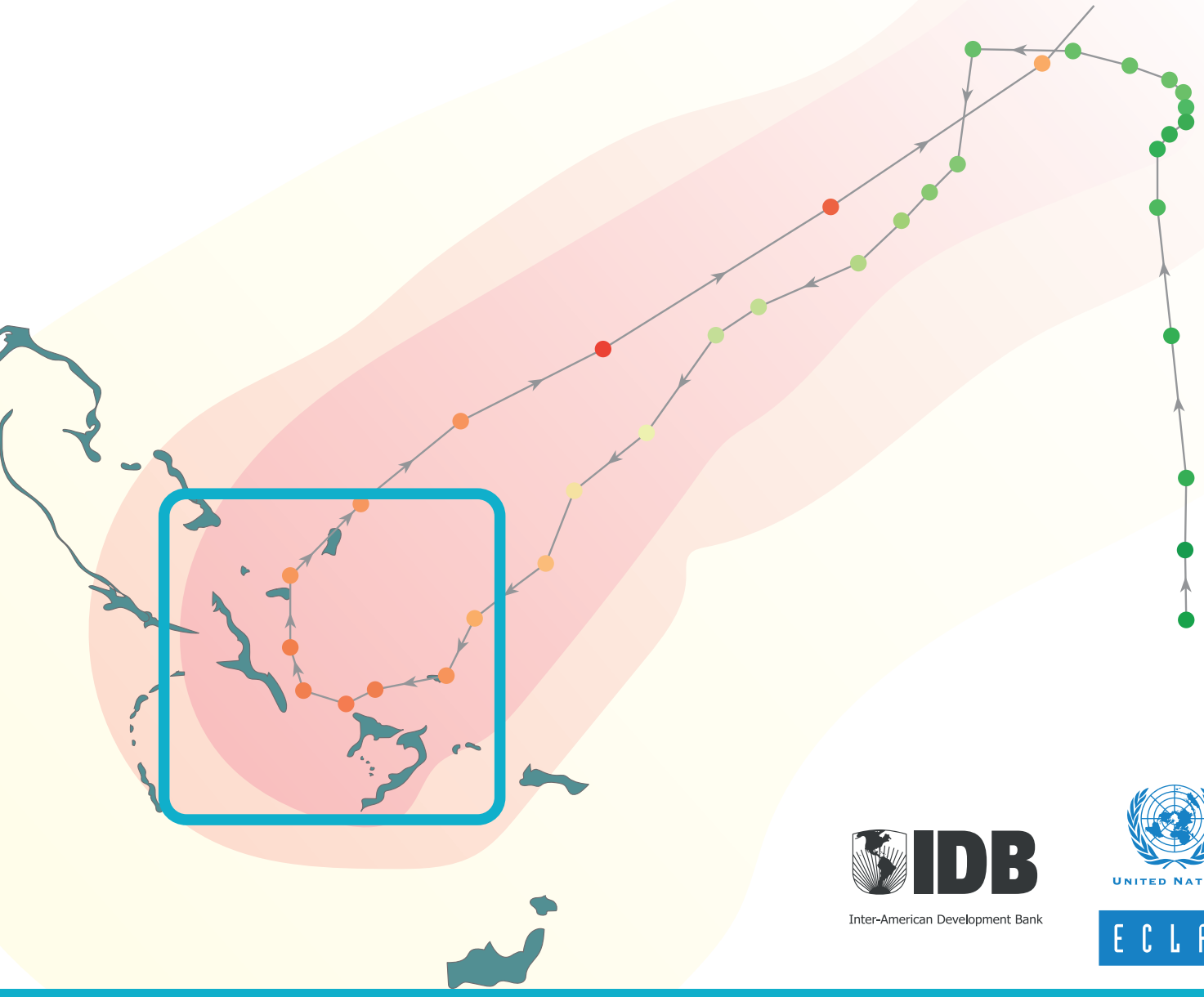
Assessment of the Effects and Impacts Caused by

Hurricane Joaquin

The Bahamas



IDB

Inter-American Development Bank

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Introduction

In 1992 the United Nations recognised the Small Island Developing States (SIDS)[1] as a unique group of countries who share a special set of challenges for sustainable development due to their location, population, and vulnerabilities to external shocks, among other factors. The Bahamas present a unique case within SIDS, with its small population spread out among 30 small islands in its large archipelago. Sitting in the Atlantic hurricane belt, disaster is a recurring possibility for The Bahamas.

Hurricane Joaquin was among the 25 hurricanes and tropical storms that have hit The Bahamas in the last 25 years, and the 10th hurricane of the 2015 hurricane season, reaching category 4 for an extended period of time over the Bahamian islands. It severely damaged islands in the southeast, central, and northwest Bahamas on its path from 30 September to 2 October, 2015. The extent of damage varies according to the amount and duration of rainfall, storm surge, the path of the storm, and other factors such as the location of the settlement, number and type of buildings in the area, the terrain, and prior conditions.

The Ministry of Finance of the Government of The Bahamas requested the Inter-American Development Bank (IDB) for an assessment in terms of damage, loss, and additional cost caused by hurricane Joaquin. The IDB requested the assistance of ECLAC for technical assistance in the assessment of the effects and impact of hurricane Joaquin. The team then made recommendations to guide a resilient reconstruction process by using the five pillars of disaster risk reduction, thereby contributing to the reduction of vulnerabilities and risks in every sector of the population associated with living in a small island developing state.

