# NATURAL HAZARD AND VULNERABILITY ASSESSMENT FOR PORTMORE, ST. CATHERINE

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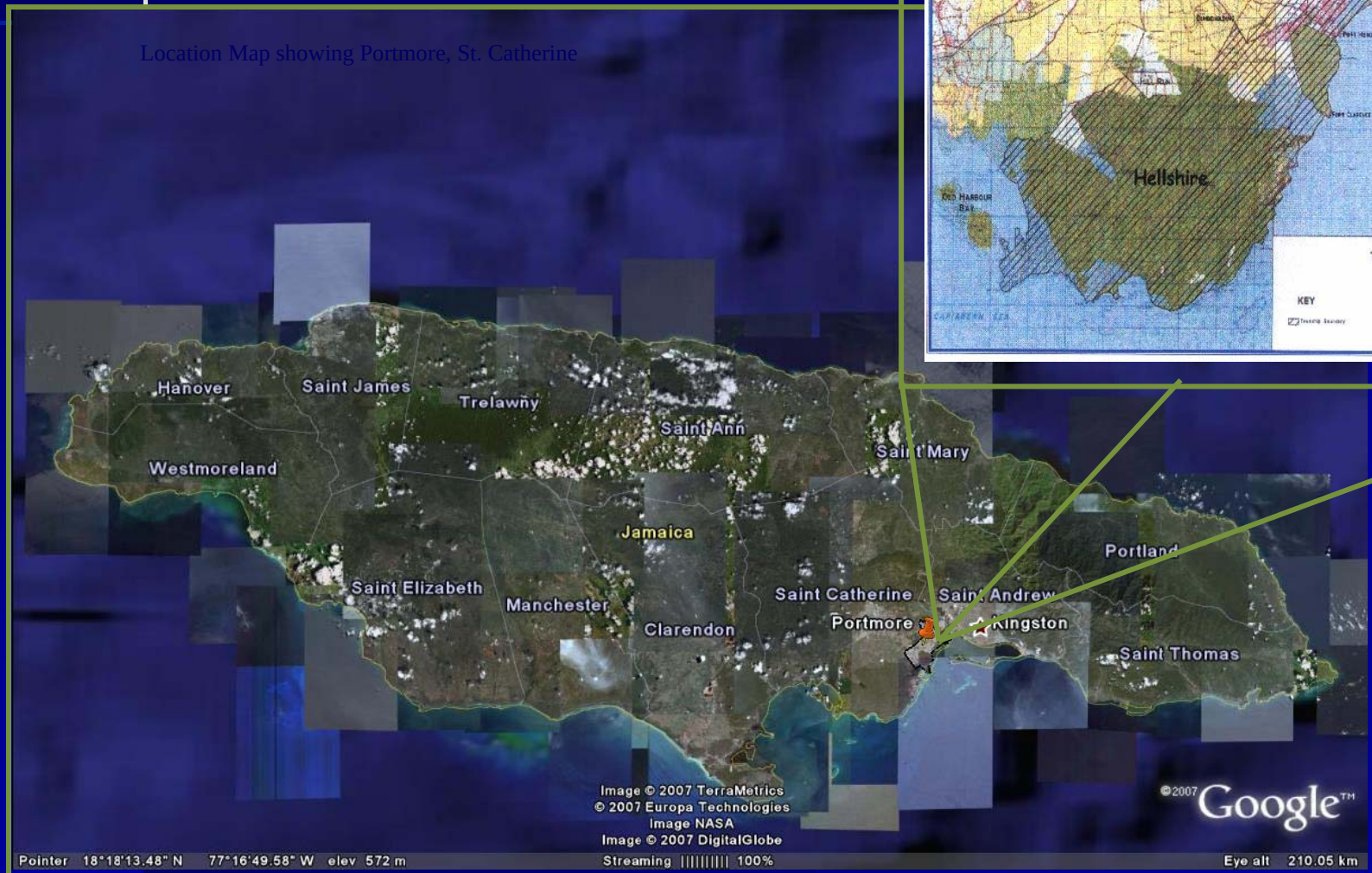
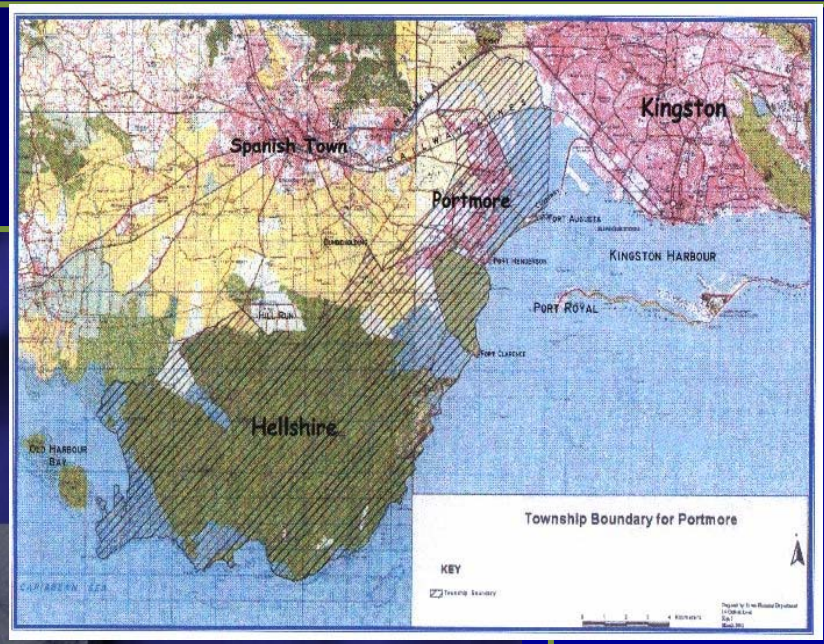
# BACKGROUND

