solutions, and nonstructural control measures to reduce repetitive losses to residences should be assessed.			X	
STX-15	Improve Recovery Hill Water Storage Tanks. Install wind girders to reinforce against hurricane storm winds.			X	
STX-7	Improve drainage system to along Melvin H. Evans Highway in the area west of Williams Delight Stop Light and Carlton. Extend drainage system to connect with drainage			X	

Action	Description	Action Completed	Action Removed	Action Remains Valid	Comment
	improvements in Williams Delight Community.				
STX-14	Conduct feasibility study and implement and provide emergency power generator units for all pumping stations on St. Croix.			X	
STX-4	Conduct a hydrological study of the Christiansted watershed or catchment area with particular attention given to the sub-watersheds of Spring Gut and Water Gut to determine technically feasible and cost effective structural solutions to address the flooding problem in Christiansted.			X	
STX-5	Resolve flooding problems and improve stormwater drainage infrastructure for "Spring Gut" all the way to Gallows Bay.			X	
STX-6	Resolve flooding problems and improve stormwater drainage infrastructure for Tide Village by implementing a low water crossing to divert surface run-off into the natural gut.			X	
STX-11	Pursue equipment anchoring program for the Richmond Electrical Generating Plant. Anchor critical equipment in the Plant to mitigate damages caused by earthquake, hurricane-strength winds, tsunami and storm surge.			X	
STX-16	Improve Various Water Storage Tanks throughout the island. Install flexible connectors at multiple water storage tanks to permit pipe flexibility during earthquake events and ensure rapid recovery and normal service.			X	
STX-1	Pursue Christiansted Gut USACE Section 205 Project. Preliminary feasibility phase currently underway by the Corps to determine whether technically feasible and cost effective solutions exist to reduce flood damages in residential and business areas adjacent to King Cross Street.			X	
STX-8	Construct a retention pond at the property line of White Bay and the National Park Service reserve within the localized depression.			X	

Action	Description	Action Completed	Action Removed	Action Remains Valid	Comment
STX-12	Construct drainage improvements at the Ricardo Richards Elementary School at Estate Barren Spot near Melvin H. Evans Highway (Route 66).			X	
STX-13	Improve Water Distribution Pump Stations at Concordia and Adventure.			X	
STX-2	Perform assessment of adjacent drainage basins that flow into Estate Williams Delight to identify alternate routing of surface runoff.			X	Modified in the 2014 Plan Update to include consideration of a stormwater detention pond below Blue Mountain.

REVIEW OF 2011 ISLAND SPECIFIC ACTIONS, ST. JOHN

Action	Description	Action Completed	Action Removed	Action Remains Valid	Comment
STJ-10	Install Storm shutters at the DeCastro Health Clinic (HMGP 1807)	X			
STJ-11	Conduct a hydrological study of Coral Bay watershed to propose technically feasible and cost-effective solutions to flooding problems in Coral Bay.			X	
STJ -12	Clean Gut at Westin Hotel	X			
STJ-6	Provide an alternate power generation substation for Coral Bay to ensure that there is power source or all public services and critical facilities on the east end of the island.			X	
STJ-5	Increase fuel capacity of the Myra Keating Health Clinic Emergency power generator unit.			X	
STJ-1	Construct drainage improvements to eliminate localized flooding at the lower end of "Carolina Gut" at Little Plantation (Across from Dominos Gas Station) where natural storm flows in the catchment area have been altered by construction and improper siting of structures.			X	
STJ-2	Construct drainage improvements to eliminate localized flooding at Pond Mouth at intersection of Rt. 102 and Rt. 105.			X	
STJ-4	Implementing a slope stabilization program to reduce damage and blockage of roads during wind storm and flooding events. A program establishment of more stable and cut and fill slopes, removal of material that may be subject to landslide and rock fall events, re-vegetation, of disturbed slopes, etc. Area of concern: Bordeaux Mountain Road and Centerline Road (Between Mile 6 and Mile 7 and (Between Reef Bay and Mile 5)) that periodically closes the road during major storm events.			X	

Action	Description	Action Completed	Action Removed	Action Remains Valid	Comment
STJ-9	Construct underground feeders from the St. John substation to various termination points within Cruz Bay to mitigate damages to hurricane winds and ensure rapid recovery and return to normal service.			X	
STJ-7	Improve drainage infrastructure (Box Culverts) at WAPA building and treatment plant, while addressing potential secondary impacts to wetlands.			X	
STJ-3	Construct drainage improvements to eliminate localized flooding along Route 20 southbound in Coral Bay (Estate Carolina).			X	
STJ-8	Coordinate with the National Park Service for the construction of appropriate drainage system improvements to eliminate localized flooding along Route Rt. 20 in Maho Bay.			X	

Hazard – type of hazard
Name – name of facility
Facility Type – type of facility
Damage Ratio – percentage of losses expected based on the defined hazard event used in t he risk assessment
Loss to Structure – estimated economic losses to the facility based on the risk assessment.
Prominent Vulnerability – General characteristics that add to a buildings vulnerability to a certain hazard. These may include:

- Well defined building types (fall into categories).
- Individual structures have been seen and scored; damage curves are adjusted by score.
- Most structures are on predominantly flat land or gently sloping ground.
- Facilities are well maintained.
- Hazard level and exposure value for each individual structure is unique.

ST. THOMAS

Hazard	Name	Facility Type	Damage Ratio	Loss to Structure	Prominent Vulnerability
Earthquake	DOE Complex	Government Building	1.00	$14,191,260	UNREINFORCED MASONRY
	Ivanna Eudora Kean High School	School	1.00	$34,755,137	UNREINFORCED MASONRY
	Office of Management and Budget	Government Building	1.00	$2,851,242	UNREINFORCED MASONRY
	West Indian Corporation Dock	Port	1.00	$2,660,861	UNREINFORCED MASONRY
	St Thomas Assemblies of God Church	Refuge	1.00	$2,458,636	UNREINFORCED MASONRY
	Tutu Fire Station - Lima	Fire Station	1.00	$2,431,318	UNREINFORCED MASONRY
	Department of Public Works	Government Building	1.00	$2,270,602	UNREINFORCED MASONRY
	VI Fire Service (Ft. Christian)	Fire Station	1.00	$1,862,603	UNREINFORCED MASONRY
	Government House	Government Building	1.00	$10,608,539	UNREINFORCED MASONRY
	Lt. Governors House	Government Building	1.00	$8,592,916	UNREINFORCED MASONRY
	Crime Prevention/Community Relations Bureau	Police Station	0.99	$422,345	UNREINFORCED MASONRY

Hazard	Name	Facility Type	Damage Ratio	Loss to Structure	Prominent Vulnerability
	Zone A Police station	Police Station	0.99	$9,227,794	UNREINFORCED MASONRY
	Queen Louise home	Hospital/Clinic	0.95	$1,037,116	UNREINFORCED MASONRY
	Property Procurement	Government Building	0.94	$6,689,467	UNREINFORCED MASONRY
	VI Legislature	Government Building	0.94	$5,058,909	UNREINFORCED MASONRY
	WAPA Administration Building	Government Building	0.90	$6,425,784	UNREINFORCED MASONRY
	Bluewater Bible College	Refuge	0.86	$21,090,525	UNREINFORCED MASONRY
	WAPA Fuel Tanks	Utility	0.83	$6,458,179	Not to Code
	Chief of Police	Police Station	0.83	$1,126,875	UNREINFORCED MASONRY
	WAPA Subbase Plant	Power Stations	0.81	$24,452,797	Highly Irregular
	Sea View Nursing Home	Hospital/Clinic	0.80	$3,494,714	Precode on Slope
	Charlotte Amalie High School	School	0.79	$40,034,670	Precode and Irregular
	Lucinda Millin Home for the Elderly	Hospital/Clinic	0.71	$7,253,342	Precode
	Fire/Police Station	Fire Station	0.66	$437,602	Trailer w/o foundation
	Mangrove Lagoon Treatment Plant	Utility	0.65	$35,571,087	Irregular or on slope
	East End Health Clinic	Hospital/Clinic	0.63	$370,891	Located in re-entrant corner of building
	Bovoni	Utility	0.63	$727,901	Irregular, precode
	Public Safety - Zone C	Police Station	0.62	$254,951	Precode on corner of building
	WAPA	Utility	0.61	$236,049	Precode
Hurricane	WAPA Administration Building	Government Building	0.94	$6,729,478	Poor Condition, 3 Story Wood Frame
	Property Procurement	Government Building	0.94	$6,729,478	Poor Condition, 3 Story wood frame
	Bassanio David Police Dept.	Police Station	0.81	$401,546	Precode
	VI Fire Service (Ft. Christian)	Fire Station	0.78	$1,445,724	Precode
	Crime Prevention/Community Relations Bureau	Police Station	0.75	$317,578	Precode