In November 2015 the members of the assessment team visited the five most severely affected islands of hurricane Joaquin: Acklins, Crooked Island, Long Island, Rum Cay, and San Salvador. After visiting each of the affected islands and speaking with local[2] and national

authorities, the team was able to analyse the damage, losses, and additional costs to the three main sectors: social, infrastructure, and productive. The social sector was broken down into health, housing, and education. The infrastructure consisted of transportation, power, telecommunications, and water sections. The productive sector was split between the tourism and fisheries industries. Each subsector sustained widespread and generalised damage and destruction among each of the affected islands.

Events like hurricane Joaquin, although large in scale and effect, can impact small regions or singular islands of The Bahamas, and the isolated nature of the settlements on each affected island make disaster risk reduction and management more challenging. The majority of settle-

1. United Nations Conference on Environment and Development. Rio de Janeiro, 1992
2. Due to logistics, authorities were unavailable at Rum Cay. Estimations for Rum Cay were made from information compiled by the Government of The Bahamas.

ments and some critical infrastructure on the affected islands exist in proximity to the coast, making them more vulnerable to disaster. In all five islands included in this report the state of infrastructure was sub-optimal prior to hurricane Joaquin. The accumulation of damage due to previous events and the lack of the routine maintenance also contributed to this situation. With pre-existing disparities between the islands in many sectors, including health, education, and infrastructure, disasters exacerbate these conditions.

Communities and families suffer stress due to damage to assets, relocation, interruption of the access to public services, and foregone economic activity. Stress can impact social cohesion and the learning ability in children. The best course of action for the affected islands is to rebuild, prepare for future disasters and mitigate the disaster risk. The Bahamas has an opportunity to resiliently reconstruct the affected islands through disaster risk management and reduction, which would prevent vulnerability and reduce future social and economic risks.

The estimated total damage to the affected islands is $104,788,224. Insurance was only able to cover approximately 13.4 per cent. In order to successfully assess the total damage of the affected islands, the team had to look at the damage to each of the three main sectors, and their individual subsectors. Damage to the infrastructure sectors made up 53 per cent of all damage caused by Joaquin. Roads were the most affected subsector of infrastructure, due to a combination of factors including vulnerable locations and poor pre-existing conditions. The telecommunications subsector was also severely damaged, with 20 per cent, and valued at $20,675,279.

The social sectors comprised 36 per cent of the damage to the affected islands with $37,969,751 in estimated damage, and the housing subsector alone accounted for $32,877,400, at 31 per cent of the total damage incurred. Finally, the productive sector accounted for 11 per cent, $11,226,000. Tourism was the predominant subsector that sustained damage.

When looking at the individual islands affected, Long Island suffered the greatest percentage of the damage with $35,693,528, which was 34 per cent of the total. This can be accounted for by Long Island having the largest population of the affected islands, which means more assets exposed to the effects of the disaster. Acklins followed with 25 per cent of the damage, at $26,476,794. San Salvador and Crooked Island sustained 19 per cent and 18 per cent, respectively, totalling over $38,000,000. Rum Cay was the smallest island in size and population that sustained damage from Joaquin, and therefore had the least damage; the estimated $4,410,435 amounted to 4 per cent.

The total estimated losses due to the suspension and disruption of services are $9,652,816, and will continue to lose until a complete recovery is made. Losses were mostly suffered by the productive sector, and just

the tourism subsector's loss is 51 per cent of the total at $4,929,425. The disruption of services like roads and water influence the losses in tourism, which is heavily relied on for employment on the affected islands.

Tourism will continue to be a primary economic driver in The Bahamas so a full and fast recovery would help prevent any further economic disparities caused by foregone income between the islands. The next largest loss by sector was to the social subsector of housing, which accounted for $2,677,500. That makes up 28 per cent of the losses. The infrastructure sector was an estimated combined loss of $1,3390,511, or 14 per cent.

The impact on GDP is 0.11 per cent. Before the disaster the expected GDP growth rate was 1.5 per cent. After the disaster is 1.39 per cent. Nevertheless, for the affected islands, if the total impact was weighted by their GDP, it would have represented a significant share of their economic activity.

The island that suffered the most losses was San Salvador, whose Club Med helped account for $4,588,272 total, which was 48 per cent of the $9,574,291 combined for the islands, and will continue to accrue until a recovery is complete. Following San Salvador was Long Island, with 37 per cent and $3,496,282 in losses. Acklins, Crooked Island, and Rum Cay together were responsible for approximately $1,500,000.

The estimated total of $5,196,300 in additional costs were spread more evenly among the affected islands. The infrastructure sector incurred approximately $2,831,000. The social sector was responsible for $2,365,383. Clean-up crews were needed on every island, and infrastructure damage created a need for generators to power critical buildings such as health centres and water desalination plants. The hiring of temporary relief employees throughout the affected islands also contributed to the additional costs.

After visiting every island and assessing damage, losses and additional costs incurred, taking into consideration the risks and vulnerabilities inherent in being a part of SIDS, the team has come up with strategic reconstruction recommendations. The recommendations include a wide range of policies, and the proposed relocating a number of important facilities and infrastructure to avoid a recurrence of the extensive damage cause by Joaquin. This document provides an estimation of the effects of hurricane Joaquin, and a recommended course of action in order to reduce vulnerabilities and risk by way of resilient reconstruction.[3]