- UNDP Funded Project
- Project began in July 2006; 14 month project period
- Portmore located on South coast, affected by frequent storms & hurricanes

# Location of Portmore



# BACKGROUND CONT'D

- Portmore accounts for 31 percent of total population of St. Catherine
- Fastest growing city in Jamaica - 4% growth rate
- The area suffered in the past from Earthquakes, Hurricane and Flooding

# AIM OF PROJECT

- Conduct technical review of major natural hazards: inland floods, storm surge and earthquake
- Conduct hazard mapping
- Conduct vulnerability mapping
- Determine current status of evacuation routes
- Recommend changes to improve/update Portmore Evacuation Plan

# METHODOLOGY

- Literature review, data gathering, aerial photo-interpretation is conducted to assess major natural hazards
- Flood hazards determined through comprehensive interviews, anecdotal evidence and literature reviews
- NOAA methodology adapted to assess vulnerability of communities in Portmore

# METHODOLOGY CONT'D

- Evacuation routes reviewed based on vulnerability analysis
- Natural Hazard and Vulnerability Maps created using GIS

# NATURAL HAZARD

- Inland Flooding - Major Focus
- Earthquake
- Storm Surge – Minor Focus

# FLOOD HISTORY - PORTMORE

- Pre-Dyke Period : Dominated by Riverine Flooding from the Rio Cobre
- Post-Dyke Period : Dominated by Urban Flooding
- Dyke built in late 1960's to prevent flooding of low lying areas in Portmore

# FLOOD HISTORY CONT'D

## Table 1: History of Flooding

| Type of Flooding | # of Events | Cause | Period of Event |
|---|---|---|---|
| **Riverine** | 4 | Flooding of Rio Cobre | Pre-Dyke 1933-1969 |
| **Urban** | 20 | 1. Inadequate Drains<br>2. Blocked Drains<br>3. Back Flows from sewage system<br>4. Under-sizing of Drains | Post - Dyke 1978-2005 |

# FLOOD HAZARD MAPPING PROCESS

**METHODOLOGY** : URBAN FLOODING

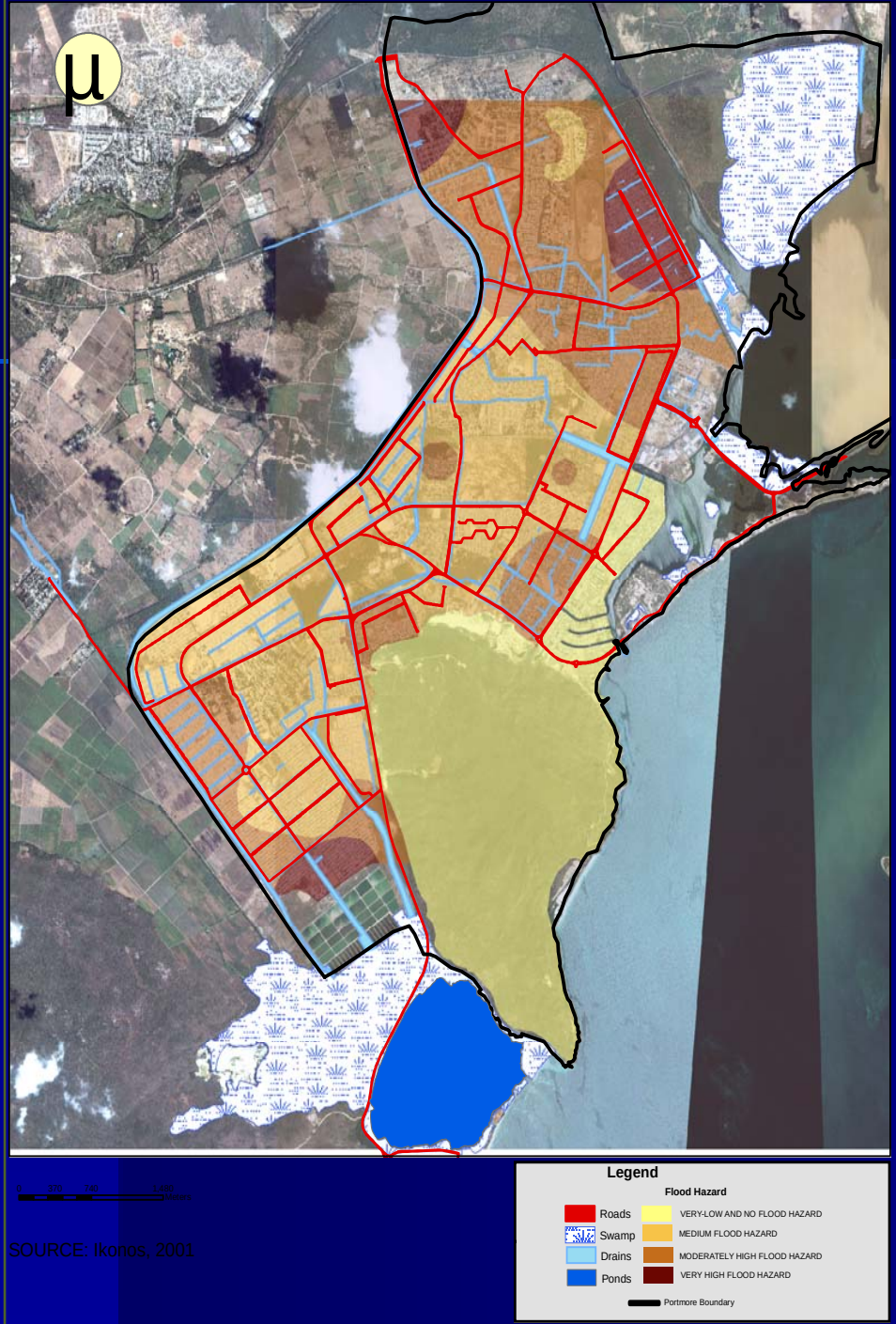
- Data collection and corrections
- Create flood database and correct for errors