Hazard	Name	Facility Type	Damage Ratio	Loss to Structure	Prominent Vulnerability
	Department of Public Works	Government Building	0.73	$1,652,556	Near debris generation source
	VI Legislature	Government Building	0.72	$3,906,915	On Water's edge, precode foundation
	Bluewater Bible College	Refuge	0.72	$17,681,827	Large surface area on steep slope
	DOE Complex	Government Building	0.71	$10,078,012	Precode
	Nisky Moravian Church	Refuge	0.71	$3,469,564	Large surface area with precode walls
	Office of Management and Budget	Government Building	0.70	$1,990,205	Precode walls
	Government House	Government Building	0.69	$7,300,025	Precode walls
	Lt. Governors House	Government Building	0.69	$5,913,020	Precode walls
	St Thomas Assemblies of God Church	Refuge	0.68	$1,670,461	Precode walls
	West Indian Corporation Dock	Port	0.68	$1,797,130	On Water's edge, precode foundation
	Tutu Fire Station - Lima	Fire Station	0.67	$1,617,592	Precode walls
	Ivana Eudora Keah High School	School	0.65	$22,702,759	Large exposed area on hillside
	Queen Louise home	Hospital/Clinic	0.64	$699,474	Precode walls
	Sea View Nursing Home	Hospital/Clinic	0.62	$2,696,569	Large exposed area on hillside
	Zone A Police station	Police Station	0.59	$5,508,291	Precode walls
River Flood Losses	Lt. Governors House	Government Building	0.98	$8,448,766	Precode walls
	Property Procurement	Government Building	0.98	$7,009,347	Precode walls
	Tutu Fire Station - Lima	Fire Station	0.95	$2,309,752	Drains to building
	Queen Louise home	Hospital/Clinic	0.95	$1,038,091	Precode walls
	Crime Prevention/Community Relations Bureau	Police Station	0.95	$404,451	Poor drainage
	DOE Complex	Government Building	0.85	$12,062,571	Vulnerable utilities, poor drainage
	VI Legislature	Government Building	0.85	$4,597,649	Precode walls
	Office of Management and Budget	Government Building	0.85	$2,423,555	Precode walls

Hazard	Name	Facility Type	Damage Ratio	Loss to Structure	Prominent Vulnerability
	VI Fire Service (Ft. Christian)	Fire Station	0.82	$1,527,334	Precode walls
	Chief of Police	Police Station	0.80	$1,092,727	Precode walls
	VI National Guard	Government Building	0.70	$7,258,221	Poor drainage
	Human Services (food)	Government Building	0.70	$645,702	Precode foundation
	Public Safety - Zone C	Police Station	0.65	$267,623	Poor drainage
	Mangrove Lagoon Treatment Plant	Utility	0.65	$35,513,628	Poor drainage
	Bovoni	Utility	0.65	$749,476	Poor drainage
	Charlotte Amalie High School	School	0.60	$30,260,132	Poor drainage
Tsunami	DOE Complex	Government Building	1.00	$14,675,325	Too close to shore
	Mangrove Lagoon Treatment Plant	Utility	1.00	$50,850,000	Too close to shore
	AA Farley Justice Center	Government Building	1.00	$44,025,974	Too close to shore
	AA Farley Justice Center	Police Station	1.00	$2,948,498	Too close to shore
	WAPA Subbase Plant	Power Stations	1.00	$49,720,000	Too close to shore
	Lucinda Millin Home for the Elderly	Hospital/Clinic	1.00	$10,566,234	Too close to shore
	WAPA Administration Building	Government Building	1.00	$7,396,364	Too close to shore
	Property Procurement	Government Building	1.00	$7,396,364	Too close to shore
	VI Port Authority (Blyden Dock)	Port	1.00	$6,420,455	Too close to shore
	VI Legislature	Government Building	1.00	$5,593,500	Too close to shore
	Office of Management and Budget	Government Building	1.00	$2,948,498	Too close to shore
	West Indian Corporation Dock	Port	1.00	$2,751,623	Too close to shore
	VI Fire Service (Ft. Christian)	Fire Station	1.00	$1,926,136	Too close to shore
	Bovoni	Utility	1.00	$1,192,370	Too close to shore
	Crown Bay Dock (VIPA)	Port	1.00	$963,068	Too close to shore

Hazard	Name	Facility Type	Damage Ratio	Loss to Structure	Prominent Vulnerability
	Crime Prevention/Community Relations Bureau	Police Station	1.00	$440,260	Too close to shore
	Human Services (food)	Government Building	1.00	$953,896	Too close to shore
	WAPA Fuel Tanks	Utility	1.00		Too close to shore
	WAPA	Utility	1.00	$399,536	Too close to shore
	Ivana Eudora Keah High School	School	1.00	$35,940,638	Too close to shore
	Charlotte Amalie High School	School	1.00	$52,153,846	Too close to shore
	Edward Wilmoth Blyden Marine Terminal	Port	1.00	$15,368,000	Too close to shore
	VI National Guard	Government Building	1.00	$10,722,570	Too close to shore
	Airport	Airport	1.00	$22,012,987	Too close to shore
Landslide					
	Sea View Nursing Home	Refuge	0.5	$ 1,257,125.00	Moderately Susceptible to Landslide
	Bluewater Bible College	Refuge	0.75	$ 3,390,000.00	Large surface area on steep slope
	St Thomas Assemblies of God Church	Refuge	0.75	$ 894,277.50	Precode walls
Wildfire				$ -	
	Bluewater Bible College	Refuge	0.4	$10,125,974.00	Large surface area on steep slope
	St Thomas Assemblies of God Church	Refuge	0.4	$ 1,017,000.00	Precode walls
	Charlotte Amalie High School	School	0.6	$21,564,382.80	Susceptible to wildfire
	Ivanna Eudora Kean	School	0.6	$31,292,307.60	Susceptible to wildfire
	Bovoni		0.6	$ -	Susceptible to wildfire (source)
	Wapa	Fuel Tank	0.6	$ -	Susceptible to wildfire (source)

ST. CROIX

Hazard	Facility Name	Facility Type	Damage Ratio	Loss to Structure	Prominent Vulnerability
Earthquake	Governor's Office	Government Building	1.00	$29,976,482	UNREINFORCED MASONRY
	Alexander Henderson Elementary School	School	1.00	$15,682,818	UNREINFORCED MASONRY
	Office of the Lt. Governor	Government Building	1.00	$15,565,166	UNREINFORCED MASONRY
	Alfredo Andrews Elementary School	School	1.00	$15,445,199	UNREINFORCED MASONRY
	Bethlehem Houses	Refuge	1.00	$983,454	UNREINFORCED MASONRY
	Property and Procurement	Government Building	0.99	$2,331,344	UNREINFORCED MASONRY
	Captain Charles A Seales Fire Station	Fire Station	0.99	$1,598,928	UNREINFORCED MASONRY
	Chief Herbert L Canegata Fire Station	Fire Station	0.99	$2,425,492	UNREINFORCED MASONRY
	Captain Renceliaz J Cribbs Fire Station	Fire Station	0.99	$1,775,081	UNREINFORCED MASONRY
	National Guard Headquarters	Government Building	0.91	$8,387,871	UNREINFORCED MASONRY
	Charles Harwood Clinic	Hospitals/Clinic	0.91	$45,115,267	UNREINFORCED MASONRY
	Claude O Markae School	School	0.91	$12,210,038	UNREINFORCED MASONRY
	Ricardo Richards Elementary School	School	0.85	$5,650,428	UNREINFORCED MASONRY
	Juanita Gardin Elementary School	School	0.83	$4,217,395	UNREINFORCED MASONRY
	Department of Public Works	Government Building	0.79	$3,254,783	Irregular precode
	Water Tanks	Utility	0.76	$6,754,600	Precode
	Patrick Sweeney Police Station	Police Station	0.76	$7,718,635	Irregular precode
	Water Treatment Plant	Utility	0.71	$34,978,919	Highly Irregular
	WAPA Water and Power Plant	Power Stations	0.71	$34,978,919	Highly Irregular
	Fire Dept. HQ	Fire Station	0.65	$139,902	Precode
	Queen Louise Home for Children	School	0.63	$4,474,377	Precode
	Department of Public Works and Human Services	Government Building	0.62	$14,024,314	Precode

Hazard	Facility Name	Facility Type	Damage Ratio	Loss to Structure	Prominent Vulnerability
	Wastewater Treatment Plant	Utility	0.61	$13,352,279	Precode
	Police Station/DPNR	Police Station	0.60	$16,366,176	Precode
Hurricane	Property and Procurement	Government Building	0.84	$1,982,790	Precode walls
	Alexander Henderson Elementary School	School	0.81	$12,646,967	Precode
	Ricardo Richards Elementary School	School	0.80	$5,282,843	Precode
	Office of the Lt. Governor	Government Building	0.77	$11,942,026	Precode
	Captain Charles A Seales Fire Station	Fire Station	0.77	$1,234,788	Precode
	Charles Harwood Clinic	Hospitals/Clinic	0.76	$37,396,182	Precode
	Claude O Markae School	School	0.73	$9,860,208	Precode
	Red Cross	Refuge	0.73	$1,889,251	Precode
	Chief Herbert L Canegata Fire Station	Fire Station	0.70	$1,717,859	Precode
	Juanita Gardin Elementary School	School	0.70	$3,566,114	Precode
	Governor's Office	Government Building	0.70	$20,996,786	Precode
	Captain Renceliaz J Cribbs Fire Station	Fire Station	0.69	$1,233,759	Precode
	Alfredo Andrews Elementary School	School	0.68	$10,431,597	Precode
	Bethlehem Houses	Refuge	0.67	$659,263	Precode
	National Guard Headquarters	Government Building	0.65	$5,948,421	Precode
River Flood Losses	Governor's Office	Government Building	0.98	$29,376,952	On drainage path
	Ricardo Richards Elementary School	School	0.98	$6,510,905	Poor drainage
	Lagoon Street Complex	Government Building	0.65	$2,312,258	Poor drainage
	Ann Schrader Comand Police Station	Police Station	0.65	$676,193	Poor drainage
Coastal Flood Losses	Lagoon Street Complex	Government Building	0.90	$3,186,392	Poor Drainage
Tsunami	Henry E Pochlsen Airport	Airport	1.00	$56,500,000	Too close to shore
	Ingerborg Nesbitt Clinic	Hospitals/Clinic	1.00	$23,002,838	Too close to shore
	Wastewater Treatment Plant	Utility	1.00	$22,600,000	Too close to shore
	Ann E Abramson Pier	Dock	1.00	$3,955,000	Too close to shore
	Lagoon Street Complex	Government Building	1.00	$3,661,200	Too close to shore