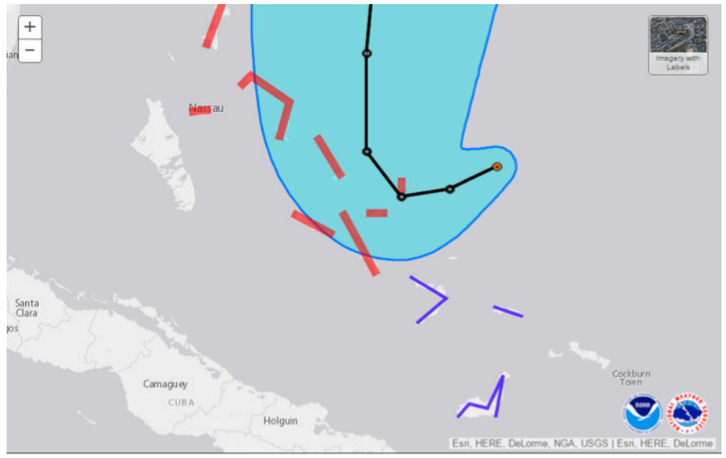
3. The following concepts are used in this assessment, and are based on the Handbook for Disaster Assessment (ECLAC 2014):
Effects: damage, loss and additional cost.
Impact: consequences of the effects on macroeconomic variables, such as GDP, public finance or balance of payments.
Damage: the effect the disaster has on the assets of each sector, expressed in monetary terms. These occur during the event giving rise to the disaster. Depending on the sector, assets may include buildings, machinery, equipment, means of transport, furnishings, roads, ports, stocks of final and semi-finished goods, among others.
Loss: goods that go unproduced and services that go unprovided during a period running from the time the disaster occurs until full recovery and reconstruction is achieved.
Additional cost: outlays required to produce goods and provide services as a result of the disaster. These represent a response by both the public and the private sectors, which may take the form of additional spending or a recomposition of spending.

Description of the event

On Sunday 27 September, the eleventh tropical depression of the 2015 hurricane season formed in the Western Atlantic. At 11:00 p.m. AST the centre of the tropical depression was located near latitude 27.5 north, longitude 68.7 west. Maximum sustained winds were near 35 mph (55 km/h) with higher gusts. On Monday 28 September, tropical storm Joaquin was 645 km northeast of the central Bahamas and a slow strengthening was forecasted for the following 48 hours. On Tuesday 29 September, Joaquin was expected to become a hurricane by Wednesday and maximum sustained winds had increased to 65 mph (100 km/h).

On Wednesday 30 September, tropical storm Joaquin was upgraded to hurricane and at 5:00 p.m. the government of The Bahamas issued a hurricane warning for the central Bahamas, including Cat Island, the Exumas, Long Island, Rum Cay and San Salvador (Map 1). Another hurricane warning was issued for the northwestern Bahamas (Abacos, Berry Islands, Eleuthera, Grand Bahama and New Providence). Additionally, a tropical storm warning was issued for the southeastern Bahamas (Acklins, Crooked Island, Long Cay, the Inaguas, Mayaguana and the Ragged Islands) and Andros Island. The Category 3 hurricane showed maximum sustained winds of 115 mph (185 km/h) and was located 90 miles (145 km) East of San Salvador and 170 miles (275 km) east of the central Bahamas.

Map 1- Trajectory of hurricane Joaquin
30 September, 5:00 p.m. AST

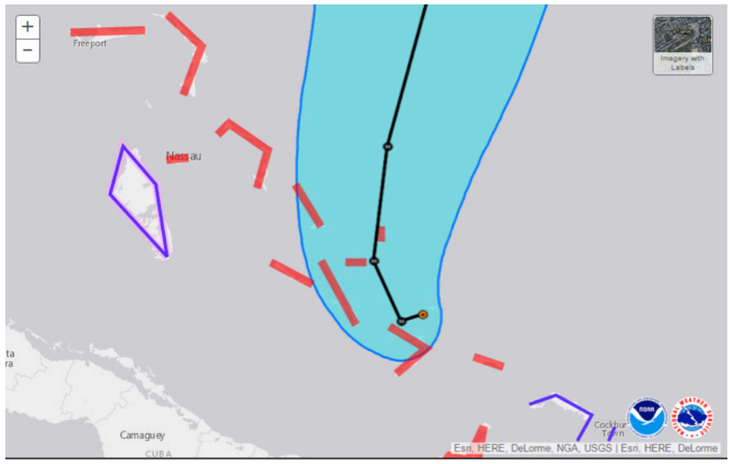


Legend:
hurricane warning
tropical storm warning
Suatined wind > 73 mph

Source: National Oceanic and Atmospheric Administration, National Hurricane Centre, Advisory #12.

Considering the dispersion of the settlements in the affected islands, and the interruption of power and telecommunications caused by hurricane Joaquin, it is necessary to draw attention to early warning systems and protocols. Even though multiple advisories were issued on 30 September, most people had already left their places of work and the alerts were not successfully transmitted to the entire population. In addition, the hurricane affected most islands since Wednesday evening and Thursday early morning, but Acklins and Crooked Island only received a hurricane warning on 1 October (Map 2). At 6:35 a.m. AST the government of The Bahamas issued a hurricane warning to include Acklins, Crooked Island, and Mayaguana of the southeastern Bahamas, and the tropical storm warning remained for the rest of the southeastern Bahamas (Long Cay, the Inaguas, and the Ragged Islands) and Andros Island, and a hurricane watch to include Bimini. Joaquin continued to move southwest at 5 mph (7km/h), and the eye was estimated to pass over Samana Cays around 12:00 p.m. AST.

Map 2- Trajectory of hurricane Joaquin
1 October, 11: a.m. AST



Legend:
hurricane warning
tropical storm warning
Suatined wind > 110 mph

Source: National Oceanic and Atmospheric Administration, National Hurricane Centre, Advisory #15.

