VOLUME 1

SECTION 3

Hazard Mitigation

Guidelines For Development In High Risk Areas

Office of Disaster Preparedness and Emergency Management

TABLE OF CONTENT

CHAPTER 1

GUIDELINES FOR DEVELOPMENT IN HIGH RISK AREAS

1.0 BACKGROUND

1.0.1 Authority of the ODPEM

The Disaster Preparedness and Emergency Management Act (1993) provides the legal framework for the functions of the ODPEM. The Act stipulates among other things, that the ODPEM should encourage measures for mitigating the effects of hazards and reducing losses from disasters. The ODPEM encourages and supports disaster preparedness and mitigation measures in all the parishes in collaboration with the local government authorities, community based organisations and the private and voluntary agencies. The ODPEM plans and also implements programmes to enhance public awareness and understanding of disaster related issues, emergency management, and hazard prevention.

The Office also has a duty to encourage measures for mitigating the effect of hazards and to reduce losses from disaster and to develop of comprehensive disaster prevention and preparedness programmes and capabilities, among other things.

1.2 DISASTERS

The occurrences of disasters are of concern to islands and small economies such as Jamaica's, as a single disaster is capable of interrupting the development process and the entire economy. Disasters have the potential to retard economic development by destroying physical infrastructure and the environment; this invariably redirects scarce resources to address recovery and rehabilitation.

The vulnerability of Jamaica is increasing and a number of factors have led to this increase. These include:

- Increased development in marginal (high risk) areas.
- Inadequate efforts to mitigate the effects of hazards
- Anticipated increase in the occurrences of extreme events due to climate change

1.3 PLANNING AND MITIGATION

The planning process is an excellent method of promoting the incorporation of mitigation measures into developments and this is essential for mitigation success, both before and after natural disasters. According to Morentz etal (1982), "Planning is a process of anticipating future needs and programming resource expenditures in light of expected hazardous conditions and human vulnerabilities." Planning for natural disasters therefore, must be a dynamic and flexible process, due to the unpredictable nature of natural disasters

The ODPEM is part of a group of technical agencies that make recommendations on subdivisions in high risk or hazard prone areas. "High-risk areas are those areas that fall within the following criteria, and are categorised as follows:

- High population density.
- History of frequent disaster occurrences
- High dependency ratio
- Large disaster impact area
- High damage magnitude
- Poor quality of construction."

Source: Jamaica's National Hazard Management Programme - A review of work in progress by F. McDonald and K. Ford

Development within such areas is considered special depending on the land use and the potential impact from the hazard. Hazard maps and other tools can aid in guiding decision makers in identifying areas requiring special standards for development. Developments within these areas will require special permission and approval may be subject to conditions.

1.4 PURPOSE OF THE GUIDELINES

Developers of land located within disaster prone areas are faced with additional issues of disaster management that must be taken into account in their project planning and design, and in the approval processes. Decisions must be taken in relation to the degree of related risk to owners, occupiers and the community in general.

These guidelines are intended to assist in the planning and design of development proposals by setting out key factors which need to be considered in assessing the degree of risk, and the management of the risk through appropriate mitigation, planning and design measures.

1.5 SCOPE OF GUIDELINES

This guideline document is intended to apply to all developments and subdivision of land. Under the Town and Country Planning Act (1958), "development" means "the carrying out of any building, engineering, mining and other operations in, on, over or under land and the making of any material change in the use of any buildings or other land". Acts such as the Local Improvements Act which deals with **subdivision of land**, the Natural Resources Conservation Act, which deals with the Environment and the KSAC and Parish Council Acts also apply.

1.6 LIMITATIONS OF GUIDELINES

The techniques included in this document in some cases represent some of the more widely used techniques used to mitigate the impacts of natural hazards. The list of mitigation techniques outlined for each hazard is by no means exhaustive as there are several other techniques that may not have been included.

It is to be further noted that these measures are to be applied only after careful analysis of site conditions to determine the appropriateness of the techniques. It is also expected that appropriate professional input will be made such as planners, engineers and architects and approval must be given by the relevant government agencies.

The guidelines are not intended to replace submission of development subdivision/building plans for approval and are not intended to be used as technical assessments of specific sites.