Hazard	Facility Name	Facility Type	Damage Ratio	Loss to Structure	Prominent Vulnerability
	Crallows Bay Warf	Dock	1.00	$2,260,000	Too close to shore
	Gordon A Finch Molasses Pier	Dock	1.00	$1,695,000	Too close to shore
	Frederiksted Fisherman's Pier	Dock	1.00	$113,000	Too close to shore
	Sewage Pumps	Utility	0.57	$14,308,442	Too close to shore
	Water Pumps	Utility	0.38	$56,959	Too close to shore
	Water Tanks	Utility	0.17	$1,526,961	Too close to shore
	Queen Louise Home for Children	School	1.00	$7,290,701	Too close to shore
	Herbert Griggs Home for the Aged	Refuge	1.00	$8,910,857	Too close to shore
	WAPA Water and Power Plant	Power Stations	1.00	$50,850,000	Too close to shore
	WAPA	Government Building	1.00	$3,260,564	Too close to shore
	Governor's Office	Government Building	1.00	$30,998,982	Too close to shore
	Office of the Lt. Governor	Government Building	1.00	$16,096,095	Too close to shore
	Property and Procurement	Government Building	1.00	$2,430,234	Too close to shore
	National Guard Headquarters	Government Building	1.00	$9,504,914	Too close to shore
	Emile Henderson Fire Station	Fire Station	1.00	$2,810,875	Too close to shore
	Chief Herbert L Canegata Fire Station	Fire Station	1.00	$2,528,375	Too close to shore
	Captain Charles A Seales Fire Station	Fire Station	1.00	$1,666,750	Too close to shore
	Captain Renceliaz J Cribbs Fire Station	Fire Station	1.00	$1,850,375	Too close to shore
	Container Port	Dock	1.00	$1,695,000	Too close to shore
Wildfire					
	Patrick Sweeny Police Station		0.6	$ 6,318,607.80	In a susceptible area
	Anna's Hope Detention Center	Government	0.5	$ 9,164,300.00	In a susceptible area
	Captain Renceliar Cribbs Fire Station	Fire	0.4	$ 740,150.00	In a susceptible area
	Charles Harword Clinic	Hospital	0.6	$30,729,078.60	In a susceptible area

Hazard	Facility Name	Facility Type	Damage Ratio	Loss to Structure	Prominent Vulnerability
	Juan Luis Hospital	Hospital	0.4	$23,590,144.00	In a susceptible area
	Herbert Griggs Home for Aging	Refuge	0.6	$ 5,346,514.20	In a susceptible area
	Bethlehem House	Refuge	0.4	$ 406,800.00	In a susceptible area
	Red Cross	Shelter	0.4	$ 1,069,302.80	In a susceptible area
	Ricardo Richards School	School	0.4	$ 2,748,160.00	In a susceptible area
	Alfredo Andrews School	School	0.4	$ 6,388,814.40	In a susceptible area
	Charles Emmanuel School	School	0.5	$ 9,583,222.00	In a susceptible area
	Alexander Henderson	School	0.5	$ 4,587,800.00	In a susceptible area
	Queen Louise Home	Refuge/Special needs	0.5	$ 31,640.00	In a susceptible area
	OMB	Government	0.4	$ 6,487,104.00	In a susceptible area
	DPW	Government	0.4	$ 2,105,958.40	In a susceptible area

ST. JOHN

Hazard	Facility Name	Facility Type	Damage Ratio	Loss to Structure	Prominent Vulnerability
Earthquake	Emmaus Roman Catholic Church	Refuge	1.00	$8,991,582	UNREINFORCED MASONRY
	Morris F de Castro Clinic	Hospital/Clinic	1.00	$1,965,376	UNREINFORCED MASONRY
	Zulu Company Fire Station	Fire Station	1.00	$936,623	UNREINFORCED MASONRY
	Department of Human Services	Government Building	0.99	$2,081,316	UNREINFORCED MASONRY
	Guy Benjamin Elentary School	School	0.99	$16,234,265	UNREINFORCED MASONRY
	Julius Sprague Elementary School	School	0.91	$9,701,993	UNREINFORCED MASONRY
	Administrator's Offices	Government Building	0.90	$2,036,915	Irregular precode
	Potable Water Tank	Utility	0.79	$52,447	On steep slope
	WAPA Administration/Power Plant	Power Station	0.76	$11,263,992	Precode
	PD Motor Vehicles Inspection Station	Police Station	0.74	$610,979	Precode
	WAPA Water Tank	Utility	0.70	$819,376	Precode
	Bethany Moravian Church	Refuge	0.67	$6,884,427	Irregular precode
	Sewage Treatment Plant	Utility	0.61	$16,597,797	Irregular
	Seventh Day Adventist Church	Refuge	0.59	$1,986,158	On steep slope
Hurricane	Morris F de Castro Clinic	Hospital/Clinic	0.82	$1,608,693	Precode
	Zulu Company Fire Station	Fire Station	0.79	$741,153	Precode
	Julius Sprague Elementary School	School	0.73	$7,770,070	Lots of debris
	Guy Benjamin Elentary School	School	0.72	$11,794,841	Precode
	PD Motor Vehicles Inspection Station	Police Station	0.72	$596,988	Precode
	Emmaus Roman Catholic Church	Refuge	0.71	$6,407,265	Precode walls

	Department of Human Services	Government Building	0.68	$1,417,001	Large roof spans
River Flood	Emmaus Roman Catholic Church	Refuge	0.98	8,811,750.53	Precode walls
	Julius Sprague Elementary School	School	0.98	10,454,388.11	Poor drainage
	National Park Service/ARC	Government Building	0.65	5,285,162.08	Poor drainage
	Sewage Treatment Plant	Utility	0.65	17,756,813.75	Poor drainage
	Police Department	Police Station	0.60	1,958,713.15	Poor drainage
Coastal Flood	National Park Service/ARC	Government Building	0.90	$7,283,182	Too close to shore
	WAPA Water Tank	Utility	0.88	$1,035,756	Precode
	Sewage Treatment Plant	Utility	0.85	$23,220,449	Low mean elevation
	WAPA Administration/Power Plant	Power Station	0.80	$11,801,452	Low mean elevation
Tsunami 2014	WAPA Administration/Power Plant	Power Station	1.00	$15,255,000	Too close to shore
	Julius Sprague Elementary School	School	1.00	$11,031,620	Too close to shore
	National Park Service/ARC	Government Building	1.00	$8,368,457	Too close to shore
	WAPA Desalinization Plant	Utility	1.00	$3,293,143	Too close to shore
	Administrator's Offices	Government Building	1.00	$2,350,764	Too close to shore
	Department of Human Services	Government Building	1.00	$2,169,600	Too close to shore
	WAPA Water Tank	Utility	1.00	$1,217,143	Too close to shore
	Zulu Company Fire Station	Fire Station	1.00	$968,571	Too close to shore
	PD Motor Vehicles Inspection Station	Police Station	1.00	$856,540	Too close to shore
	Port	Pier	1.00	$2,825,000	Too close to shore
	Sewage Treatment Plant	Utility	1.00	$28,250,000	Too close to shore
	Emmaus Roman Catholic Church	Refuge	1.00	$9,298,286	Too close to shore

	Police Department	Police Station	1.00	$3,375,875	Too close to shore
	VITEMA/DPW	Emergency Response	1.00	$5,036,571	Too close to shore
Wildfire	Police Inspection		0.6	$519324	In a susceptible area
	Seventh day Adventist Church	Refuge	0.6	$2092114	In a susceptible area
	Depart of Human Services	Government	0.6	$1301760	In a susceptible area
	WAPA Administration	Government	0.6	$9153000	In a susceptible area

A range of mitigation actions were presented to the Island Hazard Mitigation Committees for consideration in implementing the goals and objectives. The actions may be added or subtracted as this Plan evolves, taking into account the effectiveness of chosen actions, their completion, or in response to the changing vulnerabilities found in the USVI.

PROGRAMMATIC ACTIONS

Prevention

Preventative activities are intended to keep hazard-related problems from getting worse. They are particularly effective in reducing a community's vulnerability, especially in areas where development has not occurred or capital improvements have not been substantial. Many of the programmatic mitigation actions proposed for implementation at the Territorial level are preventative activities. Examples of preventative activities include:

- Planning and zoning
- Open space preservation
- Stormwater management
- Drainage system maintenance
- Capital improvements programming
- Coastal and riverine setbacks

Public Information and Awareness

Public information and awareness activities are used to advise residents, business owners, potential property buyers and visitors about hazards, hazardous areas and mitigation actions they can use to protect themselves and their property. Examples of measures to educate and inform the public include:

- Outreach
- Speaker series/demonstration events
- Hazard map information
- Real estate disclosure
- Education
- Training

PROJECTS

Emergency Services

Although not typically considered a "mitigation action," emergency services minimize the impact of a hazard event on people and property. These actions are typically taken immediately prior to, during, or in response to a hazard event. Examples include:

- Search and rescue
- Evacuation planning and management
- Flood "fighting" methods (i.e., sandbagging, use of temporary flood walls, etc.)
- Warning systems

- Emergency Operation Center (EOC)
- Retrofitting critical facilities to better withstand disaster events

Natural Resource Protection

Natural resource protection activities reduce the impact of hazards by preserving or restoring the function of environmental systems such as floodplains and wetlands. In many cases, environmentally sensitive areas are also high hazard areas. Thus, natural resource protection can serve the dual purpose of protecting lives and property while enhancing environmental goals such as improved water quality or enhancing recreational opportunities. Parks, recreation or conservation agencies and organizations often implement these measures. Examples include:

- Floodplain protection
- Riparian buffers (establishing no disturbance, no development zoning setbacks along streams, rivers or coastline)
- Fire resistant landscaping
- Erosion and sediment controls
- Wetland preservation and restoration
- Habitat preservation and restoration
- Slope stabilization

Property Protection

Property protection “hardens” existing structures to better withstand hazard events, remove them from hazard prone areas, or provide insurance to cover potential losses. A number of the Island specific mitigation actions proposed in the Plan are considered property protection, especially critical facilities retrofit projects. Examples include:

- Acquisition
- Relocation
- Building Elevation
- Critical facilities protection or “hardening”
- Insurance
- Retrofitting (i.e., windproofing, floodproffing, seismic retrofits)

Structural Projects

Structural mitigation projects are intended to lessen the impact of a hazard by physically modifying the environment. They are usually designed by engineers and managed or maintained by public works staff. Many of the Island specific mitigation actions proposed in the Plan are structural projects. Examples include:

- Flood control reservoirs
- Levees/dikes/floodwalls
- Storm water management ponds
- Channel modification
- Storm drains and culverts

APPENDIX G TERRITORIAL AND ISLAND SPECIFIC MITIGATION ACTION PLAN

Appendix I of the Plan Update presents the programmatic and island-specific actions in a matrix format that depicts the prioritization and strategic planning conducted necessary to lead to effective implementation.