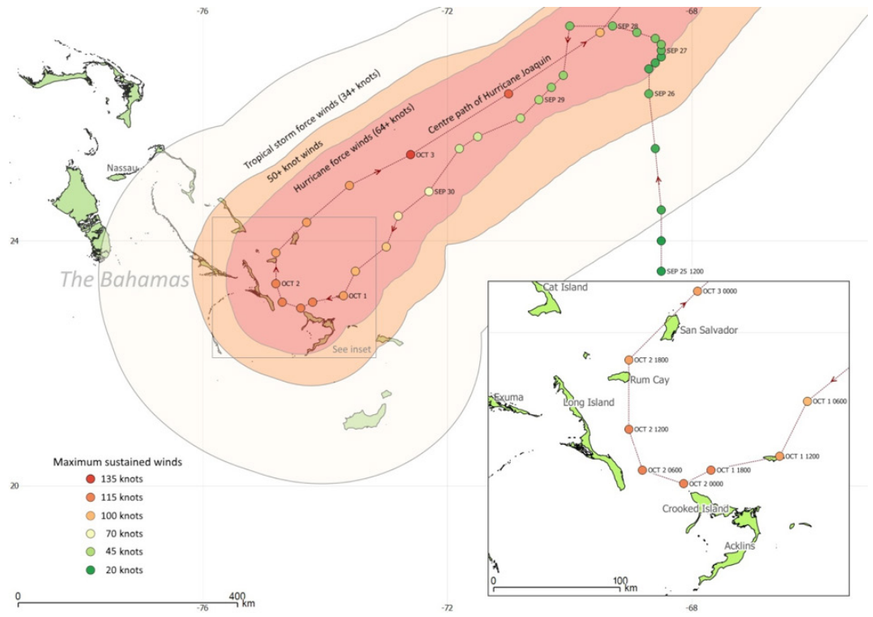
Joaquin was upgraded to a Category 4 hurricane at 3:00 p.m. AST at latitude 23.0 north, longitude 74.2 west, with maximum sustained winds reaching 130 mph (210 km/h). Joaquin was a large hurricane in area affected, with outward hurricane-force winds extending 50 miles (80 km) from the centre, and tropical-storm-force winds reaching as far as 185 miles (295 km). The central Bahamas were expected to experience 12-18 inches of rainfall, and isolated maximum amounts to reach 25 inches,

while the southeastern Bahamas expected to receive 5 to 10 inches, and 2 to 4 for the northwestern Bahamas, with flash flood warnings throughout the Bahamas. Storm surges were expected to reach 6-12 feet in the central Bahamas, and 2-4 feet for the rest of the Bahamas. The hurricane was expected to continue moving west through the night, and to pick up speed and turn toward the north on 2 October.

Joaquin hovered 15-20 miles (25-35 km) from Clarence Town, Long Island, until early morning Friday 2 October, when it began to move north-northwest at 3 mph (5 km/h). The permanence of the hurricane close to Acklins, Crooked Island and Long Island caused important sea surge of up to 4 feet, which contributed to intensifying the damage already caused by strong winds, especially considering that some areas were flooded for several weeks.[4] As Joaquin picked up speed it continued north, the core of the hurricane passed over Rum Cay, and came within 25 miles (40 km) southwest of San Salvador. A hurricane warning was in effect for the rest of the central Bahamas (Cat Island, the Exumas, Long Island), as well as the northwestern Bahamas (Abacos, Berry Islands, Eleuthera, Grand Bahama and New Providence) and Acklins, Crooked Island, and Mayaguana of the southeastern Bahamas.

Tropical-storm-force winds still reached as far as 205 miles (335 km) from the centre of the storm.

Map 3- Complete trajectory of hurricane Joaquin



Source: National Oceanic and Atmospheric Administration, National Hurricane Centre

4. Interviews with local Administrators and residents.

At 6:00 p.m. AST on 2 October, Joaquin was downgraded to a Category 3 hurricane, as the maximum sustained winds decreased to near 125 mph (205 km/h), and was forecasted to continue to weaken over the following 48 hours. The Bahamas Meteorology Department in San Salvador reported the minimum central pressure at 944.3 mb (27.88 inches). Joaquin increased in forward speed to 7 mph (11 km/h) and began to move north-northeast late on 2 October. Map 3 shows the complete path of hurricane Joaquin.

The government of the Bahamas discontinued all warnings and watches for the northwestern Bahamas (Abacos, Berry Islands, Eleuthera, Grand Bahama and New Providence) at 12:00 a.m. AST on 3 October, as Joaquin continued to move 13 mph (20 km/h) northeast. By 12:00 p.m. AST all warnings and watches for the Bahamas for Joaquin had been discontinued, as the eye of the storm was located at latitude 26.0 north, and longitude, 72.5 west, and continued to move away from the Bahamas. Water levels were expected to slowly subside throughout the day, with 2-5 inches of additional rainfall expected.

Weather-related events in The Bahamas

According to the Global Assessment Report on Disaster Risk Reduction, "disaster risk continues to be disproportionately concentrated in low and middle-income countries, in particular in small island developing states (SIDS), and is being magnified by climate change."[5] In this scenario, the Commonwealth Secretariat and the World Bank developed a Composite Vulnerability Index, which demonstrates that in general, small states are more vulnerable than large states to external economic forces and natural hazards. The Bahamas was ranked fourth among 111 countries, denoting the country's high vulnerability.

In addition to being located in the Atlantic hurricane belt, the Bahamian islands also face environmental, geographic, social and economic vulnerabilities. The archipelagic nature of the country has resulted in dispersed settlements with small populations.

