



**Grenada, Hurricane Ivan
Preliminary Assessment of Damages
September 17, 2004**

On September 13, the World Bank damage reconnaissance team arrived in St George's, Grenada to conduct a rapid evaluation of the direct damage inflicted by Hurricane Ivan. On arrival, the team met with Prime Minister Mitchell to discuss the situation and develop its initial assessment plan. Over the 3 day period, September 13 to September 15, the team visited several localities around the island. An aerial survey was conducted and interviews with representatives of aid organizations, government staff and affected citizens were held to develop the basis for this assessment.

This report is filed as a preliminary assessment of the direct damage caused during Hurricane Ivan. Given the early nature of this assessment, no monetary figure is provided. A formal assessment mission, led by the OECS Secretariat, is scheduled to arrive in Grenada on Monday September 20, 2004.

Acknowledgements

The team would like to extend its grateful appreciation to Prime Minister Keith Mitchell and his staff for their assistance in developing this initial assessment.

Additionally we would like to extend our thanks to Hon. Claris Charles – Minister of Education, Grenada; Hon. Timothy Antoine - Permanent Secretary of Finance, Grenada; Maj. Nazrul Hussein, Caribbean Disaster Response Unit; Dr. Dana van Alphen, Regional Advisor, Program on Emergency Preparedness and Disaster Relief, PAHO/WHO; and Nigel John, Grenada Chamber of Commerce.

The team is grateful to the representatives of the following organizations for providing their observations and preliminary reports to assist with the preparation of this assessment: Pan American Health Organization; U.S. Agency for International Development; National Rural Electric Cooperative Association; Axis International Ltd; The OECS Defense System; Grenada Police Department; Grenada Ministry of Education; Grenada Ministry of Finance; Grenada Ports Authority; Airport Authority, Salines International Airport; OXFAM, UK.

Finally the team would like to thank the local citizens who were so kind as to take time from their personal recovery efforts to assist with this assessment.

A list of persons formally interviewed is provided in annex 1 of this report.

Storm Details

Hurricane Ivan struck Grenada with full force on September 7, 2004. The storm was well organized with a sharply defined eye. At that time, the storm was rated as category 3 on the Safford-Simpson scale.

According to eyewitness accounts and based on the type and distribution of damages, the southern end of Grenada was hit by the northern portion of the eye and spent the majority of the storm exposed to the eye wall section of the hurricane. During the course of the storm, the area of St. George's experienced approximately 20 minutes of respite associated with eye passage before re-entering the eye wall.

The southern portion of Grenada was exposed to severe winds in excess of 135 mph. Based on the pattern of downed trees, nature and distribution of damages, microburst downdrafts appear to have been a major cause of damage. No evidence was noted by team members of tornado touchdown, however, given the type of damage observed, (i.e. cars and trucks blown over, telephone poles snapped, structures completely destroyed) winds of F-2 and F-3 velocity (Fujitsu scale) seem to have affected most of this region.

The island was exposed to hurricane force winds for approximately 6 hours. The storm moved through Grenada fairly rapidly and did not produce a large volume of rainfall. The relative lack of rain coupled with the hurricane's arrival during daylight hours served to mitigate the potential loss of life (37 confirmed dead at this writing), and limit damages to road and drainage infrastructure. Had it passed during nighttime hours, the death toll would undoubtedly have been much higher.

General Damage Observations

Hurricane Ivan affected the entire island of Grenada. The vast majority of the severe damage was experienced in the southern portion of the island below a line drawn roughly from Grenville to north of St. George's. Visible damages included the partial or total loss of building structures, broken and uprooted trees, broken utility poles and damaged vehicles.

As Ivan was a relatively dry hurricane, damage from flooding and mudslide was not extensive. Streams did flood and where debris piled up to block water flow, in areas such as bridges and culverts, flooding was more pronounced. Roadways were blocked by debris and fallen trees, but generally remained intact with little evidence of landslides or washouts. The storm surge associated with Ivan was apparently not a major factor and sea defenses appear to have resisted the wave action forces without damage.

The electrical distribution network and communications grid were the public utilities most affected by the storm. Telephone access was damaged but mobile communication is partially available and should be fully operation within a matter of weeks. The water distribution system was only partially affected. Airport and port facilities suffered damages but are receiving traffic and are nearly 100% functional. Both the port and

airport lost lighting systems and are currently restricted to daylight operations only. Warehouses in both facilities have lost roofs and cladding.