The evaluation technique use a weighted **STAPLEE** scoring formula described below:

Social; the mitigation strategy must be socially acceptable.

- **S** high (3); moderate (2); low (1); and neutral or unknown (0)

Technical; the proposed action must be technically feasible.

- **T** feasible (1); not applicable or unknown (0)

Administrative; the community must have the capability to implement the action (for example, the logical lead agency must be capable of carrying out oversight of the project).

- **A** existing capability (3); training needed (2); staff needed (1); NA

Political; mitigation actions must be politically acceptable.

- **P** high (3); moderate (2); low (1); NA or neutral (0)

Legal; the community must currently have the authority to implement the proposed measure.

- **L** yes (1); no (0)

Economic; economic considerations must include the present economic base, projected growth and opportunity costs.

- **E** weighted at high (6); moderate (4); low (2); neutral or unknown (0)

Environmental; the impact on the environment must be considered because of statutory considerations and the public's desire for sustainable and environmentally healthy communities.

- **E** high adverse (-3); moderate (-2); minor (-1); NA or unknown (0); and beneficial (2)

A separate matrix is provided for each programmatic or island-specific action that includes the following information:

- Description of the mitigation action,
- Potential for Loss Reduction Rating,
- Priority ranking,
- The goal and objective that the action is intended to achieve,
- The specific hazard the action is intended to achieve (or all hazard),
- Responsible agency, department or division,
- Projected timeframe, Short Term (1-2 years), Medium Term (3-5 years), and Long Term (6-10 years)
- Projected resources,
- Comments on rationale for action, contribution to goal, or other comment, and
- STAPLEE criteria evaluation, by individual criterion and total score.

TERRITORIAL MITIGATION ACTION PLAN: PROGRAMMATIC ACTIONS

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority
USVI-1	VITEMA collaborates with DPW to prioritize annual budget and action plans to remove built up sediment, debris and maintain natural guts, roadside ditches, drainage channels and storm drains in areas that are designated in this Plan as **Repetitive Loss Strategy (RLS)** designated areas.	Goal 1, Objective 1.1	H	1
Hazard	Flood			
Lead Agency	DPW			
Projected Timeframe	Annual activity			
Comments	VITEMA meets annually with DPW to assist in prioritizing work activities to maintain natural guts			
Projected resources	USVI line item			

S	T	A	P	L	E	E	Score
3	1	3	2	1	4	2	16

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority
USVI-2	Seek FMA funding for a planning study to map of **severe repetitive loss and repetitive loss properties**, conduct limited fieldwork, and evaluate hazard mitigation measures that would cost-effectively address clustered repetitive loss properties.	Goal 1, Objective 1.1	H	2
Hazard	Flood			
Lead Agency	VITEMA			
Projected Timeframe	Medium Term			
Comments	This planning and evaluation study involves mapping repetitive losses, determining clusters of repetitive losses and evaluating a range of alternatives to reduce the number of repetitive losses on all three islands.			
Projected resources	FMA			

S	T	A	P	L	E	E	Score
3	1	3	3	1	4	0	15

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority
USVI -3	Strengthen partnerships with the Office of the Governor and media to disseminate information to the general public on hazard mitigation programs and importance of reducing number of **USVI repetitive loss properties.**	Goal 1, Objective1.2	M	9
Hazard	All Hazards			
Lead Agency	VITEMA			
Projected Timeframe	Short Term			
Comments	This action seeks to develop an outreach program to provide the community hazard mitigation educational materials, including those on the NFIP, Community Rating System, as well as repetitive loss properties. These outreach activities will educate citizens on the impact of repetitive loss properties in their communities and flood insurance premiums.			
Projected resources	USVI Operating Budget, PDM			

S	T	A	P	L	E	E	Score
3	1	1	2	1	2	2	12

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority
USVI-4	Conduct **watershed planning study** based on a hydrological and hydraulic (H&H) model that would provide the quantitative basis for assessing flood mitigation measures on basin and sub-basin level. The H&H modeling can be used to determine best management solutions for **RLS designated areas** and to build resilience in communities and reduce economic losses. This phased project would begin with St. Croix.	Goal 1, Objective 1.1	H	3
Hazard	Flood			
Lead Agency	VITEMA			
Projected Timeframe	Three year phased project; one year for each island			
Comments	Having a flexible hydrologic model and using a standardized set of basins and sub-basins will provide a consistent baseline of hydrology for all three islands and can then be used to evaluate mitigation actions and future development proposals in a systematic and uniform fashion over time.			
Projected resources	FMA			

S	T	A	P	L	E	E	Score
2	1	2	2	1	4	0	12

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority
USVI-5	VITEMA will establish relationships in the steady-state (pre-disaster) timeframe with **US HUD and US DOC** and other representatives of primary Federal agency partners of **NDRF Recovery Support Functions** that could facilitate recovery with technical assistance and potential funding in future post-disaster conditions.	Goal 4, Objective 4.2	L	4
Hazard	All Hazards			
Lead Agency	VITEMA			
Projected Timeframe	Short Term			
Comments	The implementation of the National Disaster Recovery Plan (NDRP) establishes clear roles for primary and support Federal agencies in disaster recovery. US HUD and US DOC will play a greater role in short and long-term recovery in future Presidentially-declared disasters. VITEMA should establish roles with key agency representations during the steady-state time, in order to reach out more effectively to those agencies in post-disaster scenarios.			
Projected resources	USWI Operating Budget			

S	T	A	P	L	E	E	Score
3	1	3	3	1	6	0	17

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority
US Virgin Islands-6	Construct a database management program and develop procedures to collect information on and to track **repetitive loss** properties in the Territory.	Goal 4, Objective 4.1	H	5
Hazard	Flood			
Lead Agency	VITEMA			
Projected Timeframe	Short Term (one year) to develop database then annual updates going forward			
Comments	This action seeks to gather important information for the implementation of island specific actions focused on minimizing losses in high priority repetitive loss properties. This action will help with the implementation of the specific projects but will also facilitate more accurate reporting on the total number of repetitive loss properties targeted or retrofitted by the Territory.			
Projected resources	USVI Operating Budget, PDM			

S	T	A	P	L	E	E	Score
2	1	1	1	1	2	2	10

Action	Description			Goal/Objective	Potential for Loss Reduction	Priority	
US Virgin Islands-7	Define and implement arrangements for the collection of data on **Landslides, Wildfire, and Drought** that can affect the Territory, including information on location (maps), history, and probability of hazard events.			Goal 4, Objective 4.1	M	6	
Hazard	All Hazards						
Lead Agency	DPW, VITEMA						
Projected Timeframe	Medium Term for defining tracking methodology and researching past events, then annual updates going forward						
Comments	The collection of hazard data, especially data related to hazard identified in the Plan, is vital on developing more accurate vulnerability and risk assessments, especially when considering climate change variability. This 2014 mitigation action combines several actions first introduced in the 2011 Plan Update.						
Projected resources	USVI Operating Budget						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
2	1	1	2	1	4	2	13

Action	Description			Goal/Objective	Potential for Loss Reduction	Priority	
USVI-8	Construct a **database management program** and develop procedures to track mitigation project progress and effectiveness from project award to project completion so as to provide a record on the aggregate actual costs avoided of implemented mitigation projects in the territory.			Goal 4, Objective 4.3	M	10	
Hazard	All Hazards						
Lead Agency	VITEMA						
Projected Timeframe	Medium Term to develop database and then annual updates going forward						
Comments	This action will help VITEMA to track mitigation projects over time and assist in demonstrating improvement in management of FMEA grants						
Projected resources	USVI Operating Budget						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
2	1	2	2	1	4	0	12

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority
USVI-9	Update the multi-hazard risk assessment to incorporate **climate change models** into the hazard and vulnerability analysis.	Goal 3, Objective 3.1	L	8
Hazard	Landslide, flood, coastal flooding, drought, wildfire, hurricane			
Lead Agency	VITEMA			
Projected Timeframe	Medium Term			
Comments	This project will utilize regional climate change models in refining the hazard identification and risk assessment, so that climate change variability can be better incorporated into the next update of the hazard mitigation strategy.			
Projected resources	PDM, HMGP			

S	T	A	P	L	E	E	Score
3	1	2	3	1	4	2	16

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority
USVI-10	Develop or update Territorial **Debris Management Plan,** including identification of potential satellite locations for collecting and segregating building and woody debris, white goods, and hazardous materials.	Goal 4, Objective 4.1	L	7
Hazard	All Hazards			
Lead Agency	VITEMA			
Projected Timeframe	Medium Term			
Comments				
Projected resources	PDM, HMGP			