# FLOOD HAZARD MAPPING PROCESS CONT'D

- Generate flood zones/classes using Geostatistical Analyst Extension of Arc GIS

- Correction and modification of flood zones

# FLOOD HAZARD MAP



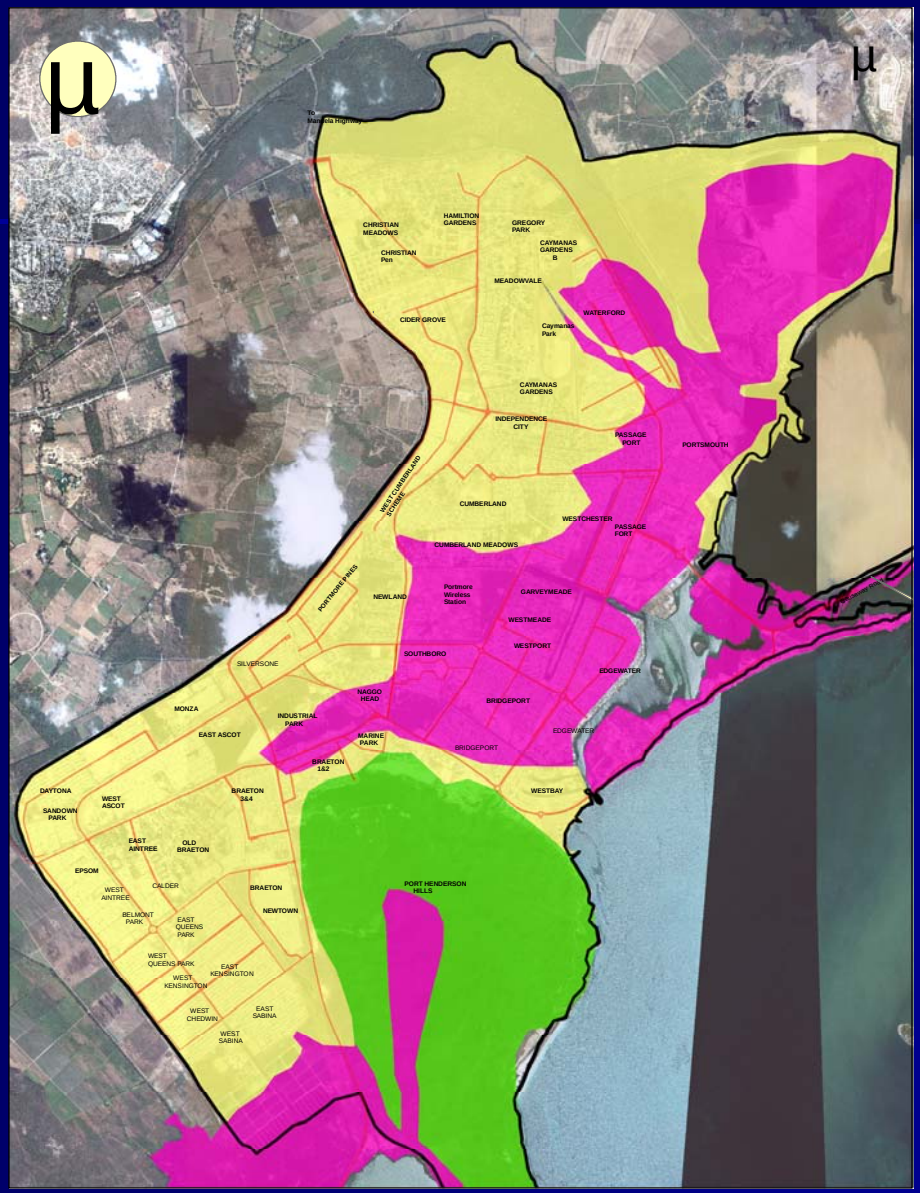

SOURCE: Ikonos, 2001

# EARTHQUAKE HAZARD MAP

- Earthquake Hazard Map for KMA (CDMP Seismic Hazard Assessment Project 1999)

- Three Seismic Hazard Zones
  - Zone of Ground acceleration : 30% gravity
  - Zone of Ground acceleration : 45% gravity
  - Zone of Site Specific assessment