Watershed loss is extensive with trees down or damaged. Agricultural resources are severely affected, however for the present, water sources and agricultural lands are in relatively good condition. Crop damage is nearly 100% for banana and sugar cane. Nutmeg and other spice production infrastructure is likely seriously affected. Nutmeg plantations in St. Andrews parish were devastated but farms located predominately in the northern portion of the island (e.g. St Patrick Parish) may have escaped with minimal losses.

Public infrastructure, in particular school buildings, suffered major losses. While St. George's Hospital has been remained functional, Princess Alice Hospital (the island's second largest) is more than 70% destroyed. Only 2 of the islands 75 primary and secondary schools have survived with minimal damage. Other government buildings, including the government complex have suffered significant water damage.

Sectoral Damage Observations

Education

An initial assessment of the education sector indicated that of 19 secondary schools, 18 are severely damaged. Primary schools number 56 on the island with 55 suffering significant damages. Most of the 74 preschool and 23 daycare centers, as well as the national college have also been severely affected. A review of damage levels to schools broken down by parish is presented in table 1.

Typical losses include partial or total collapse of roof structures, collapse of walls in older structures and rainwater damage to classrooms, offices and other structures. Aside from the structural losses, books, lab equipment, teaching aids etc. have been damaged beyond usefulness. In some cases, looting has further exacerbated the losses realized.

It is worthy to note that the two surviving schools were the object of a recent World Bank retrofitting program. In particular, the school at Westerhall survived with only minor damages and is currently serving as temporary housing for displaced hurricane refugees.

Table 1
Summary Assessment of Schools Damaged

Parish	Average level of Damages
Carriacou & Petite Martinique	Level 1
St. Patrick	Level 2
St. Mark	Level 3
St. John	Level 3
St. Andrew	Level 3
St. David	Level 4
St. George's	Level 4

Legend:

- ND No damages
- Level 1 Windows, doors and furnishing destroyed or damaged
- Level 2 Partial roof covering destroyed or damaged
- Level 3 Roof structure destroyed or damaged
- Level 4 Complete roof destroyed
- Level 5 Significant damage to structural frame

Housing

Housing damage is extensive, particularly in the south. Estimates based on sample surveys suggest that over 90% of the housing stock has been destroyed or suffered some type of damage. Virtually 100% of the houses in the southern region of the island have suffered damages of one kind or another.

Damages range from broken windows and water damage to the complete destruction of the structure. Estimates suggest that approximately 40% of the houses on Grenada are uninhabitable. The nature of the damages observed is so extensive that the impact will extend to other sectors. Re-establishing the power grid and water service will be problematic. Before utilities are restored, service connections for each structure will need to be individually shut down, inspected and reconnected.

Houses on the northern end of the island appear to be less affected than those located in the south. Observations made during a helicopter over-flight on September 16 revealed a substantially lower number of houses in the northern section of the island suffering from obvious roof and structure damage. Table 2 presents a housing damage overview by parish.

Table 2
Assessment of Houses Damaged
(% of sample in category):

Parish	ND	Level 1	Level 2	Level 3	Level 4	Level 5
Carriacou & Petite Martinique	60	25	10	5	0	0
St. Patrick	30	30	20	15	5	0
St. Mark	30	30	25	10	5	0
St. John	20	25	35	15	5	0
St. Andrew	5	15	20	30	20	10
St. David	0	5	10	20	50	15
St. George's	0	5	10	20	50	15

Legend:

ND	No damages
Level 1	Windows, doors and furnishing destroyed or damaged
Level 2	Partial roof covering destroyed or damaged
Level 3	Roof structure destroyed or damaged
Level 4	Complete roof destroyed
Level 5	Significant damage to structural frame

Government Offices and Facilities

The government complex in St. George's suffered wind and water damages but appears to be structurally intact. A walkthrough of the main complex and of the Ministry of Education's facilities revealed significant water damage. Most of the floor area on all building levels was covered with standing water. A power generator is located on the premise, but until the facility dries out and an electrical inspection can be made, power will not be available. Furniture water damage is evident and there will undoubtedly be damage to file and information handling systems. Depending on the type of damage to computer systems, data salvage and recovery may become a recovery priority.

- The financial complex in St. George's is relatively intact with broken windows and limited water damages. Power is presently off and water service has yet to be restored.
- Police stations, fire stations and other government facilities were not specifically visited on this mission but according to reports, suffered significant damages as well.
- Nero's temporary offices were destroyed early during the storm. This prompted the unit to move to their new headquarters facility. Emergency operations are being conducted from the new facility at this time.