S	T	A	P	L	E	E	Score
3	1	3	2	1	2	2	14

ST. THOMAS PRIORITIZED MITIGATION ACTIONS

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority			
STT-1	Construct drainage improvements on Turpentine Run (Brookman Road) to alleviate localized flooding.	Goal 3, Objective 3.2	H	5			
Hazard	Flood						
Lead Agency	DPW						
Projected Timeframe	Short Term						
Comments	Committee ranked this stormwater improvement project as being very important for STT						
Projected Resource	PDM, HMGP						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
3	1	1	3	1	6	-1	14

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority			
STT-2	Construct drainage improvements to improve the capacity of the drainage system by Yvonne Bowsky Elementary School (Peace Corp) to alleviate localized flooding.	Goal 3, Objective 3.2	H	6			
Hazard	Flood						
Lead Agency	DPW						
Projected Timeframe	Short Term						
Comments							
Projected Resource	PDM, HMGP						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
3	1	1	3	1	4	-1	12

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority
STT-3	Construct drainage improvements to improve the capacity, and clean, the storm water drainage system in Frydenhoj (next to and across from ball field) to alleviate localized flooding and damage of private property.	Goal 3, Objective 3.2	H	7
Hazard	Flood			
Lead Agency	DPW			
Projected Timeframe	Medium Term			
Comments	Resolving this localized flooding problem would minimize future flood damages to private property			
Projected Resource	PDM, HMGP			

S	T	A	P	L	E	E	Score
3	1	1	3	1	4	-1	12

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority
STT-4	Construct drainage improvements on Rt. 30 adjacent to Bolongo Bay.	Goal 1, Objective 1.1	H	9
Hazard	Flood			
Lead Agency	DPW			
Projected Timeframe	Medium Term			
Comments	Reduce repetitive flooding on this main roadway by the implementation of appropriate drainage infrastructure			
Projected resource	HMGP, PDM, FMA			

S	T	A	P	L	E	E	Score
2	1	1	2	1	4	2	13

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority			
STT-5	Construct drainage improvements for major drainage channel that conveys flood waters from the surrounding Altona and Anna's Fancy areas to resolve recurrent flooding after heavy rainfall events.	Goal 3, Objective 3.2	H	12			
Hazard	Flood						
Lead Agency	DPW						
Projected Timeframe	Medium Term						
Comments	This improvement would eliminate localized flooding						
Projected Resource	PDM, HMGP, FMA						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
3	1	1	3	1	4	-1	12

Action	Description	Goal/ Objective	Potential for Loss Reduction	Priority			
STT-6	Construct Lindberg Estates, Phase IV Drainage Project north through Kirwin Terrace Public Housing Units.	Goal 1, Objective 1.1	H	16			
Hazard	Flood						
Lead Agency	DPW						
Projected Timeframe	Medium Term						
Comments	The construction of this system would provide controlled water runoff through this residential area and reduce localized flooding						
Projected Resource	HMGP, PDM						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
3	1	1	2	1	6	2	16

Action	Description	Goal/ Objective	Potential for Loss Reduction	Priority			
STT-7	Improve drainage infrastructure along Rt. 30 Estate Hope / Fortuna to eliminate flooding of nearby residences in Fortuna 3C Subdivision.	Goal 1, Objective 1.1	H	19			
Hazard	Flood						
Lead Agency	DPW						
Projected Timeframe	Medium Term						
Comments	The construction of effective drainage would reduce local flooding and consequent property damage						
Projected Resource	PDM, HMGP, FMA						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
3	1	1	2	1	6	0	14

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority			
STT-8	Expand and reinforce communication infrastructure that is being implemented by BIT to mitigate damages from hurricanes to ensure rapid recovery and return to normal service.	Goal 3, Objective 3.1	H	13			
Hazard	All Hazards, but primarily hurricane-strength winds						
Lead Agency	VITEMA						
Projected Timeframe	Medium Term						
Comments	This action would require VITEMA to encourage BIT to undertake hazard mitigation measures that would benefit all residents of the islands.						
Projected resources	USVI Operating Budget						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
3	1	3	2	1	2	0	12

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority			
STT-9	Replace and improve drainage infrastructure at Food Center in order to resolve flooding of roads, businesses, while addressing potential secondary impacts to wetlands.	Goal 3, Objective 3.2	H	14			
Hazard	Flood						
Lead Agency	DPW						
Projected Timeframe	Medium Term						
Comments	Reduce or eliminate repetitive flood damage to infrastructure and commercial property. Surface runoff also affects nearby sensitive wetlands						
Projected Resource	PDM, HMGP, USVI line item						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
2	1	1	2	1	4	2	13

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority			
STT-10	Conduct hydrologic study of the Smith Bay basin and implement drainage improvements to resolve the flooding problems at Coki Point and Smith Bay Roads, and, improvements to open channels draining through the resort complex into Water Bay to resolve localized flooding problems that periodically close roads, create traffic hazards, prevent emergency vehicle and public access, and cause damage to adjacent businesses and road pavement.	Goal 3, Objective 3.2	H	3			
Hazard	Flood						
Lead Agency	VITEMA						
Projected Timeframe	Medium Term						
Comments	Flooding along key roads in the Smith Bay basin impede emergency and residential traffic. A hydraulic analysis in the basin is needed to determine the best approaches to resolve this problem. A long-term solution to this problem would also have significant benefits to coastal and off-shore marine resources in Smith Bay.						
Projected resources	FMA, PDM, and HMGP						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
3	1	3	3	1	2	2	15

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority
STT-11	Construct drainage improvements to secondary road that provides access to Caret Bay West. Improvements could include paving and/or providing proper roadside drainage and properly-sized culverts.	Goal 3, Objective 3.2	H	18
Hazard	Flood			
Lead Agency	DPW			
Projected Timeframe	Medium Term			
Comments	Roadway improvements including effective drainage would minimize local flooding and prevent soil erosion			
Projected Resource	HMGP, PDM			

S	T	A	P	L	E	E	Score
2	1	1	2	1	6	2	15

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority
STT-12	Complete Installation of Hurricane Shutters at main police station in Charlotte Amalie.	Goal 3, Objective 3.2	L	20
Hazard	Hurricane			
Lead Agency	DPW, OMB			
Projected Timeframe	Short Term			
Comments	This action would reduce the possibility of Hurricane damage to this critical installation			
Projected Resource	PDM, HMGP			

S	T	A	P	L	E	E	Score
3	1	1	3	1	4	0	13

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority			
STT-13	Improve drainage infrastructure along Hospital Gade from Antonio Jarvis School to the Police Station on Verteran's Drive, paying particular attention to the intersection of Hospital and Kongens Gade (Moravian Church and Zoras).	Goal 3, Objective 3.2	M	21			
Hazard	Flood						
Lead Agency	DPW						
Projected Timeframe	Medium Term						
Comments	The construction of effective drainage would reduce local flooding and consequent property damage including critical facilities.						
Projected Resource	PDM, HMGP						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority			
STT-14	Replace and improve drainage infrastructure along Rt. 33 (Estate Dorothea)	Goal 3, Objective 3.2	M	22			
Hazard	Flood						
Lead Agency	DPW						
Projected Timeframe	Medium Term						
Comments	Reduce possible localized flooding and roadway damage as well as soil erosion						
Projected Resource	DPW Operating Budget, PDM, and HMGP						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
3	1	1	2	1	4	2	14

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority			
STT-15	Resolve flooding problems at Subbase Entrance. Pursue Phase II drainage improvements which include the installation of properly-sized culverts from Bellows across Veterans Drive to connect to Phase I drainage improvements.	Goal 3, Objective 3.2	H	8			
Hazard	Flood						
Lead Agency	DPW						
Projected Timeframe	Medium Term						
Comments	Minimize local flooding to commercial property. Preliminary designs have already been completed for this project.						
Projected resources	HMGP, PDM, and FMA						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
3	1	1	3	1	4	0	13

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority			
STT-16	Enlarge box culverts, storm drains, and improvements to open channels from Veterans Drive to the Bay along the east edge of Frenchtown in southwest Charlotte Amalie, in order to resolve flooding, traffic access and business interruption.	Goal 3, Objective 3.2	H	10			
Hazard	Flood						
Lead Agency	DPW						
Projected Timeframe	Medium term						
Comments	Flooding affects a major thoroughfare and access to an economically important community and also impacts local businesses						
Projected Resource	HMGP, PDMC, and FMA						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
3	1	1	3	0	4	-2	11

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority			
STT-17	Harden WAPA Substations. Design and construction of hardened switchgear buildings at the East End and Tutu Substations.	Goal 3, Objective 3.2	M	25			
Hazard	All Hazards						
Lead Agency	WAPA						
Projected Timeframe	5 Years						
Comments	This action would reduce the disruption of electrical energy to the growing business community and populous of the east end of St. Thomas and St. John						
Projected Resource	PDMC, HMGP						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
2	1	1	3	1	4	0	12

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority			
STT-18	Water Island Ferry Dock at “Philips Landing” experiences periodic flooding in the main turn around area. Periodic flooding caused by inadequate drainage at this facility impedes ferry traffic and emergency vehicles	Goal 3, Objective 3.2	M	8			
Hazard	Flood						
Lead Agency	DPW						
Projected Timeframe	Medium Term						
Comments	Critical Facility						
Projected resources	PDM, HMGP						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
3	1	3	3	1	2	0	13