1.7 AIM

The main aim of the guidelines contained in this document is to promote sustainable development through the integration of mitigation techniques in the development of land in order to minimise the effects of hazards on lives, property and the environment.

CHAPTER 2

FLOODING

2.0 FLOOD PRONE AREAS

When siting a development in an area affected by flooding, the following must be taken into consideration:

i Floor levels are elevated more than the required 15cm (6") above ground level.

ii Avoid Redirection of flows which may create detrimental impact or damage to adjacent properties should be avoided.

iii Unless mitigation measures are in place, the development should not cause increase in velocity of run-off which will cause an erosion risk.

iv Developments should also be designed to avoid debris build up, which may increase flood levels and divert flows.

v Construction debris should be removed from all sites to prevent it being mobilised and choking existing drainage systems.

vi Drainage systems should be so designed that external flooding is unable to penetrate the basement area and vents and staircases, lifts and voids etc should not act as floodwater inlets to floor levels below the flood level.

vii Where sites are located below known flood levels, it is recommended that the building be raised on stilts, pile or columns.

viii Site levels should be raised above known flood levels to minimise the risk of flooding.

ix Flood resistant materials should be used to construct buildings located in flood prone areas. It should be ensured that these materials do not lose strength when immersed in water.

x Suitable foundations should be utilised which takes into consideration soil type, type and use of building, height of water table.

xi Incorporate flood-proofing measures in the development which may include the construction of flood walls, berms/embankments/levees.

xii A careful determination of the type of flooding should be made so that the mitigation measures correspond to the type of flooding. For example, divergent "V" walls are best suited for sediment floods and debris flows.

xiii As far as possible subdivision bridges must be clear span to prevent the accumulation of debris.

xiv Proper drainage and sewage that take floodwaters capacities into account must be included

xv Roads within the sub-division should be constructed as high as is economically possible above known flood levels to reduce the risk of inundation.

xvi Developments within flood zones of a river's flood plain should be selective. As a general rule the following uses should be prohibited within flood prone areas:

- Gas stations
- Schools
- Hospitals
- Fire Stations
- Police Stations
- Infirmaries
- Cemeteries
- Industries that use or generate hazardous materials
- Livestock/Animal husbandry

Should any of the above listed development take place in there areas, appropriate mitigation measures **MUST** be employed.

2.1 GUIDE FOR PERMISSIBLE USES - RIVER FLOOD PLAIN

The following table can be used as a guide for permissible uses within the flood plain of a river.

	Single Zone[1]	Two- Zone[2]	
		Floodway	Floodway Fringe
Permitted Use	Agricultural uses such as farming, pasture, outdoor plant nurseries, horticulture. Industrial uses such as loading areas, parking, and airport landing strip. Recreational uses such as parks, golf courses, picnic grounds etc. Residential uses such as lawns, gardens, parking areas.	All uses permitted in the Single-zone	All uses permitted in the flood way. Structures constructed on stilts or fill so first floors are above regulatory flood elevation.
Special Exceptions	For-structures - a technical assessment is required of the actual flood level. Increases in flood levels that may be caused by proposed developments need to be assessed so that regulatory standards for its approval can be applied. Consideration of the effects shall be based on the assumption of equal degree of encroachment over an extended reach of both banks.	**Structures not designed for human habitation, have low damage potential and minimal obstruction to flood flows. Transient amusement enterprises: circus, carnivals. Drive-in theatres, car parks Sand and gravel mining Storage for material and equipment	Usage permitted in the flood way.

***Structure acting alone or in combination with existing or future use should not increase the flood heights above some threshold level. NB. This requires that a hydraulic assessment be done.*

[1] In the single-zone approach a single zone is demarcated as the regulatory flood boundary. This zone can be based on technical studies or from historical floods or high water marks. This approach is most appropriate for rural areas undergoing scattered developments and is likely to attract large sub-divisions. Areas with steep valley slopes, unstable banks and poor soils and areas with frequent flooding occurrences are also suitable for this approach.

[2] This approach divides the regulatory flood boundary into a floodway and a floodway fringe. The former is the area of the channel which is kept open to carry flood water, no building or fill is allowed. In the latter zone, use is permitted if it is protected by fill, flood proofed or otherwise protected.

2.1.1 The two Zone Approach

The two-zone approach should be used in urban areas and other areas subject to development pressure and every effort should be made to obtain the necessary data for hydrologic and hydraulic studies to demarcate flood boundaries.