Distance between islands, dispersion within islands and diseconomies of scale have contributed to high per capita costs, which challenge the ability of the national government to provide equitable access to quality public infrastructure and services throughout its inhabited islands.

These disparities in the levels of social and economic development among New Providence and Grand Bahama, and the Family Islands are deepened by disasters such as hurricane Joaquin that set back social and economic accomplishments. Furthermore, the existing vulnerabilities combined with suboptimal land use, fiscal constraints and damaged or depreciated private and public assets, hinder resilient reconstruction efforts.

5. United Nations Office for Disaster Risk Reduction (UNISDR). (2015). "Making Development Sustainable: The Future of Disaster Risk Management. Global Assessment Report on Disaster Risk Reduction" Available at: http://www.preventionweb.net/english/hyogo/ gar/2015/en/gar-pdf/GAR2015_EN.pdf

Between 1990 and 2015, The Bahamas was affected by over 25 tropical storms and hurricanes (Table 1).[6] As with hurricane Joaquin, each event did not affect all the Bahamian islands, and the intensity of the effects was also variable. However, it exemplifies the country's vulnerability to natural hazards. It is also important to note that, even if the effects of the event were limited in coverage area, they still impact the overall country's economy to some degree. Relatively small events are happening every one or two years, contributing to the degradation of infrastructure and weighing on the country's budget. Additionally, devastating events are taking place every 4 to 5 years, causing widespread damage and having a larger impact in the country's ability to invest in reducing disparities.

Table 1- Natural events in The Bahamas

Year	Event
1990	Hurricane Klaus
1991	Tropical storm Fabian
1992	Hurricane Andrew
1995	Hurricane Erin
1996	Hurricanes Bertha & Lili
1998	Hurricanes Georges & Inez
1999	Hurricanes Dennis & Floyd
	Tropical storms Harvey & Irene
2001	Hurricane Michelle
2004	Hurricanes Frances & Jeanne
2005	Hurricanes Katrina, Rita & Wilma
2007	Hurricane Noel
2008	Hurricanes Hanna & Ike
	Tropical storm Fay
2011	Hurricane Irene
2012	Hurricane Sandy
2014	Hurricane Arthur
2015	Hurricane Joaquin

Based on information retrieved from: Centre for Research on the Epidemiology of Disasters (EM-DAT database), National Oceanic and Atmospheric Administration (National Hurricane Centre), and The Bahamas Meteorology Department.

Based on information retrieved from: Centre for Research on the Epidemiology of Disasters (EM-DAT database), National Oceanic and Atmospheric Administration (National Hurricane Centre), and The Bahamas Meteorology Department.

6. The list includes some of the most important events to affect The Bahamas; the list is not exhaustive.

In addition, as a low-lying archipelago, the islands of The Bahamas are exposed to the effects of climate change, and the country is already being affected by sea level rise and coastal erosion. Climate change projections suggest that temperatures will continue to rise and exacerbate the effects of weather events.

The recurrence of weather related events and the effects of climate change contribute to expanding existing disparities between and within islands. The effects and impacts of disasters hinder the countries' ability to make the capital investments and social expenditures necessary to achieve national and international development goals. Furthermore, this situation delays the capacity of the government of investing in a resilient reconstruction process after major disaster.

This situation highlights the relevance of reducing social and economic vulnerabilities and mapping risks. By identifying risk areas and vulnerabilities, it is possible to improve policies and other technical regulations in order to reduce the risk of disaster. The recurrence of weather events also highlights the importance of resilient reconstruction to protect government investments, communities' assets and productive activities. It is also relevant to characterise the disasters that affect the country to improve its response in terms of disaster risk management. The assessment of the effects and impacts of hurricane Joaquin provides an important opportunity to learn lessons, identify weaknesses and plan a resilient reconstruction process.

Affected Population

This chapter analyses the affected population with particular emphasis on those persons who suffered direct consequences of the disaster. Two sets of information were utilised to estimate the primary affected population. First, a registry of persons evacuated to shelters was compiled. However, representatives from the Ministry of Social Services and Community Development stated that many people chose to stay with friends and relatives, or to relocate temporarily to New Providence or other islands. Therefore, shelter registries were complemented by housing data to provide a more accurate estimation.

The population affected is where all tangible and intangible effects of the disaster come together. This section provides a general overview of the effects of the disaster on the population. Subsequent sections describe the effects on particular sectors, such as health, education, housing, and access to public utilities and services.

This report defines affected population as those persons who suffer the indirect or secondary effects of the disaster. This includes deficiencies in the provision of public services, trade or employment, as well as isolation. Likewise victims, or primary affected population, are persons affected by the direct effects of the disaster and consists of the dead, the injured, the disabled (primary trauma victims), those displaced and living in shelters, and those who suffer material losses as a direct and immediate consequence of the disaster.[7] There were no casualties as a consequence of the event, and information on injuries related to the disaster is subsequently provided in the analysis of the health sector.

Most Caribbean countries are relatively small in size, therefore disasters tend to have a national connotation. However, due to the archipelagic characteristic of the Bahamas, disasters can be a local phenomenon. Hurricane Joaquin affected islands throughout the country, especially in the southeast and central regions. The analysis of the effects of hurricane Joaquin focuses on Acklins, Crooked Island, Long Island, Rum Cay and San Salvador.

The 2010 Census states the five affected islands under analysis contain 1,834 occupied dwellings and have an average household size of 2.6 inhabitants (below the national average of 3.5 dwellers per home). Based on the scope of this assessment, approximately 5,028 persons (1.4 per cent of the total population of The Bahamas) were affected by the disaster to varying degrees (Table 2).