# EARTHQUAKE HAZARD MAP




## LEGEND

**Peak Ground Acceleration %g 10% probability of exceedance in 50 years**

- **30**
- **45**
- **Site specific study areas (geotechnical study needed)**

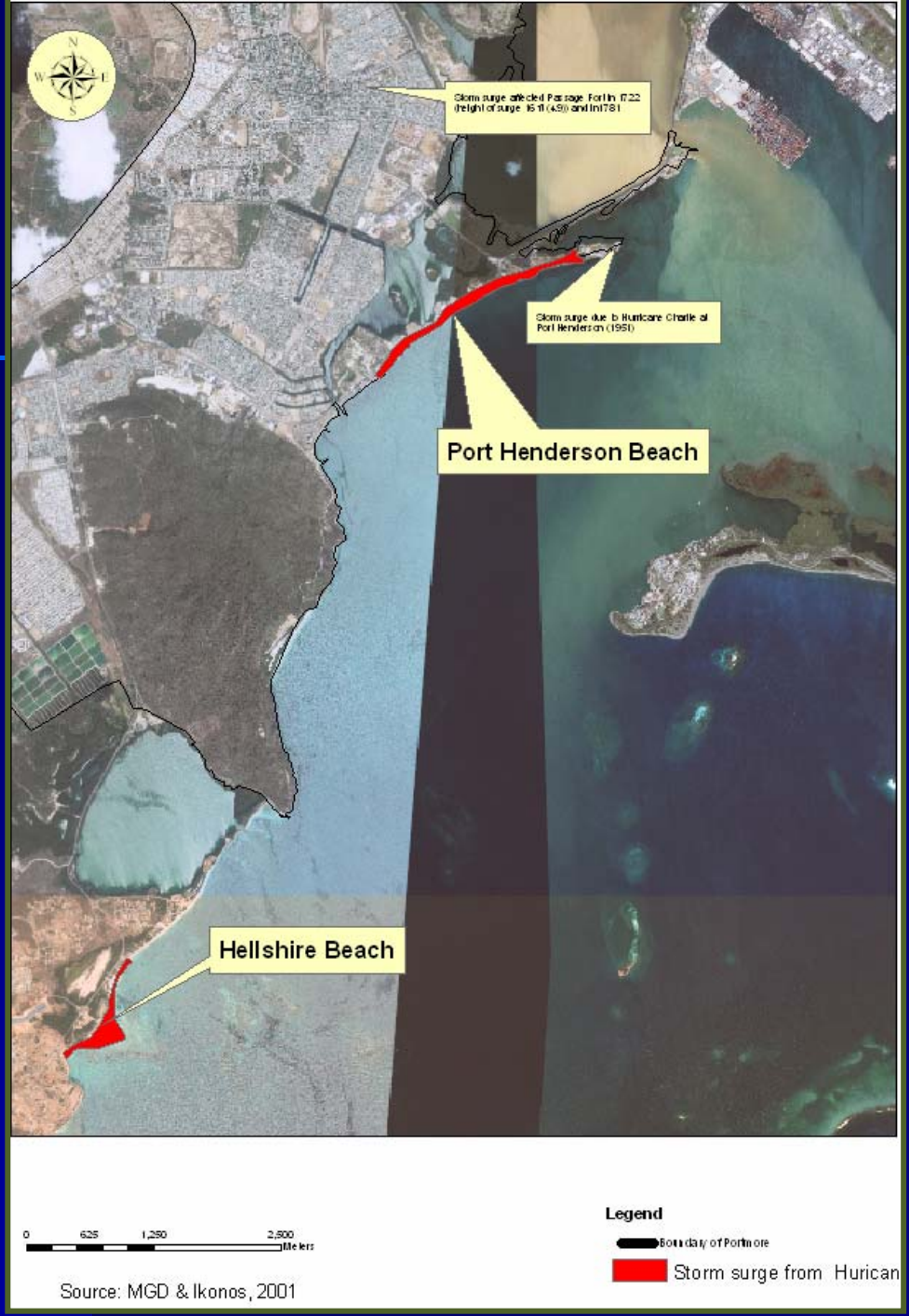
**Source: KSA, CDMP, 1999**

# STORM SURGE

- Data from Hurricanes Ivan (2004) and Dean (2007) used to generate flood incident map

- Storm Surge hazard and vulnerability assessment conducted for Portmore under CDB funded project (Smith Warner and ESL)

# STORM SURGE INCIDENT MAP



# Hazard Vulnerability Assessment in an Urban Area

Using Portmore case study

# Table of Contents

# Vulnerability

- What is Vulnerability

  “The likelihood that an individual or group will be exposed to and adversely affected by a hazard. It is the interaction of the hazards of place (risk and migration) with the social profile of communities” (Susan Cutter, 1993).

# Vulnerability Assessment Methodology

- Hazard identification & analysis
- Vulnerability analysis which included
  - Societal analysis
  - Built Environment Analysis
  - Critical Facilities Analysis

# Societal Analysis

- Identification of the Vulnerable groups
- Data Acquisition
- Calculation of Social Vulnerability Score

# Societal Analysis cont.

- Identification of the Vulnerable groups
  - Youth and Infant Population
  - Female Population
  - Elderly Population
  - Total Population
- Data Acquisition
  - The Portmore enumeration data obtained from Statistical Institute of Jamaica

# Societal Analysis cont.

- Calculation of Social Vulnerability Score
  - Calculation of the percentage (X) of the vulnerable group in each enumeration district in Portmore e.g. elderly group.

$$X = \frac{\text{\# of people over 65 (elderly) in Enumeration District}}{\text{\# of people over 65 (elderly) in the City}}$$