- The national prison has suffered significant damage and will need extensive repair.
- The national stadium has suffered extensive damage, particularly to roofs and lighting structures. The facility will probably serve as an emergency staging area for supplies and material during the initial reconstruction phase of the disaster.

Hospitals and Clinics

The hospital in St. George's has lost its laboratory and suffered limited roof damage. The facility is currently the principal health center for the island.

Princess Alice hospital in Grenville is virtually destroyed. The roof is completely missing and internal damage, as viewed from the air, is extensive. Reinforced walls are still standing but all windows are gone. Hospital equipment is obviously damaged and most of the facility cannot be used.

Damage suffered by regional clinics was apparently minor but staffing and supply problems, coupled with the massive power loss, have limited their effectiveness. Efforts are underway to re-staff and re-supply local clinics to relieve the pressure on the hospital at St. George's.

Finally, the Red Cross headquarters facility in St. George's was destroyed.

Water, Power, and Communications

Water

The water supply system suffered little damage owing to the limited rainfall and erosion associated with Ivan. Reservoirs are intact; dams appear from the air, to be undamaged and serviceable. The pumping and distribution system appears to have suffered little damage, as most of the network is underground and protected. Pumps are out of service since power has not been re-established. System damages will likely be confined to pipes located within specific structures. These systems can be isolated by their respective service valves.

As the water system is largely dependent on surface water supplies, there is a concern that watershed damage may adversely affect water quality over the coming months. While the reservoir system is presently undamaged, the extensive damage to the watershed will promote erosion affecting water supply. Additionally, watershed loss will result in an increase in the surface runoff expected during storm events, promoting flooding in streams and catchments areas.

Power

Electric power is shutdown throughout the entire island. Facilities with power are relying on their own generating systems. Most affected is the power grid. Transformers have been displaced from their mounts, turned over, or have lost their cooling oil and are not serviceable. Transmission lines are down and have been damaged not only due to the hurricane forces, but also during damage cleanup operations. Downed lines have been cut and removed, and are not considered reusable. Preliminary estimates are that the entire distribution system has been damaged and that more than 80% of the grid will need to be rebuilt.

Power generation capacity is intact and undamaged. Island power is produced using oil-fired generators which can be brought back on line as the distribution grid is restored. A damage assessment team from the Rural Electric Cooperative Association in Washington D.C. is onsite performing a damage assessment which should be available by Tuesday 21 September. This team is under contract to USAID.

Communications

Communications have been severely affected. Limited cellular coverage (cable and wireless) is available but most of the land based phone service is still down. Where phone lines are operational, off-island calls cannot be made. Restoration depends on the reestablishment of the wired grid, which is attached to the same utility poles used for electrical service.

Transportation

Airport

The transportation sector survived well, owing to the lack of rain and flooding activity. The airport suffered wind damage to the perimeter fence and loss of power to lighting and navigation aids such as its VOR (VHF Omnidirectional Radio) and runway lights. This will affect nighttime and instrument flight operations. Power to the terminal area and tower has been restored using the Airport's onsite generator system.

A walk-through inspection of the facility revealed the loss of a rooftop air conditioner, some roof damage, and a few broken windows. Approximately 250 meters of perimeter fencing will need to be reattached and approximately 100 meters, located along beach areas, will require complete reconstruction.

Runway, terminal, and wastewater treatment facilities, survived with little or no damage. The hanger bays and storage buildings suffered damages to walls and roofs. The fire and rescue facility lost its roof and suffered damage to its walls. Ground equipment such as trucks, mobile stairs and cargo handling equipment have been damaged by winds. Most of the damage resulted from being blown over and rolled during the storm.

In terms of passenger and aircraft operations, the airport is 100% functional for daylight operations. While the tower has suffered some wind damage, it too is 100% functional.

Port at St. George's

On September 12, a walk-through inspection of the port of St. George's was conducted and interviews were taken with the Port facility manager. According to interviews, port channel and marine access are unimpeded. No damage to shipping lanes resulting from sunken vessels or accumulations of debris has been noted. Lighting is down and the port is currently restricted to daylight operations. Temporary portable lighting can be provided to support nighttime operations.