7. Economic Commission for Latin America and the Caribbean (ECLAC). (2014). Handbook for Disaster Assessment LC/L.3691 2013-817. United Nations, Santiago, Chile

Table 2- Affected population by island

Island	Female	Male	Population	%
Acklins	245	320	565	11.24
Crooked Island	162	168	330	6.56
Long Island	1,559	1,535	3,094	61.54
Rum Cay	47	52	99	1.96
San Salvador	471	469	940	18.70
Total	**2,484**	**2,544**	**5,028**	**100.0%**

Source: Department of Statistics of the Bahamas, Census 2010.

Acklins is the southernmost island under analysis, with an estimated 565 inhabitants, 56.6 per cent male and 43.3 per cent female.

The settlements located in the southern part of the island did not suffer considerable damage. Salina Point is the most populated settlement in the island (190 people), and significant damage to dwellings was not reported. Minor damage was sustained in the settlements located in the central part of the island, such as Spring Point, Delectable Bay and Pompey Bay (81 people).

Table 3- Acklins population

Settlement Name	Sex		Total	Total occupied dwellings	Average household size
	Female	Male			
Lovely Bay	48	58			
Chester's	21	28	49	20	2.45
Pestel Point	1	0	1	1	1.00
Pine Field	4	4	8	3	2.67
Hard Hill	9	9	18	7	2.57
Snug Corner	28	31	59	28	2.11
Masons Bay	20	33	53	25	2.12
Spring Point	11	25	36	19	1.89
Delectable Bay, Pompey Bay and Binnacle Hill	19	26	45	23	1.96
Salina Point	84	106	190	47	4.04
Population	**245**	**320**	**565**	**209**	**2.70**

Source: Department of Statistics of the Bahamas, Census 2010.

The northern section of the island was the most severely affected, particularly the settlements of Lovely Bay, Chester's, Masons Bay and Snug Corner. Besides Salina Point, these settlements are the most populated on the island and it is estimated that their entire population of 267 people was affected by the disaster. Most persons suffered damage to their property and businesses. Also in the north, the settlements of Hard Hill and Pine Field were not affected due to their adequate locations on the highest points of the island. However, they sustained minor damage due to strong winds.

It is estimated that 52 per cent of the population of Acklins was directly affected by the disaster. Most victims' assets in Lovely Bay, Chester's, Masons Bay and Snug Corner were destroyed or severely damaged, including dwellings and businesses.

Crooked Island also sustained severe and widespread damage. The island has approximately 330 inhabitants, 50.9 per cent male and 49.1 per cent female. According to the 2010 Census, there are 124 occupied dwellings in the island. The Ministry of Social Services and Community Development provided alimentation and assisted the evacuation of fourteen vulnerable persons after the disaster.

Table 4- Crooked Island population

Settlement Name	Sex		Total	Total occupied dwellings	Average household size
	Female	Male			
Long Cay	14	15	29	9	3.22
Pitts Town	4	5	9	5	1.80
Landrail Point	47	60	107	34	3.15
Richmond and Moss Town	8	5	13	6	2.17
Cripple Hill	11	8	19	6	3.17
Fairfield	5	13	18	5	3.60
Cabbage Hill	30	26	56	24	2.33
Church Grove	5	5	10	6	1.67
Colonel Hill	30	21	51	20	2.55
Major Hill, Bullet Hill and True Blue	8	10	18	9	2.00
Total	**162**	**168**	**330**	**124**	**2.66**

Source: Department of Statistics of the Bahamas, Census 2010.

Most of the settlements are located on the east coast, which was severely affected by strong winds as a result of hurricane Joaquin's trajectory. The most severely affected settlements were Cabbage Hill, Colonel Hill, Landrail Point, Major's Cay, Moss Town and Pitts Town, with a combined population of approximately 254 inhabitants (77 per cent). Coincidentally, the most affected settlements are also the most populated, providing insight on how comprehensive the impact of the hurricane was on the island's population.

Based on the collected information on housing (see Table 22), 56.4 per cent of the occupied homes in the island were partially damaged or destroyed. With an average household size of 2.66, it is estimated that 186 persons were directly affected by hurricane Joaquin, mainly as a result of damage to their assets of property and businesses. This information was corroborated by representatives of the Local Government and the Bahamas Defence Force, who informed the assessment team that approximately half of the island's population had relocated temporarily to New Providence and other islands.

According to the island's Deputy Administrator, a large percentage of senior citizens relocated to other islands because their homes were severely damaged or destroyed. In this regard, the Local Government and NEMA decided to prioritise the reconstruction efforts on senior citizens who lost their homes and are still in New Providence or other islands.

The entire population of 330 inhabitants was affected by the interruption in the provision of waste collection services (still suspended as of 20 November 2015). Additionally, most government offices were damaged and remained closed at the time of the visit as of 20 November 2015.

Long Island is both the largest and most populated island within the scope of the assessment. There is an approximate population of 3,094 inhabitants, 50.3 per cent male and 49.6 per cent female. Seven persons with disabilities and forty-five senior citizens were assisted by the Ministry of Social Services and Community Development.

Damage was sustained throughout the entire island to varying degrees. According to the findings of the assessment team, and based on the information provided by the Long Island Administrator, the southern settlements suffered more severe devastation.