  - Calculation of the vulnerable score: divide value of X by the Maximum X

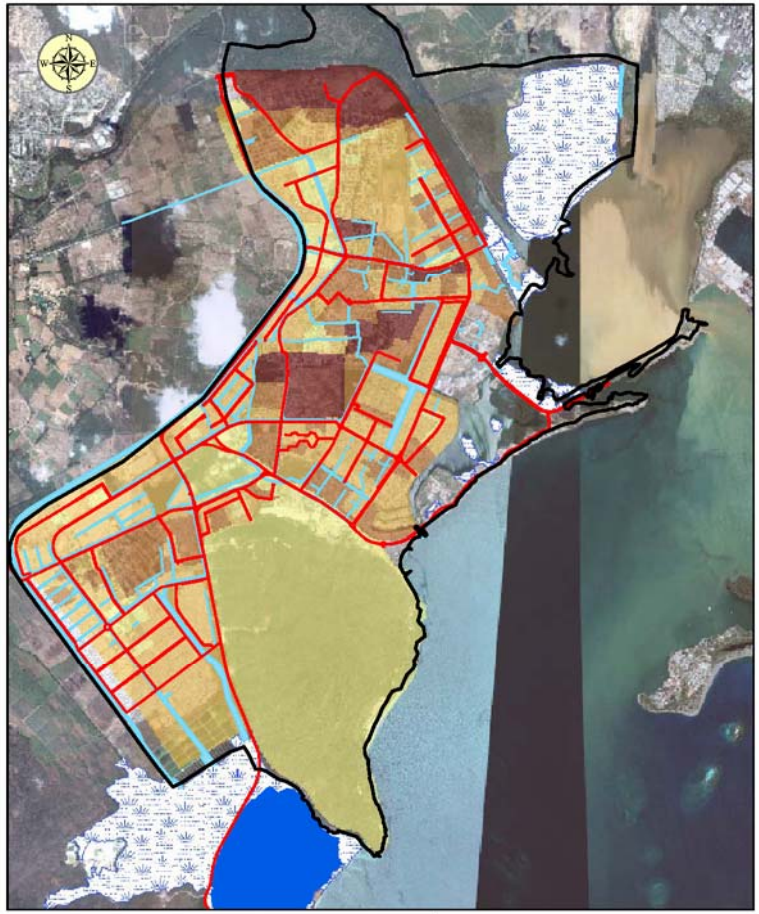
$$\text{Elderly Score} = \frac{\mathbf{X}}{\text{Maximum } \mathbf{X}} \quad \text{range 0 - 1}$$

  - The scores are ranked with 0- lowest to 1- highest

# Societal Analysis cont.

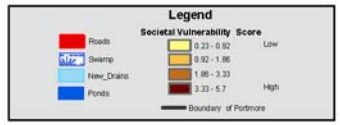
- Social Vulnerability Score
  - The vulnerable group scores are combined to obtained the social vulnerable score for each enumeration.
  - The social vulnerable scores are grouped into four categories which is presented spatially using GIS.
- The Hazard and Societal Vulnerability
  - The hazard data is combined with the social vulnerability data to create a vulnerability map for each of the hazard, termed hazard vulnerability maps.