All docks are open and functional with the exception of the loss of approximately 500 feet along the northern pier in the vicinity of the Blue Shed. This is due to the sinking of a small (25 foot) pilot boat used for ferrying harbor pilots to and from larger cargo vessels. Upon its removal, the entire cay will again be available to shipping. Of the 1330 linear feet of dock space, 1200 feet is currently available to shipping.

Specifically:

- The container patio is undamaged and ground cargo handling equipment is completely operational with no loss attributed to the storm. Grain handling equipment was damaged but the port has historically relied on shipboard equipment to discharge vessels.
- All warehouses and maintenance sheds are damaged. Damages include the complete loss of roof and cladding on "Queens Warehouse", loss of portions of the roof and sidewalls on the "Blue Shed", severe damage to the "Geest Shed", and loss of the agricultural storage facility. All maintenance buildings have suffered damage as well.
- The cruise ship welcome center was damaged with some loss of roofing but is being used presently to house security forces. The customs house has lost its roof and all windows are missing. The building housing the Grenada Tourism Authority has also lost its roof and has suffered significant damages to the interior structure.

Port operations are near 100% functional with the exception of their ability to protect cargos from the elements. Damages to the warehousing structures have crippled their ability to store goods under roof and the port authority has set reconstruction priorities (initially the repair of the blue shed) to accommodate relief efforts. Additionally, anticipating the enormous demand for reconstruction supplies, the port authority is in the process of commandeering the national stadium as an ancillary storage facility.

Roads

Roadways on the island survived with remarkably little damage. The lack of intense rainfall associated with the storm limited the flood and erosion damages, preserving the existing structures and roadway. Bridges are intact and passable.

Roadway obstruction is the principal problem, but most of the blockages are due to fallen trees or debris. Landslides were uncommon which is attributable to the dry nature of the storm. All major roadways were open at this writing.

Watershed damage suffered during the storm may have created vulnerabilities to the transportation network and are discussed under the watershed section of this report.

Agriculture

The agriculture sector was particularly hard hit by Hurricane Ivan. Based on observations made during the over-flight, the current banana crop appears to be a 100% loss. The principal region for banana production is west of Granville in the vicinity of Clabony – Mount Hope. This area was the site of intense wind activity, which resulted in the complete destruction of the standing banana crop. According to representatives from the Ministry of Agriculture and local farmers, the damage has not destroyed the crop base and cutting the banana plants back to their roots will allow the next crop to develop over the next 6 months.

Nutmeg is another principal export but depressed market conditions have resulted in a significant stockpiling of nutmeg in island warehouses. The level of damage to the nutmeg industry has not yet been assessed but according to interviews, plantations located in St. Andrew Parish were severely affected with significant tree loss. Those plantations located in the northern sections of the island are likely still intact.

Tilled soils in the region appear to be intact showing little sign of erosion or physical damage. However, as with the water supply, the severe damage to the surrounding watershed presents an opportunity for continued soils damage due to erosion from rainfall. Grazing lands and the livestock inventory appears to have survived but agricultural infrastructure (i.e., facilities, processing centers and distribution centers) is likely damaged.

Environmental Damage and Watershed Integrity

Damage to the natural features of Grenada was widespread. In Saint Andrew Parish, the Grand Etang Forest Reserve suffered extensive and severe damage. On inspection, an estimated 50% of the canopy trees are on the ground. The Remaining 50% have been stripped of virtually all their leaves and suffered significant bark limb damage. Forest understory has also suffered severe damage.

At higher elevations, along the ridges of Mount Hope and Mount St. Catherine, the damage was similarly severe with landslides emanating from the ridge tops. To the north of Mount Saint Catherine in St. Patrick Parish, tree damage was notably less severe. Most trees retained their leaves and fallen trees were much less abundant. Rivers in the region appear to be clear of sediments and debris but will be vulnerable to erosion and silting due to the watershed damage.

The watershed damage is of particular concern, due to the potential for increased erosion and flooding. The damage to the central and southeastern mountains is extensive and will take years to recover. Ground cover will likely return quickly, but the ability of the watershed to provide flood and erosion control services is limited. A ground reconnaissance will be required to assess the region's potential for regeneration.

Watershed damages will likely affect the water supply, agricultural and health sectors. Additionally the tourism value of many of the natural features of the region has been greatly affected. The rainy season begins in June and lasts until October; during which time, rainfall amounts are variable with up to 350 centimeters falling in the northeastern mountains, to 180 centimeters western lowlands.