Table 5- Long Island population

Settlement Name	Sex		Total	Total occupied dwellings	Average household size
	Female	Male			
Alligator Bay	33	33	66	19	3.47
Berrys	17	23	40	12	3.33
The Bight	15	12	27	9	3.00
Buckleys	28	26	54	16	3.38
Buckleys Hill	11	14	25	7	3.57
Burnt Ground	164	160	324	87	3.72
Carlton Hill	21	28	49	20	2.45
Cartwrights	61	48	109	48	2.27
Clarence Town	42	44	86	34	2.53
Combers	10	14	24	7	3.43
Deadman's Cay	57	53	110	47	2.34
Deans and Turtle Cove	7	8	15	5	3.00
Doctors Creek	40	24	64	16	4.00
Dunmore and Victoria Village	32	47	79	24	3.29
Glinton's	56	81	137	45	3.04
Gordons and Mortimers	42	32	74	27	2.74
Greys	15	22	37	13	2.85
Hamilton	94	102	196	74	2.65
Lower Deadman's Cay	143	129	272	116	2.34
Mangrove Bush	69	73	142	59	2.41
Mckanns	12	19	31	17	1.82
Mckenzie	24	19	43	17	2.53
Mckenzie and Hard Bargain	11	10	21	8	2.63
Miley and Lochabar	17	16	33	12	2.75
Millers	37	36	73	23	3.17
Millerton	42	48	90	32	2.81
Morrises and Bains	39	31	70	27	2.59
Morrisville	12	13	25	12	2.08
New Hope	40	36	76	30	2.53
Old Grays and Andersons	7	8	15	5	3.00
O'Neils	29	35	64	24	2.67
Pettys	41	38	79	32	2.47
Pinders	11	3	14	6	2.33
Roses and Taits	30	30	60	22	2.73
Salt Pond	54	44	98	32	3.06
Scrub Hill and Benzie	24	27	51	15	3.40
Seymour and Galliot Cay	44	37	81	28	2.89
Simms, Bos'n Hill And Scrub Hill	32	28	60	25	2.40
Stella Maris	43	37	80	32	2.50
Stevens	18	13	31	10	3.10
Thompson Bay	8	9	17	6	2.83
White House, Sam Mckinnons and Wemyss	17	14	31	11	2.82
Wood Hill, Fords and Cabbage Point	10	11	21	8	2.63
Total	**1,559**	**1,535**	**3,094**	**1,119**	**2.76**

Source: Department of Statistics of the Bahamas, Census 2010.

According to information on housing, it is possible to confirm generalised damage throughout the island as reports include damaged structures in most of the 43 settlements identified in the 2010 Census. Several settlements in the centre of the island contain most of the population, as well as critical public infrastructure. Clarence Town, Deadman's Cay, Buckleys, Cartwrights, Mangrove Bush, Pettys, Mckenzie, Hamilton and Scrub Hill are home to almost one third of the population, and most suffered considerable damage. Other settlements in the south were substantially affected, such as Roses, with a high percentage of houses destroyed or severely damaged.

It is estimated that 60.5 per cent of the homes were partially damaged or destroyed. Considering the average household size of 2.76, it is estimated that 1,868 persons were directly affected by the disaster.

According to CDEMA,[8] Long Island was affected by 18 feet of storm surge, and as late as 7 October two thirds of the island remained under 4 to 6 feet of water. Wells were contaminated and waste collection services were interrupted due to damage in the roads. Movement was also limited in various parts of the island either because of important flooding or damage to road infrastructure.

Rum Cay has the smallest population of the islands under analysis, with 99 inhabitants. According to CDEMA,[9] 32 persons were placed in a shelter. Two senior citizens with disabilities were assisted after the hurricane. Additionally, 32 dwellings were damaged or destroyed. It is estimated that the primarily affected population in the island was approximately 79 persons (80 per cent). The entire island population was affected by the disaster as a result of interruption in the provision of electricity and telecommunications, and docks were also affected.

Table 6- Rum Cay population

Settlement Name	Sex		Total	Total occupied dwellings	Average household size
	Female	Male			
Rum Cay	47	52	99	40	2.48

Source: Department of Statistics of the Bahamas, Census 2010.

8,9. Caribbean Disaster Emergency Management Agency (CDEMA). (2015). Hurricane Joaquin Situational Report #2 October 2. Available at: http://www.cdema.org/index.php?option=com_content&view=article&id=151 5:hurricane-joaquin-situation-report-2-as-of-900-pm-on-october-2nd-2015&catid=39:situation-reports&Itemid=347

10.

San Salvador has a population of 940 inhabitants, 50.1 per cent male and 49.9 per cent female. According to CDEMA,[10] 72 persons were placed in shelters. The island had sixteen persons with disabilities and 66 senior citizens required assistance from the Ministry of Social Services and Community Development.

Reports show damaged or destroyed dwellings in every settlement on the island, approximately 75 per cent of the occupied homes were affected. The island has an average household size of 2.75, therefore it is estimated that 698 persons were directly affected by hurricane Joaquin as a result of damage to their assets.

Table 7- San Salvador population

Settlement Name	Sex		Total	Total occupied dwellings	Average household size
	Female	Male			
Sugar Loaf	54	73	127	47	2.70
Long Bays	29	31	60	19	3.16
Hall's Landings	11	10	21	12	1.75
Cockburn Town	138	133	271	106	2.56
Bonefish Bay	20	10	30	17	1.76
North Victoria Hill	54	59	113	45	2.51
United Estates	134	128	262	79	3.32
Sandy Point	31	25	56	17	3.29
Total	**471**	**469**	**940**	**342**	**2.75**

Source: Department of Statistics of the Bahamas, Census 2010.