**Portmore Societal Vulnerability Score**

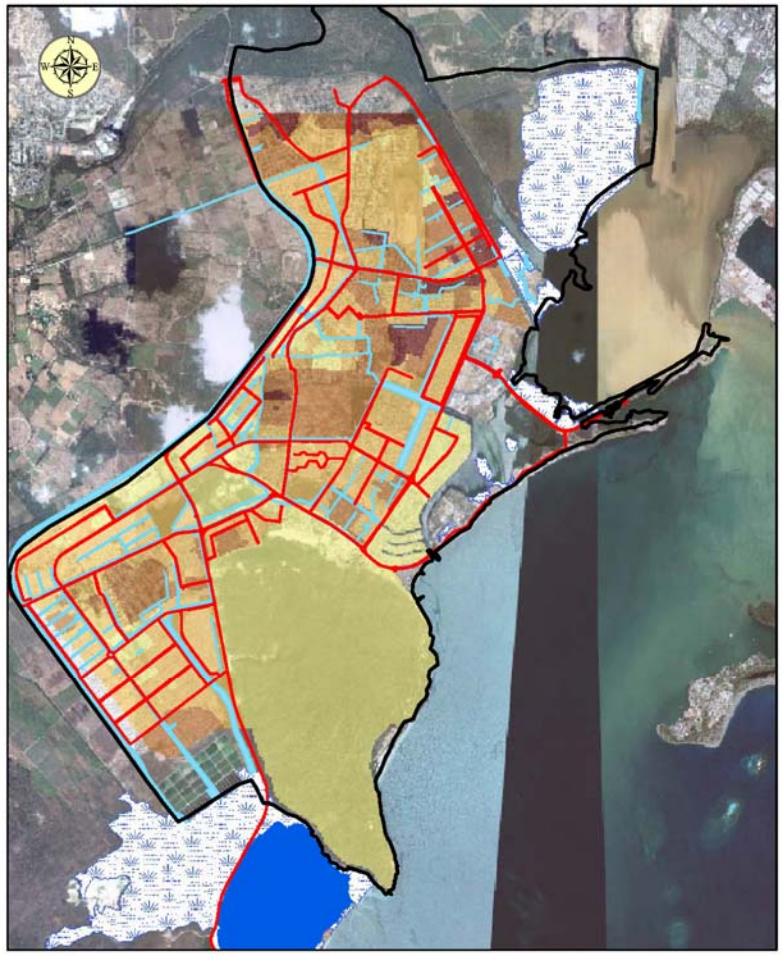



0 435 870 1,740 Meters

SOURCE: Ikonos, 2001



Portmore's Flood Hazard & Societal Vulnerability Score



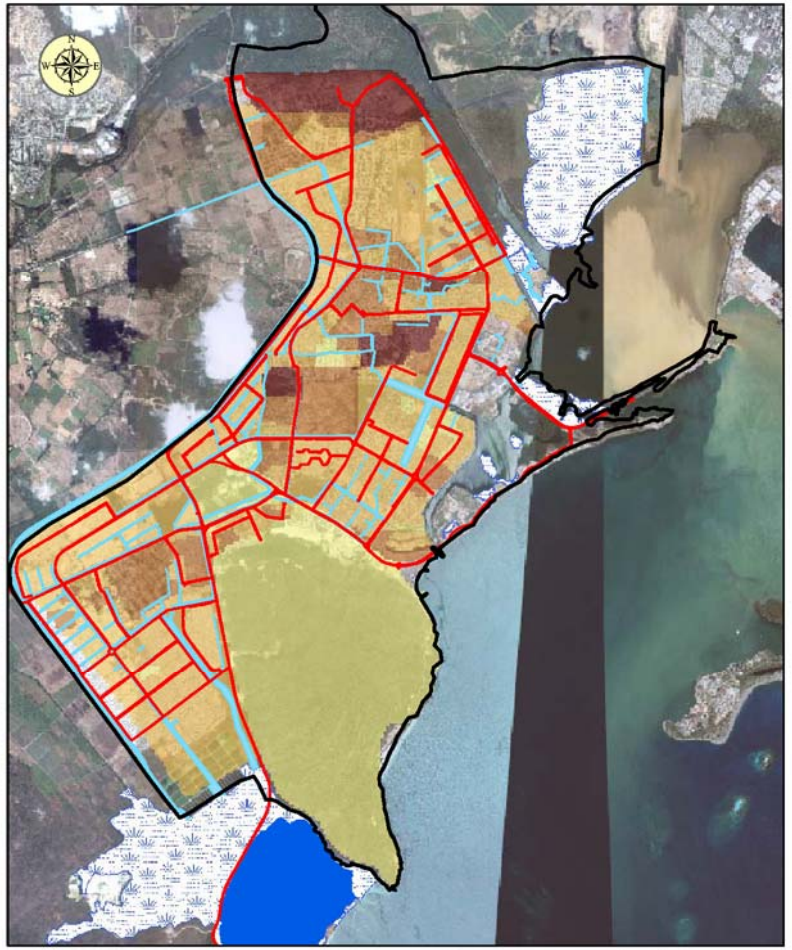

0 440 880 1,760
Meters

SOURCE: Ikonos, 2001

# Built Environment Analysis

- The Built Environment
  - Resident
  - Commercial
- The Residential Built Environment
  - Residential environs are group based on the various communities in the Portmore.
  - The residential built environment is represented as dot density to ascertain the spatial distribution of the households.
  - The residential area is subsequently overlain on the seismic data and represented spatially using GIS.

**Portmore Seismic Hazard & Societal Vulnerability Score**

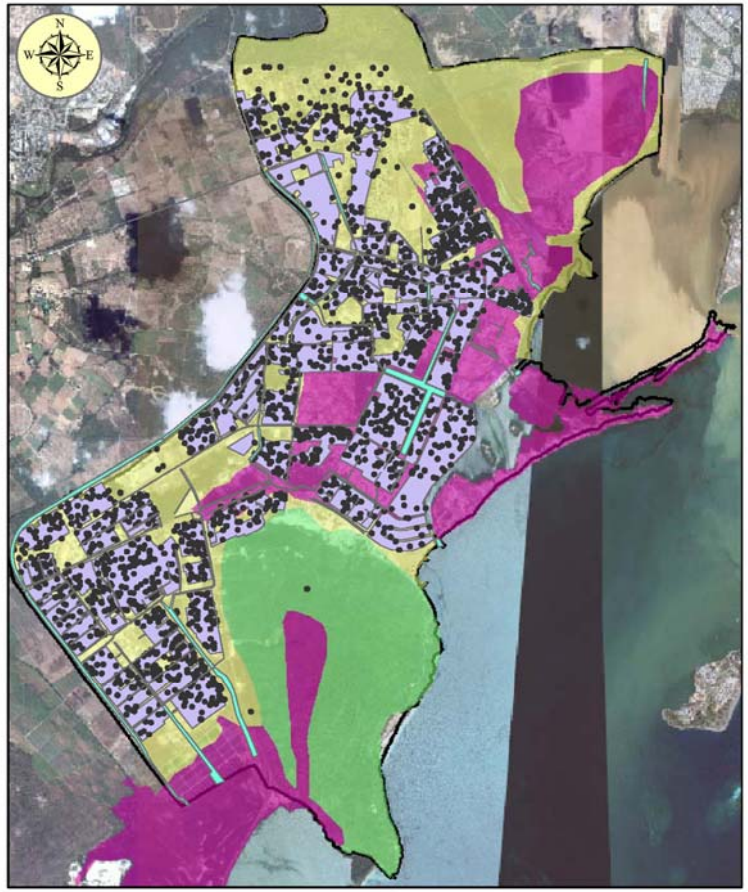



SOURCE: Ikonos, 2001

# Number of Houses with the seismic vulnerable zone that require site specific assessment

| Community | Population | Number of Homes |
|---|---|---|
| Edgewater | 4428 | 700 |
| Waterford | 18111 | 3725 |
| Westchester | 4907 | 1140 |
| Portsmouth | 6416 | 1000 |
| Bridgeport | 6688 | 1140 |
| Southborough | 4129 | 900 |
| Garvey Meade | 3369 | 842 |
| Passage Fort | 7378 | 1200 |

Residential Seismic hazard vulnerability (PORTMORE)