<table>
<tr><th>Action</th><th colspan="3">Description</th><th colspan="2">Goal/Objective</th><th>Potential for Loss Reduction</th><th>Priority</th></tr>
<tr><td>STT-19</td><td colspan="3">Honeymoon Beach at Druif Bay, western end of Water Island; flooding caused from inadequate drainage blocks vehicular passage and covers road with as much as 3 feet on the beach road and then takes as much as 3 weeks to drain. Economic impacts by blocking access to two commercial establishments and public health issue from mosquito breeding.</td><td colspan="2">Goal 1, Objective 1.1</td><td>H</td><td>10</td></tr>
<tr><td>Hazard</td><td colspan="7">Flood</td></tr>
<tr><td>Lead Agency</td><td colspan="7">DPW</td></tr>
<tr><td>Projected Timeframe</td><td colspan="7">Medium Term</td></tr>
<tr><td>Comments</td><td colspan="7">Public health issue and no action would adversely affect tourism and local businesses</td></tr>
<tr><td>Projected resources</td><td colspan="7">PDM, HMGP</td></tr>
<tr><td>S</td><td>T</td><td>A</td><td>P</td><td>L</td><td>E</td><td>E</td><td>Score</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><th>Action</th><th colspan="3">Description</th><th colspan="2">Goal/Objective</th><th>Potential for Loss Reduction</th><th>Priority</th></tr>
<tr><td>STT-20</td><td colspan="3">Pearl and Larsen School structural retrofit of roof</td><td colspan="2">Goal 1, Objective 1.1</td><td>H</td><td>2</td></tr>
<tr><td>Hazard</td><td colspan="7">Hurricane</td></tr>
<tr><td>Lead Agency</td><td colspan="7">Department of Education</td></tr>
<tr><td>Projected Timeframe</td><td colspan="7">Medium Term</td></tr>
<tr><td>Comments</td><td colspan="7"></td></tr>
<tr><td>Projected resources</td><td colspan="7">HMGP, PDM</td></tr>
<tr><td>S</td><td>T</td><td>A</td><td>P</td><td>L</td><td>E</td><td>E</td><td>Score</td></tr>
<tr><td>3</td><td>1</td><td>3</td><td>3</td><td>1</td><td>2</td><td>0</td><td>13</td></tr>
</table>

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority			
STT-21	Evelyn Williams School hurricane-strength wind mitigation retrofit of structural roof system and roof replacement.	Goal 1, Objective 1.1	H	6			
Hazard	Hurricane						
Lead Agency	Department of Education						
Projected Timeframe	Medium Term						
Comments							
Projected resources	HMGP, PDM						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
3	1	3	3	1	4	0	15

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority			
STT-22	Resolve flooding problems at Abattoir Estate Nadir (race track) due to inadequate drainage.	Goal 1, Objective 1.1	M	23			
Hazard	Flood						
Lead Agency	DPW						
Projected Timeframe	Medium						
Comments							
Projected resources	PDM, HMGP, DPW Operating Budget						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
3	1	3	3	1	4	0	15

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority			
STT-23	Address inadequate drainage at Tutu Fire Station	Goal 1, Objective 1.1	M	12			
Hazard	Flood						
Lead Agency	DPW						
Projected Timeframe	Short Term						
Comments	This mitigation action could be resolved by straight forward drainage improvements at this critical facility						
Projected resources	DPW Operating Budget						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
3	1	3	3	1	2	-1	12

Action	**Description**				**Goal/Objective**	**Potential for Loss Reduction**	**Priority**
STT-24	Structural retrofit of following critical facilities used for sheltering (Lockhart School, Bertha Bochulte Middle School, and, Human Services Head Start building).				Goal 3, Objective 3.2	H	4
Hazard	Hurricane						
Lead Agency	Department of Education						
Projected Timeframe	Medium Term						
Comments	Critical facility used for sheltering						
Projected resources	HMGP, PDM						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
3	1	3	3	1	6	0	17

Action	**Description**				**Goal/Objective**	**Potential for Loss Reduction**	**Priority**
STT-25	Retrofit of electrical system at Blue Water Bible College to enable back-up power for all 3 main buildings from existing generator.				Goal 1, Objective 1.1	L	11
Hazard	All Hazards, but primarily hurricane-strength winds						
Lead Agency	DPW						
Projected Timeframe	Medium Term						
Comments	Not a generator mitigation action, in that the generator is already in place, only needs modification to the electrical system to provide emergency power to all 3 main buildings at this educational non-profit facility.						
Projected resources	HMGP, Public Assistance Section 406						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
2	1	3	1	1	2	0	10

Action	**Description**			**Goal/Objective**	**Potential for Loss Reduction**		**Priority**
STT-26	Four power line projects to place feeder lines underground to eliminate damage from hurricane strength winds. They include feeder lines: 9A; 8E; 13; and, 7E)			Goal 3, Objective 3.2	H		9
Hazard	Hurricane						
Lead Agency	WAPA						
Projected Timeframe	Mid-Term						
Comments							
Projected resources	HMGP, PDM						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
3	1	2	3	1	2	-1	11

Action	**Description**			**Goal/Objective**	**Potential for Loss Reduction**		**Priority**
STT-27	Rehabilitation of Water Storage Tank at Sara Hill to include seismic and wind retrofit. Complete rehabilitation and upgrade of the 105 MG Water Storage Tank. Work includes structural repairs and new wind girders and seismic joints.			Goal 3, Objective 3.2	H		7
Hazard	Hurricane and Earthquake						
Lead Agency	WAPA						
Projected Timeframe	Mid-Term						
Comments							
Projected resources	HMGP, PDM						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
3	1	2	3	1	2	0	12

ST. CROIX PRIORITIZED MITIGATION ACTIONS

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority
STX-1	Resolve flooding problems and improve storm water drainage infrastructure in the "Grove at La Reine".	Goal 1, Objective 1.1	H	24
Hazard	Flood			
Lead Agency	DPW			
Projected Timeframe	Medium Term			
Comments	Emphasis on reducing potential flood damages to private properties			
Projected Resource	PDM, HMGP			

S	T	A	P	L	E	E	Score
3	1	3	3	1	0	-1	10

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority
STX-2	Conduct a hydrological study of the St. Croix watersheds with particular attention given to the La Grange, Prosperity, Bethlehem and Salt River basins. Up[grade inadequate drainage systems to reduce the impact of flooding (see USVI-4 Mitigation Action).	Goal 1, Objective 1.1	M	1
Hazard	Flood			
Lead Agency	DPW			
Projected Timeframe	Medium Term			
Comments	Phasing required; should prioritize basins based upon flood risk and potential flood damages			
Projected Resource	HMGP, PDM, USACE			

S	T	A	P	L	E	E	Score
3	1	3	3	1	4	0	15

	Description	Goal/Objective	Potential for Loss Reduction	Priority
STX-3	Perform assessment of flooding problems within La Grande Princess Estate. Approximately 50 of 225 NFIP-insured losses occur in La Grande Princess. (see USVI-2 Mitigation Action).	Goal 1, Objective 1.1	H	2
Hazard	Flood			
Lead Agency	DPW, DPNR, VITEMA			
Projected Timeframe	Long Term			
Comments	This action seeks to reduce severe repetitive property losses.			
Projected Resource	PDM, HMGP, FMA			

S	T	A	P	L	E	E	Score
3	1	1	3	1	6	2	17

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority
STX-4	Construct drainage system to along Melvin H. Evans in the area west of Williams Delight Stop Light and Carlton. Extend drainage system to connect with drainage improvements in Williams Delight Community.	Goal 1, Objective 1.1	H	10
Hazard	Flood			
Lead Agency	DPW			
Projected Timeframe	Medium Term			
Comments	This action would reduce and eliminate chronic localized flooding along this important roadway			
Projected Resource	HMGP, PDM			

S	T	A	P	L	E	E	Score
2	1	1	1	1	4	2	12

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority			
STX-5	Conduct a hydrological study of the Christiansted watershed or catchment area with particular attention given to the sub-watersheds of Spring Gut and Water Gut to determine technically feasible and cost effective structural solutions to address the flooding problem in Christiansted	Goal 1, Objective 1.1	M	12			
Hazard	Flood						
Lead Agency	VITEMA, DPW, DPNR						
Projected Timeframe	Short Term						
Comments	This study would determine the viability and cost effectiveness of establishing and executing a plan for the long term reduction of the chronic flooding in Christiansted						
Projected Resource	PDM, HMGP, and USACE						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
2	1	1	2	1	4	2	13

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority			
STX-6	Resolve flooding problems and improve storm water drainage infrastructure for “Spring Gut” all the way to Gallows Bay.	Goal 1, Objective 1.1	H	13			
Hazard	Flood						
Lead Agency	DPW						
Projected Timeframe	Medium Term						
Comments	The construction of adequate drainage infrastructure would reduce and eliminate localized flooding to commercial and residential properties.						
Projected Resource	PDM, HMGP						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
2	1	1	1	1	6	2	14

<table>
<tr><th>Action</th><th colspan="2">Description</th><th>Goal/Objective</th><th colspan="2">Potential for Loss Reduction</th><th colspan="2">Priority</th></tr>
<tr><td>STX-7</td><td colspan="2">Resolve flooding problems and improve storm water drainage infrastructure for Tide Village by implementing a low water crossing to divert surface run-off into the natural gut.</td><td>Goal 1, Objective 1.1</td><td colspan="2">H</td><td colspan="2">14</td></tr>
<tr><td>Hazard</td><td colspan="7">Flood</td></tr>
<tr><td>Lead Agency</td><td colspan="7">DPW</td></tr>
<tr><td>Projected Timeframe</td><td colspan="7">Short Term</td></tr>
<tr><td>Comments</td><td colspan="7">This action seeks to reduce and eliminate localized flooding in Tide Village. The roadway was constructed without adequate drainage.</td></tr>
<tr><td>Projected Resource</td><td colspan="7">PDM, HMGP</td></tr>
<tr><td>S</td><td>T</td><td>A</td><td>P</td><td>L</td><td>E</td><td>E</td><td>Score</td></tr>
<tr><td>2</td><td>1</td><td>1</td><td>2</td><td>1</td><td>4</td><td>2</td><td>13</td></tr>
</table>