Coastal zone damages appear limited. The majority of the losses were observed on the southeast section of the island. Storm surge was not a significant problem and reef areas were scoured but not destroyed. Locally, there were some damages to reef structures evident but generally, coastal areas survived well. The lack of rain associated with Ivan served to mitigate near shore damage resulting from sedimentation and debris deposition. The majority of the coastline, as observed from the air, appears relatively clear, clean and undamaged.

Tourism

The tourism industry was particularly hard hit during Hurricane Ivan. Damage to structures and grounds was extensive with roofs destroyed and landscaping up-rooted. While beaches and shore areas remain intact, 70% of the supporting infrastructure been damaged. Aside from the loss of infrastructure, the damages to the island's inland natural resources have diminished the appeal of the island.

According to industry experts, infrastructure recovery is expected to take over a year. Approximately 30% of the hotel infrastructure will be operational by January 2005, another 30% is estimated to be operational by June 2005, and by January 2006, 90% of the hotel infrastructure is expected to be reestablished.

While no estimates are currently available, demand for services in the tourism sector is expected to drop over the coming 2-3 years. The quality of the tourism product available during the reconstruction period will be diminished and will likely be reflect in a discounting of tourism services to retain the client base. Apart from the lodging and restaurant sub sectors, ecotourism and agro-tourism components have suffered fundamental damage to their base resource.

Aside from the direct losses in vessels and facilities, the recreational boating industry is also likely to lose its safe-haven insurance status. This will change the cost structure of this subcomponent.

Priority Reconstruction Activities

- Solid waste and debris are high management priorities. Loss of trees and wood structures have created an enormous volume of debris. Building cladding and roof material (corrugated sheet metal) litters the island. Arrangements for debris management must be made soon to conserve landfill space and to prohibit the build-up of debris on public roads and in other areas.
- Housing is the obvious reconstruction priority. Transportation facilities such as roads, airports, and port facilities are largely intact. Warehousing space is very limited in both the public and private sectors. Water and power are short-term priorities, as power generating capacity is intact but the distribution grid has been destroyed.
- The education sector was particularly damaged. Of 75 primary and secondary schools only 2 remain in a usable condition. Priorities should be focused on the repair and opening of schools with limited damage, and on the establishment of temporary classroom spaces.
- Communication is limited but cell phone service is available on the island. Telephone service has been severely affected and is a restoration priority as well.
- The island's major hospitals are severely damaged and should be addressed immediately.
- Finally, there will be an urgent need for covered, secure storage areas for reconstruction supplies. The damage suffered by airport and seaport storage facilities should be addressed as soon as possible. Additionally, the commercial storage infrastructure has also been severely damaged. This may require the construction of temporary dry storage facilities to accommodate reconstruction efforts. The status of cold storage capacity on the island is unknown. An assessment of this infrastructure should be completed as soon as possible to assure that perishable relief supplies (food and medicine) can be accommodated.

Annex 1. Persons Interviewed during the Mission

Timothy Antoine, Permanent Secretary, Ministry of Finance
Lennox Andrews, Deputy Permanent Secretary, Ministry of Finance,
Clarice Charles, Minister, Ministry of Education
Belfon Charles, Head of Security, Point Saline Airport
Ronald Charles, Chief Executive Officer, Point Saline Airport
Sidney Charles, Operations Director, Point Saline Airport
Ian Evans, Port Manager, Grenada Port Authority
Tim Forster, Oxfam UK
Al Gooding, Procurement Officer, Ministry of Education
Carlyle Glean, Civil Engineer, Glean's Engineering Co.
Hauke Hoops, Oxfam UK
Nazrul Hussein, Major, Guyana Military
Colin Jack, Project Director, NRECA Intl. Ltd.
David Jamison, Director, Axis International Ltd.
Nigel John, President, Grenada Chamber of Commerce
Peron Johnson, Project Manager, Ministry of Education
Junior, Officer, Grenada Police
Leroy Languaine, Inspector, Grenada Police
Shirmaine Lynch, Project Officer, Econ. Affairs, Ministry of Finance
Ian McIntyre, NERO Coordinator
Adele Moore, Ass. Procurement Officer, ERP/ERDMP PCU
Edward Niles, Environment & Physical Planning , PEER Consulting
Keith Patrick, Driver, Ministry of Education
Karline Purcell, Project Officer, Ministry of Finance
Numa Rais, Architect, Ministry of Works
Peter Shortland, Group Director, Axis International Ltd.
Edwald Spitaler, Solid Waste Expert, Oxfam UK
Dana van Alphen, Regional Advisor, PAHO