0 295 590 1,180 1,770 2,360
Meters

Ikonos, 2001

**Legend**

Residential area
House density
1 Dot = 20
Drains
Portmore Boundary

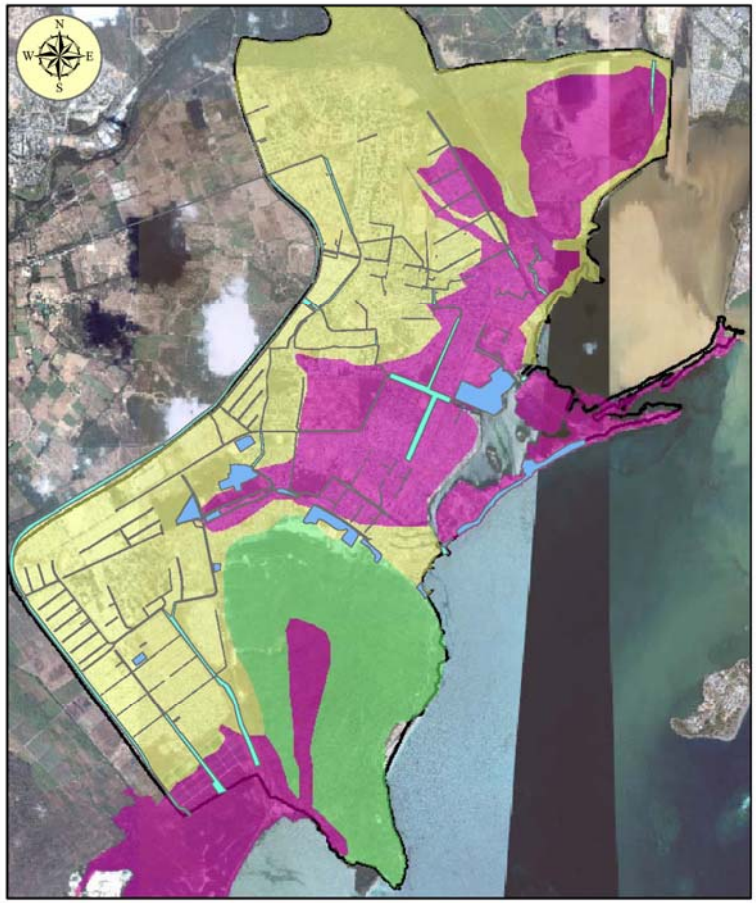
Peak Ground Accelearation (%g)
[10% probability of exceedance in 50 years]
30
45
site specific study-areas (geotechnical studies needed)

Source: ESA,CDMP,1999

# Built Environment Analysis cont.

- The Commercial Built Environment
  - The commercial areas were spatially analyzed with respect to the seismic data and areas that were located within the seismic specific zone identified.

Commercial Activity Seismic hazard vulnerability (PORTMORE)




0 295 590 1,180 1,770 2,360 Meters

Ikonos, 2001

**Legend**

- Commercial area
- Drains
- Portmore Boundary

Peak Ground Accelearton (%g) [10% probability of exceedance in 50 years]

- 30
- 45
- site specific study-areas (geotechnical studies needed)

Source: ESA,CDMP,1999

# Critical Facilities Analysis

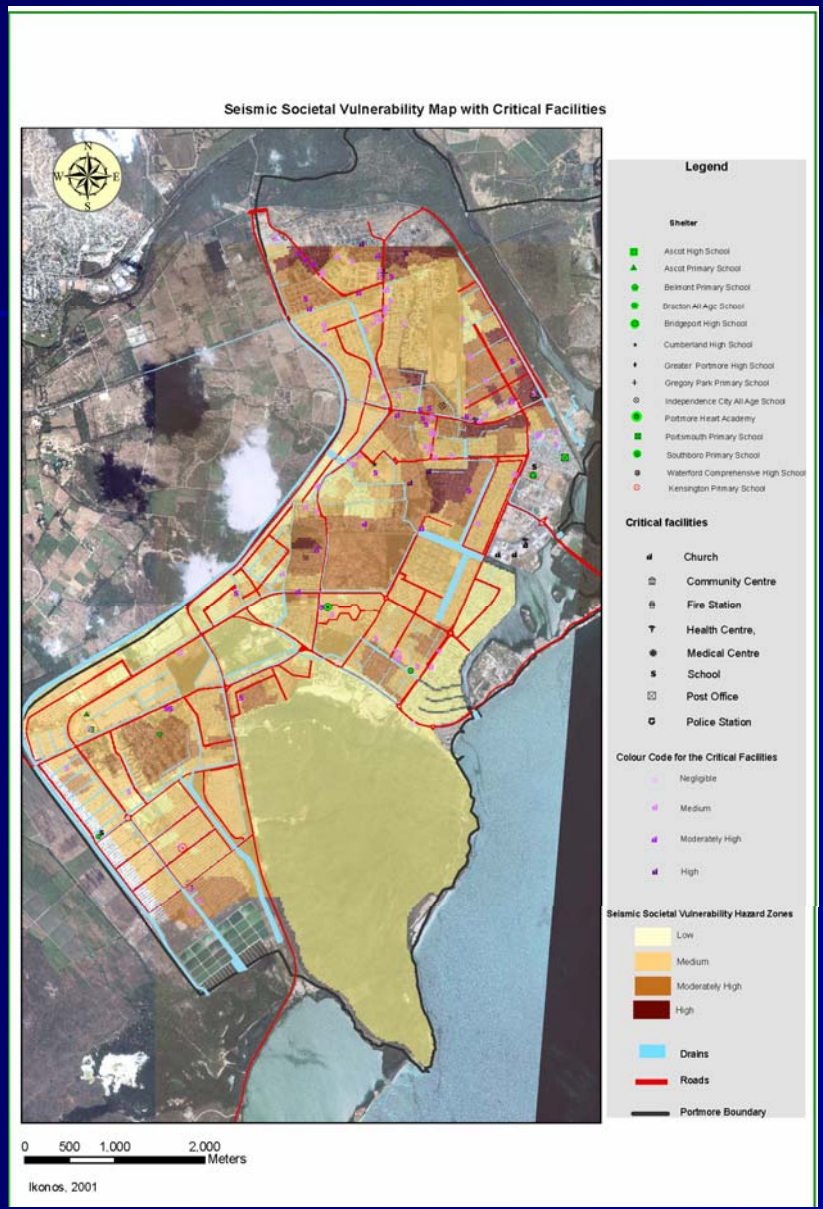
- Identification of the Critical Facilities
  - The critical facilities are located using data from the National Land Agency
  - The critical facilities are overlain on the Hazard vulnerability maps.
  - The critical facilities are colour -coded according to the hazard vulnerability zone they are situated in.