<table>
<tr><th>Action</th><th colspan="2">Description</th><th>Goal/Objective</th><th colspan="2">Potential for Loss Reduction</th><th colspan="2">Priority</th></tr>
<tr><td>STX-8</td><td colspan="2">Pursue Christiansted Gut USACE Section 205 Project. Preliminary feasibility phase currently underway by the Corps to determine whether technically feasible and cost effective solutions exist to reduce flood damages in residential and business areas adjacent to King Cross St.</td><td>Goal 1, Objective 1.1</td><td colspan="2">M</td><td colspan="2">17</td></tr>
<tr><td>Hazard</td><td colspan="7">Flood</td></tr>
<tr><td>Lead Agency</td><td colspan="7">VITEMA</td></tr>
<tr><td>Projected Timeframe</td><td colspan="7">Short Term</td></tr>
<tr><td>Comments</td><td colspan="7">This study would create a solution for the reduction and elimination of structural and infrastructure loss due to flooding.</td></tr>
<tr><td>Projected Resource</td><td colspan="7">PDM, HMGP, and USACE</td></tr>
<tr><td>S</td><td>T</td><td>A</td><td>P</td><td>L</td><td>E</td><td>E</td><td>Score</td></tr>
<tr><td>2</td><td>1</td><td>1</td><td>1</td><td>1</td><td>4</td><td>2</td><td>12</td></tr>
</table>

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority		
STX-9	Construct a retention pond at the property line of White Bay, and the National Park Service reserve within the localized depression.	Goal 1, Objective 1.1	H	18		
Hazard	Flood					
Lead Agency	DPW, NPS					
Projected Timeframe	Medium Term					
Comments	The construction of a retention pond would reduce and eliminate localized flooding to residences in White Bay. Environment Assessment may be required by National Park Service.					
Projected Resource	PDM, HMGP, NPS,					
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
2	1	1	2	1	4	2	13

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority		
STX-10	Perform assessment of adjacent drainage basins that flow into Estate Williams Delight to identify alternate routing of surface runoff. Evaluate creation of stormwater detention pond below Blue Mountain.	Goal 1, Objective 1.1	H	21		
Hazard	Flood					
Lead Agency	DPW					
Projected Timeframe	Medium Term					
Comments	This assessment and eventual construction of an adequate drainage system would reduce and eliminate localized flooding.					
Projected Resource	HMGP, PDM					
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
1	1	1	1	1	4	2	11

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority			
STX-11	Implement and improve storm water drainage infrastructure to relieve flooding at the Alfredo Andrews School and adjacent low-lying areas.	Goal 1, Objective 1.1	H	5			
Hazard	Flood						
Lead Agency	DPW						
Projected Timeframe	Medium Term						
Comments	Localized flooding problem						
Projected Resource	PDM, HMGP						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
2	1	1	2	1	4	2	13

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority			
STX-12	Construct drainage improvements at the Ricardo Richards Elementary School at Estate Barren Spot near Melvin H. Evans Highway (Route 66).	Goal 3, Objective 3.1	H	19			
Hazard	Flood						
Lead Agency	DPW						
Projected Timeframe	Short term						
Comments	This action would reduce and eliminate localized flooding and at this critical facility and related property loss						
Projected Resource	PDM, HMGP						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
2	1	1	2	1	4	0	11

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority
STX-13	Improve Recovery Hill Water Storage Tanks. Install wind girders to reinforce against hurricane-strength winds.	Goal 3, Objective 3.2	M	9
Hazard	Hurricane			
Lead Agency	WAPA			
Projected Timeframe	Medium Term			
Comments	This action would reduce the loss of vital potable water from a hurricane event			
Projected Resource	PDM, HMGP			

S	T	A	P	L	E	E	Score
3	1	1	3	1	2	0	11

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority
STX-14	Implement and provide emergency power generator units for all wastewater pumping stations on St. Croix.	Goal 3, Objective 3.2	L	11
Hazard	All Hazardsw			
Lead Agency	WAPA			
Projected Timeframe	Medium Term			
Comments	This action would reduce the interruption of wastewater treatment following disaster events			
Projected Resource	PDM, HMGP			

S	T	A	P	L	E	E	Score
3	1	1	3	1	2	0	11

<table>
<tr><th colspan="2">Action</th><th colspan="2">Description</th><th>Goal/Objective</th><th colspan="2">Potential for Loss Reduction</th><th colspan="2">Priority</th></tr>
<tr><td colspan="2">STX-15</td><td colspan="2">Pursue equipment anchoring program for the Richmond Electrical Generating Plant. Anchor critical equipment in the Plant to mitigate damages caused by earthquake, hurricane-strength winds, tsunami and storm surge.</td><td>Goal 3, Objective 3.2</td><td colspan="2">H</td><td colspan="2">15</td></tr>
<tr><td colspan="2">Hazard</td><td colspan="7">All Hazards</td></tr>
<tr><td colspan="2">Lead Agency</td><td colspan="7">VIWAPA</td></tr>
<tr><td colspan="2">Projected Timeframe</td><td colspan="7">Medium Term</td></tr>
<tr><td colspan="2">Comments</td><td colspan="7">The anchoring of essential equipment would reduce damage to electrical generating systems due to a natural disaster event</td></tr>
<tr><td colspan="2">Projected Resource</td><td colspan="7">PDM, HMGP</td></tr>
<tr><th>S</th><th>T</th><th>A</th><th>P</th><th colspan="2">L</th><th>E</th><th>E</th><th>Score</th></tr>
<tr><td>2</td><td>1</td><td>1</td><td>2</td><td colspan="2">1</td><td>4</td><td>0</td><td>11</td></tr>
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<table>
<tr><th colspan="2">Action</th><th colspan="2">Description</th><th>Goal/Objective</th><th colspan="2">Potential for Loss Reduction</th><th colspan="2">Priority</th></tr>
<tr><td colspan="2">STX-16</td><td colspan="2">Improve Water Storage Tanks throughout the island. Install flexible connectors at multiple water storage tanks to permit pipe flexibility during earthquake events and ensure rapid recovery and normal service.</td><td>Goal 3, Objective 3.2</td><td colspan="2">M</td><td colspan="2">16</td></tr>
<tr><td colspan="2">Hazard</td><td colspan="7">Earthquake</td></tr>
<tr><td colspan="2">Lead Agency</td><td colspan="7">WAPA</td></tr>
<tr><td colspan="2">Projected Timeframe</td><td colspan="7">Long Term</td></tr>
<tr><td colspan="2">Comments</td><td colspan="7">This action would reduce and eliminate the loss of vital potable water in the event of a natural hazard event</td></tr>
<tr><td colspan="2">Projected Resource</td><td colspan="7">PDM, HMGP</td></tr>
<tr><th>S</th><th>T</th><th>A</th><th>P</th><th colspan="2">L</th><th>E</th><th>E</th><th>Score</th></tr>
<tr><td>2</td><td>1</td><td>1</td><td>2</td><td colspan="2">1</td><td>3</td><td>0</td><td>10</td></tr>
</table>

Action	Description			Goal/Objective		Potential for Loss Reduction	Priority
STX-17	Lew Muckle School shutter project			Goal 1, Objective 1.1		H	23
Hazard	Hurricane						
Lead Agency	Department of Education						
Projected Timeframe	Medium Term						
Comments							
Projected resources	HMGP, PDM						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
3	1	3	3	1	2	0	13

Action	Description			Goal/Objective		Potential for Loss Reduction	Priority
STX-18	The 30" Coastal Interceptor transports sewage from the La Grande Princess area to the LBJ Pump Station in Christiansted. Shoreline erosion from coastal storms has left the interceptor submerged in the sea approximately 50' from the shore. The mitigation action would reroute the pipeline inland, replacing approx. 1900' of pipe, construct new lift station and associated improvements.			Goal 3, Objective 3.2		H	4
Hazard	Coastal Flooding and Storm Surge						
Lead Agency	WMA						
Projected Timeframe	Medium Term						
Comments	This is a very important mitigation action as not taking action could led to failure of the Coastal Interceptor, a critical infrastructure for moving sewage to the waste water treatment plant. It would not only pose a public health and social issues due to the failure of the system but would have significant environmental impacts to marine resources. This issue has been caused by natural hazards operating over a number of years, could lead to failure from a future coastal storm or hurricane, and should receive serious attention by Territorial and Federal funding agencies. It should be addressed as soon as possible, subject to available funding.						
Projected resources	EPA, HMGP, PDM, HUD, DOC, USDA RDA						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
3	1	3	3	1	6	2	19

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority
STX-19	FEMA Community Rating System (CRS). Initiate a planning project to have STX become a CRS Community by developing a strategy and action plan for improving the flood management program on the Island. The planning study would include an outreach strategy and series of community meetings on the NFIP Program, first living floor and base flood elevation determinations, LOMARS, and other flood insurance questions and concerns.	Goal 4, Objective 4.1	M	3
Hazard	Flood			
Lead Agency	VITEMA			
Projected Timeframe	Long Term			
Comments	FEMA representatives have indicated that St. Croix would be considered as a community within the USVI and therefore could pursue designation as a community participating in the CRS initiative			
Projected resources	USVI Operating Budget			