CHAPTER 3

HURRICANES

3.0 Hurricane Protection Measures

A new development in an area prone to the effect of a hurricane can be carried out providing the selection of good soil, which will not lose its bearing capacity when inundated is used for siting of the foundation.

Hurricanes can cause damage to buildings mainly by the wind which affect roofs and windows and by rainfall which can damage foundations. Hurricanes also cause storm surges which can also destroy structures. Appropriate mitigation measures should therefore be taken into consideration.

3.0.1 Porches

The following are the guidelines for erection of porches:

i Reinforce porches as they are a major source of weakness in a building

ii It is not recommended that half porches be constructed, as wind trapped underneath an open or half porch will increase high uplift forced on the roof.

iii Buildings should be well anchored and all elements of the buildings connected together.

iv Separate roofs from porches and verandas from the main roof, as they are more vulnerable to uplift from heavy winds.

v The use of bracing for stability is crucial (important in Hall Type Buildings such as schools)

vi Window frames should be well anchored in wall.

vii Use timber or metal louvers if possible as they have been proven to have the highest resistance to damage. Glass is prone to shattering from flying debris.

viii Separate doors from windows if possible.

ix Buildings can be protected by planting trees no less than fifteen metres (15m) from the buildings and there should be no unnecessary felling of trees which will act as windbreaks especially in coastal areas.

x Provide shutters for windows and doors, especially glass which has very little resistance to wind.

3.0.2 Roofs

Roofs of buildings are the most vulnerable to wind damage. It is therefore important that they be properly constructed to minimise damage. The are some guidelines for roof construction:

Minimise the use of flat or low-pitched roofs. Hip roofs are best and roofs should not be pitched at less than 15^0.

Section 4.1.2 of the National Building Code provides the basis of design for wind pressures and stresses due to wind loading.

i Verges, eaves and overhangs should be no longer than 18".

ii Rafters should be attached to wall plates with twisted metal hurricane straps

iii Pockets under eaves should be minimized by boarding or sheeting to the underside.

iv Detail at ends of eaves should protect open edges of sheet covering to avoid uplift.

v Fascia boards must be installed with appropriate capping

vi The following specifications for Galvanized Shingle Roof must be adhered to:

- Hurricane twisted straps to every rafter
- 26 Gauge Alusteel or Galvalume Sheeting should be used.
- Wall plates to hold down bolts at 1050 mm centers.
- Maximum specification of timber purling 900 mm.
- Use more fixings, that is, zinc nails or screws, to secure sheeting that are thin. Putting the laths at closer centres and the nails closer together can do this. See table on overleaf:

Gauge Of Sheeting	Spacing Of Lath
28	18 ins – 2ft
26	2ft. – 2ft. 6ins
24	2ft for nails 3ft. for screws

CHAPTER4

STORM SURGES AND TSUNAMIS

4.0 STORM SURGE

Storm surges can accompany a hurricane. The most significant damage from storm surges often result from the direct impact of waves on fixed structures and indirect impact including coastal flooding and undermining of infrastructure.

A new development in an area prone to flooding or storm surges can be permitted providing:

i Developments be **set back** appropriately from the coastal high water mark according to the distances specified in the manual for development. The line of permanent vegetation can also be used as a base for setbacks. For areas where storm surge inventory maps exist, the maximum-recorded surge distance and surge height can be used as a guide for offsetting developments from the coastline. Storm Surge hazard maps, where they exist should also be used to determine setbacks.

ii Buildings should be constructed at **higher elevations**, with timber piles or poles on concrete piles or columns embedded in grain so that the first floor structure is at the high water level. Care must be taken in using this strategy, as it must be ensured that the design takes into consideration water, wind, waves, velocity and erosion.

iii Critical facilities should not be located in areas susceptible to storm surges

iv No development will be permitted seaward of the baseline of permanent vegetation, except for jetting and docking facilities. Non-permanent structures can be permitted.

v An evacuation plan will be required for large subdivisions and large facilities. Infrastructure must be designed to support access by emergency vehicles, and large vehicles.

4.1 TSUNAMI

Developments may be permitted in areas prone to tsunamis provided that certain

precautions are observed.