# Number of critical facilities per seismic hazard zones

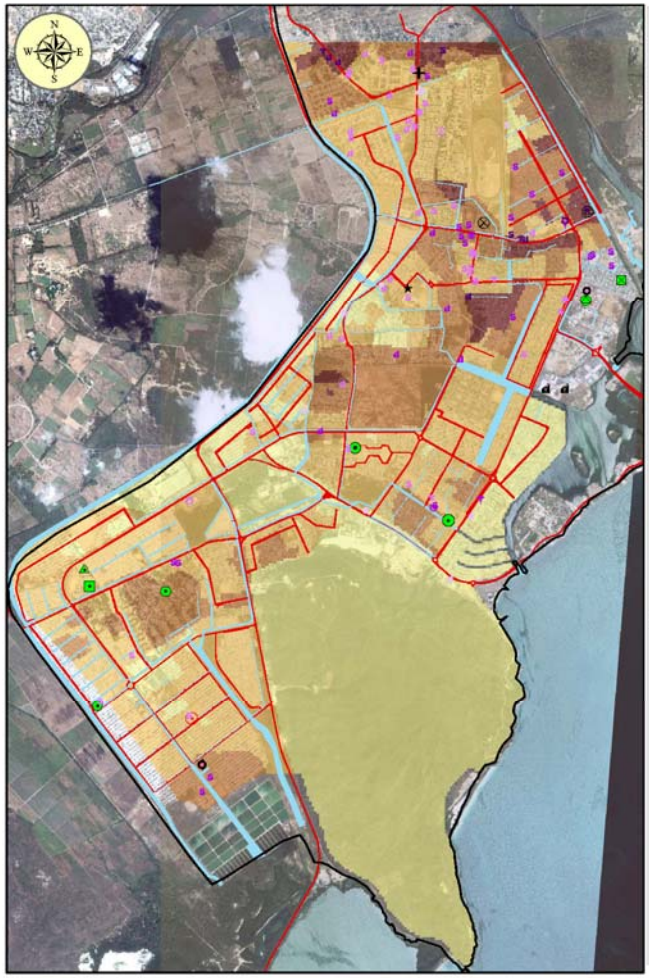
| Critical Facilities | Zones | | | |
|---|---|---|---|---|
| | High | Moderately High | Medium | Low |
| Church | 3 | 10 | 16 | 1 |
| School | 1 | 17 | 35 | 1 |
| Community Centre | | | 2 | |
| Police | | | 3 | 1 |
| Fire Station | | 1 | | |
| Health Centre | 1 | 1 | 3 | 1 |
| Medical Centre | | | 8 | |
| Post Office | | 1 | 2 | |

# The number of critical facilities per flood hazard zones

| Critical Facilities | Zones | | | |
|---|---|---|---|---|
| | High | Moderately High | Medium | Low |
| Church | 4 | 7 | 15 | 4 |
| School | 3 | 21 | 23 | 4 |
| Community Centre | | | | 1 |
| Police | 1 | 1 | 1 | |
| Fire Station | | 1 | | |
| Health Centre | 2 | 2 | 2 | |
| Medical Centre | | 1 | 6 | 1 |
| Post Office | | 1 | 2 | |


Seismic Societal Vulnerability Map with Critical Facilities
N
W
E
S
Legend
Shelter
Ascot High School
Ascot Primary School
Belmont Primary School
Bracton All Age School
Bridgeport High School
Cumberland High School
Greater Portmore High School
Gregory Park Primary School
Independence City All Age School
Portmore Heart Academy
Portsmouth Primary School
Southboro Primary School
Waterford Comprehensive High School
Kensington Primary School
Critical facilities
Church
Community Centre
Fire Station
Health Centre,
Medical Centre
School
Post Office
Police Station
Colour Code for the Critical Facilities
Negligible
Medium
Moderately High
High
Seismic Societal Vulnerability Hazard Zones
Low
Medium
Moderately High
High
Drains
Roads
Portmore Boundary
0 500 1,000 2,000
Meters
Ikonos, 2001

## Flood Societal Vulnerability Map with Critical Facilities




**Legend**

**Shelter**

- Ascot High School
- Ascot Primary School
- Belmont Primary School
- Braeton All Age School
- Bridgeport High School
- Cumberland High School
- Greater Portmore High School
- Gregory Park Primary School
- Independence City All Age School
- Portmore Heart Academy
- Portsmouth Primary School
- Southboro Primary School
- Waterford Comprehensive High School
- Kensington Primary School

**Critical Facilities**

- Church
- Community Centre
- Fire Station
- Health Centre,
- Medical Centre
- School
- Post Office
- Police Station

**Colour Code for the Critical Facilities**

- Negligible
- Medium
- Moderately High
- High

**Flood Hazard Zones**

- Negligible
- Medium
- Moderately High
- High

- Drains
- Roads
- Portmore Boundary

0 262.5 525 1,050 1,575 2,100
Meters

Ikonos, 2001

# Conclusions and Limitations

- The urban areas such as Portmore are vulnerable to various hazards.
- The vulnerability to these hazard involve both the natural factors as well as socio-economic factors

# REFERENCES


- Cutter, S. L., 1993. *Living with Risk*. London: Edward Arnold. 214 pp
- Cutter, S. L., Mitchell, J.T and Scott, M. S., 1997. Handbook For Conducting A GIS- Based Hazard Assessment at The County Level. Report, South Carolina Emergency Preparedness Division, and Hazard Research Lab, Department of Geography, University of South Carolina