S	T	A	P	L	E	E	Score
3	1	2	3	1	2	0	12

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority
STX-20	LBJ Pump Station flood and storm surge protection. The pump station is located 215' south of an existing gut and 125' from the shoreline. Mitigation action involves improving conveyance from existing gut, regarding and rising existing roadway to site, fabrication of flood prevention brackets to provide protection from floodwaters and storm surge.	Goal 3, Objective 3.2	H	7
Hazard	Coastal Flooding and Storm Surge			
Lead Agency	WMA			
Projected Timeframe	Medium Term			
Comments	Increased probability of damage to this facility by flash flooding from the nearby gut, coastal flooding and storm surge argue that this proposed mitigation action deserves attention. It also has environmental impacts if not addressed.			
Projected resources	HMGP, FMA, EPA			

S	T	A	P	L	E	E	Score
3	1	3	3	1	2	2	15

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority			
STX-21	Structural retrofits of Claude Markoe School and St. Croix Educational Complex critical facilities used for sheltering.	Goal 3, Objective 3.2	H	8			
Hazard	Hurricane						
Lead Agency	Department of Education						
Projected Timeframe	Medium Term						
Comments	Critical facilities used for sheltering should receive high priority for funding						
Projected resources	HMGP, PDM						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
3	1	3	3	1	4	0	15

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority			
STX-22	Structural retrofits of Juan Luis Hospital for enhanced protection from hurricane-strength winds and earthquake hazards.	Goal 3, Objective 3.2	H	22			
Hazard	Hurricane and Earthquake						
Lead Agency	VITEMA						
Projected Timeframe	Long Term						
Comments	Critical Facility						
Projected resources	HMGP, PDM						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
3	1	1	3	1	2	0	11

Action	**Description**	**Goal/Objective**	**Potential for Loss Reduction**	**Priority**			
STX-23	Place Queen Street power lines in Christiansted underground to eliminate damage from hurricane-strength winds.	Goal 3, Objective 3.2	H	6			
Hazard	Hurricane						
Lead Agency	WAPA						
Projected Timeframe	Mid-term						
Comments							
Projected Resource	HMGP, PDM						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
3	1	3	3	1	0	-1	10

Action	**Description**	**Goal/Objective**	**Potential for Loss Reduction**	**Priority**			
STX-24	Storm flows from Tropical Storm Otto collapsed a culvert and road crossing of Gut 5 in Enfield Green that connects the east and west sides of the Estate. Mitigation action involves replacing culvert with a larger diameter and implementing drainage improvements on Gut 5.	Goal 3, Objective 3.2	M	20			
Hazard	Flood						
Lead Agency	DPW						
Projected Timeframe	Medium Term						
Comments	Challenge for this action is that it is a private road within a development with a homeowners association without the funds to undertake the necessary work to replace the culvert and stream crossing.						
Projected resources	HMGP, PDM, FMA						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
2	1	3	2	0	0	0	8

ST. JOHN PRIORITIZED MITIGATION ACTIONS

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority
STJ-1	Conduct a hydrological study of Coral Bay watershed to propose technically feasible and cost-effective solutions to flooding problems due to storm drain locations, undersized drainage, and lack of consideration of natural drainage guts.	Goal 1, Objective 1.1	M	2
Hazard	Flood			
Lead Agency	VITEMA, DPNR			
Projected Timeframe	Medium Term			
Comments	Flooding is a persistent problem in Coral Bay. VITEMA should have direct liaison with Coral Bay Community Council to define specifications for such a project			
Projected Resource	HMGP, PDM, FMA			

S	T	A	P	L	E	E	Score
1	1	1	1	1	4	2	11

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority
STJ-2	Evaluate and construct drainage improvements to eliminate localized flooding at the lower end of “Carolina Gut” at Little Plantation.	Goal 1, Objective 1.1	H	6
Hazard	Flood			
Lead Agency	DPNR, DPW			
Projected Timeframe	Short Term			
Comments	The construction of this drainage system would alleviate localized flooding to reduce repetitive losses to residential and commercial properties that resulted from incorrect siting			
Projected Resource	PDM, FMA, USVI Operating Budget			

S	T	A	P	L	E	E	Score
3	1	1	1	1	4	2	13

Action	Description		Goal/Objective		Potential for Loss Reduction	Priority		
ST-3	Construct drainage improvements to eliminate localized flooding at Pond Mouth at intersection of Rt. 102 and Rt. 105.		Goal 1, Objective 1.1		H	7		
Hazard	Flood							
Lead Agency	DPW							
Projected Timeframe	Short Term							
Comments	Alleviate localized flooding due to inappropriate infrastructure constructed during port expansion at Pond Mouth exacerbating flooding problems.							
Projected Resources	HMGP, PDM, FMA, USVI Operating Budget							
S	**T**	**A**	**P**	**L**		**E**	**E**	**Score**
3	1	1	2	1		4	-1	11

Action	Description		Goal/Objective		Potential for Loss Reduction	Priority		
STJ-4	Implementing a slope stabilization program to reduce damage and blockage of roads during wind storm and flooding events. A program establishment of more stable and cut and fill slopes, removal of material that may be subject to landslide and rock fall events, re-vegetation, of disturbed slopes, etc.		Goal 1, Objective 1.1		H	8		
Hazard	Flood, Landslide and Hurricane							
Lead Agency	DPW							
Projected Timeframe	Medium Term							
Comments	To minimize the possibility of road closure. The assessment will provide DPW with technically feasible and cost effective options and facilitate emergency access to Coral Bay							
Projected Resources	HMGP, PDM, USVI USVI Operating Budget							
S	**T**	**A**	**P**	**L**		**E**	**E**	**Score**
3	1	1	2	1		4	2	14

Action	Description		Goal/Objective	Potential for Loss Reduction		Priority	
STJ-5	Evaluate and construct drainage improvements to eliminate localized flooding along Route 20 southbound in Coral Bay (Estate Carolina).		Goal 1, Objective 1.1	H		11	
Hazard	Flood						
Lead Agency	DPW						
Projected Timeframe	Medium Term						
Comments	The construction of this drainage improvement wou9ld reduce localized flooding and damage to residential and commercial property and provide emergency access						
Projected Resource	HMGP, PDM, FMA , USVI Operating Budget						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
3	1	1	1	0	4	-1	9

Action	Description		Goal/Objective	Potential for Loss Reduction		Priority	
STJ-6	Increase fuel capacity of the Myra Keating Health Clinic Emergency power generator unit.		Goal 3, Objective 3.1	H		5	
Hazard	All Hazards						
Lead Agency	WAPA, DH						
Projected Timeframe	Medium Term						
Comments	Ensure a more constant and longer lasting source of power at only health facility on the island						
Projected Resource	PDM						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
2	1	1	3	0	4	0	11

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority
STJ-7	Provide an alternate power generation substation for Coral Bay to ensure that there is adequate power source for all public services and critical facilities on the east end of the Island.	Goal 3, Objective 3.2	H	4
Hazard	All Hazards			
Lead Agency	WAPA			
Projected Timeframe	Medium Term			
Comments	This action would provide critical emergency power supply to eastern end of island that may be isolated during a hazard event.			
Projected Resources	HMGP, PDM			

S	T	A	P	L	E	E	Score
2	1	1	1	2	6	2	15

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority
STJ-8	Construct underground feeders from the St. John substation to various termination points within Cruz Bay to mitigate damages to hurricane winds and ensure rapid recovery and return to normal service.	Goal 3, Objective 3.2	H	9
Hazard	Hurricane			
Lead Agency	WAPA, VITEMA			
Projected Timeframe	Medium Term			
Comments	This hardening of the electrical distribution system would provide for the timely restoration of power			
Projected Resources	HMGP, PDM			

S	T	A	P	L	E	E	Score
2	1	1	2	0	6	2	14

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority			
STJ-9	Improve drainage infrastructure (Box Culverts) at WAPA building and treatment plant, while addressing potential secondary impacts to wetlands.	Goal 3, Objective 3.2	H	10			
Hazard	Flood						
Lead Agency	DPW, VIWAPA						
Projected Timeframe	Medium Term						
Comments	This action would reduce potential localized flooding						
Projected Resources	HMGP, PDM, USVI Operating Budget						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
2	1	1	3	1	4	2	14

Action	Description	Goal/Objective	Potential for Loss Reduction	Priority			
STJ-10	Coordinate with the National Park Service for the construction of appropriate drainage system improvements to eliminate localized flooding along Route Rt. 20 in Maho Bay.	Goal 3, Objective 3.2	H	12			
Hazard	Flood						
Lead Agency	DPW						
Projected Timeframe	Medium Term						
Comments	This action would reduce localized flooding along central Road and assure emergency access						
Projected Resource	HMGP, PDM, FMA						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
3	1	1	1	1	4	2	13

Action	**Description**			**Goal/Objective**		**Potential for Loss Reduction**	**Priority**
STJ-11	Resolve flooding concerns from inadequate drainage at Cruz Bay Fire Station.			Goal 3, Objective 3.2		M	3
Hazard	Flood						
Lead Agency	DPW						
Projected Timeframe	Short Term						
Comments	For the more frequent storm events, inadequate drainage at the Cruz Bay Fire Station could be addressed by straight forward drainage improvements in the immediate vicinity.						
Projected resources	USVI Operating Budget, PDM, FMA						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
3	1	3	3	1	2	0	13

Action	**Description**			**Goal/Objective**		**Potential for Loss Reduction**	**Priority**
STJ-12	Functional replacement and relocation of the Fire Station in Coral Bay due to multiple coastal hazards and structural issues of this critical facility resulting from subsidence.			Goal 3, Objective 3.2		H	1
Hazard	Coastal Flooding and Storm Surge						
Lead Agency	Fire Service						
Projected Timeframe	Long Term						
Comments	Over the long term there is a clear need to relocate this critical facility away from coastal hazards.						
Projected resources	HMGP, DHS, other potential Federal funding sources						
S	**T**	**A**	**P**	**L**	**E**	**E**	**Score**
3	1	3	1	1	2	0	11

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