4.1.1 Criteria for development in the above areas

The following are the criteria for development in areas prone to tsunamis:

i Precautions for the quick drying of immersed houses are similar to those in the case of inundation.

ii The protection of settlements on the coast against tsunami by the construction of embankments and flood – walls (This is very expensive and can be justified economically only in special cases).

iii The most efficient way of protecting buildings in the tsunami areas is the construction of new settlements, if possible above the locally acceptable risk level.

iv Buildings and houses in tsunami areas should be built of solid material (brick, concrete) to be able to resist the horizontal drag exerted on them, while submerged.

v If the coastal topography is flat, the protection of structures against tsunamis can be provided by supporting structures on timber piles and poles or concrete piles and columns to provide a sufficient clearance of the structure above high water level.

vi Setbacks from high watermarks must be observed.

CHAPTER 5

EARTHQUAKES AND LANDSLIDES

5.0 EARTHQUAKES

5.0.1 The National Building Code

The National Building Code of Jamaica, 2nd Edition, contains specifications for building construction, that is, general requirements, public safety requirements, material and construction standards, service requirements and miscellaneous requirements. For earthquake loads, section 4.1.3.1 speaks to the basis for design:

Every building and structure and every portion thereof shall be designed and constructed in accordance with the latest edition of 'Recommended Lateral Force Requirements and Commentary' by the seismology Committee of the Structural Engineer's Association of California.'

The ODPEM recommends that all developments MUST be submitted to the Local Planning authority for approval prior to construction. That way, conformity with the Building Code can be ensured.

5.0.2 Guidelines for Designing and Locating Facilities in Earthquake Prone Areas

The following guidelines should be considered when designing and locating facilities in earthquake prone areas:

i Care should be taken not to site critical facilities/sensitive functions in areas having a high earthquake risk, for example, areas near to fault lines.

ii Densities- zones with high hazard proneness should only have low-density functions. Limiting building height can be an efficient way of controlling density.

iii Layout – The width of streets and the availability of open spaces are escape possibilities for the population. Main streets should be wide enough so that if a building collapses it does not completely obstruct the roadway.

5.1 LANDSLIDES

5.1.1 Site Assessment

Prior to any development being carried out in an area prone to landslide, it is recommended that a site-specific assessment be carried out to determine the level of vulnerability of site. It is recommended that a geo-technical engineer carry out this assessment due to the nature of landslide hazards. The assessment will indicate the type of landslide to which the site is vulnerable, that is shallow or deep-seated landslide and the best mitigation measure to reduce the risk of the site. In the case of the deep seated landslides may be the best option.

5.1.2 Guidelines To Minimise Landslide Risks

The following are guidelines that developers can follow to minimise this risk of landslides:

i Avoid massive site clearance which will remove majority of the vegetation cover and expose the site to the risk of erosion

ii Replace vegetative cover if necessary with vegetation that can assist with soil stabilisation.

iii Carefully select foundations which are suited to geological conditions

iv Construct engineered structures to retain slopes such as Gabion baskets, retaining walls, etc.

v Reduce the probability of landslide activation by minimising density and height of structures.

vi Modify slopes to reduce the risk of landslides, for example, the use of the cut and fill technique.

vii Implement proper drains which can channel water away from the slopes to reduce the risk of activating landslides.

viii Construct engineered structures to control landslides.

CONTACT INFORMATION

5.2 CONTACT INFORMATION

Director general
Office of Disaster Preparedness and Emergency Management
Camp Road, Kingston 4
Tel: (876) 928-5111-3
Fax:
E-mail:
Website:

Appendix 1

REFERENCES

UNDRO/MND, United Nations: Mitigating Natural Disasters Phenomena, Effects and Options, A Manual for Planners and Policy Makers, United Nations 1991.

UNEP/USAID/CAST: Caribbean Regional Training Manual on Environmentally Sound Tourist Design Facility Design And Development.
UNEP/Caribbean Environment Programme, Kingston 1999.

The Standing Review Committee on the Building Code, Ministry of Finance and Planning:
National Building Code of Jamaica, 2nd Edition (Metric Units), CAST Printery 1992.

Federal Emergency Management Agency: Design Manual for Retrofitting Flood Prone Residential Structures. Federal Emergency Management Agency September 1986.

OAS/DRDE: Primer on Natural Hazard Management in Integrated Regional Development Planning