In sum, the entire population of the five islands (5,028 inhabitants) was affected by hurricane Joaquin to varying degrees. The most widely recognised impact on disaster victims is the deterioration in their living standards. The effect of the hurricane was magnified by the fact that settlements are small concentrations of inhabitants scattered throughout each island. Damage to roads and docks complicated relief efforts and delayed the start of the reconstruction process, as many communities were isolated. The entire population suffered from interrupted access to public services and damage to critical public infrastructure.

Additionally, the primary affected population is estimated at 62 per cent due to damaged or destroyed homes and belongings. Businesses were also affected, and economic activity was interrupted, further reducing normal living standards. Finally, according to the Ministry of Social Services and Community Development, 150 vulnerable persons were assisted as a consequence of the hurricane. The Ministry provided assistance in terms of temporary accommodation, evacuation and provision of supplies.

Besides support provided by the public sector, the private sector was also very active during the relief efforts. Based on information gathered during the mission, it is estimated that $604,306 were donated.[11] Head Knowles collected $271,260 in cash and supplies; the Moore Bahamas Foundation destined $120,000 to relief efforts and the Bahamas Hurricane Relief group collected $13,000. In addition, PAHO donated the equivalent of $200,046 in supplies and equipment.

The United States Foreign Disaster Assistance donated 37,000 pounds of supplies, and the U.S. Coast Guard collaborated with over 100 helicopter hours. The U.S. National Geospatial Intelligence Agency provided NEMA with pre and post storm satellite imagery.

As a local phenomenon, the disaster highlighted pre-existing vulnerabilities and regional gaps. Many persons temporarily relocated to New Providence, which also impairs social cohesion, and relief and reconstruction efforts; it affects the feeling of normalcy as daily activities were interrupted for several weeks. Even though reconstruction efforts have started in all the islands, some students are still relocated in New Providence, which has psychosocial effects on families and communities.

Although many people left their home islands and were temporarily relocated to New Providence due to the effects of the hurricane, there is already a depopulation trend in relative terms in all the Family Islands. According to the Government of The Bahamas, the national population growth rate was 15.8 per cent between 2000 and 2010.[12] However, in the Family Islands it has been lower than the national average. There has been a population decrease in absolute terms in Crooked Island and San Salvador, while on some islands, such as Acklins, Long Island and Rum Cay, the increase has been minor and not in line with the national trend.

Table 8- Population by island and percentage of total population for census years 1970-2010

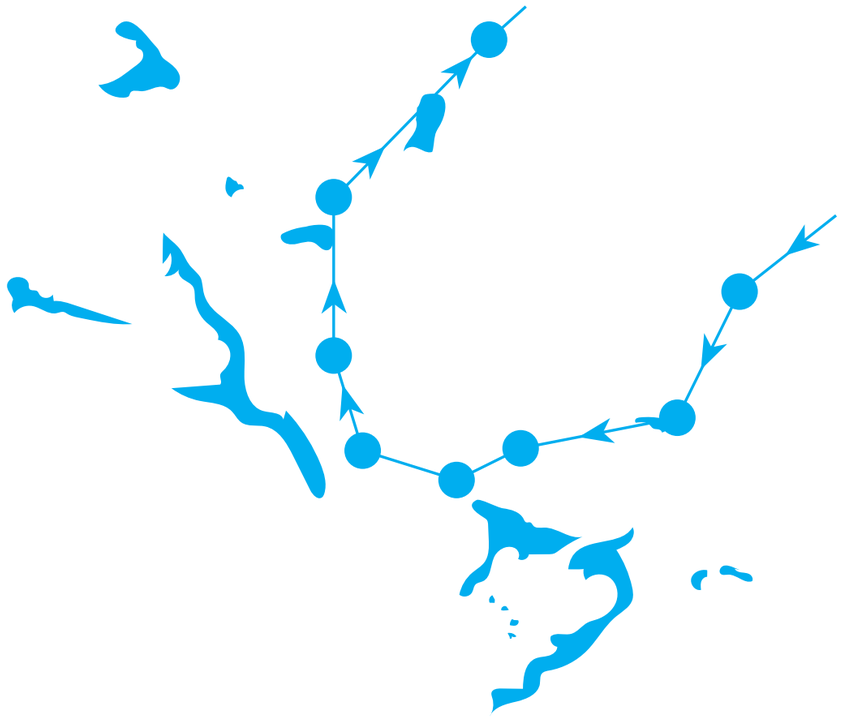
Island	1970	%	1980	%	1990	%	2000	%	2010	%
Acklins	936	0.56	618	0.30	405	0.16	428	0.14	565	0.16
Crooked Is.	689	0.42	518	0.26	412	0.17	350	0.11	330	0.09
Long Island	3,861	2.29	3,404	1.62	2,949	1.16	2,992	0.99	3,094	0.88
Rum Cay					53	0.02	80	0.02	99	0.03
San Salvador					465	0.18	970	0.32	940	0.27

Source: Department of Statistics of the Bahamas.

11. Note that the analysis of the relief efforts exceeds the scope of this assessment; therefore, this estimate is not exhaustive and does not include all donations received after hurricane Joaquin.
12. Government of The Bahamas. (2015). Vision 2040. National Development Plan. State of the Nation: Human Capital.

Small Island Developing States (SIDS) face scale challenges, and public services and infrastructure have high per capita costs. The archipelagic nature of The Bahamas combined with small and dispersed populations in the Family Islands has hindered the provision of universal access to basic public services and increased these costs even further. As a result, the country shows uneven socioeconomic development and increased poverty in the Family Islands. Inequality is deepened and expressed by varying quality and access to public infrastructure and services, limited employment opportunities resulting from weak economic activity, and educational and skill levels that do not satisfy the demands from particular sectors. This situation has resulted in migration from certain Family Islands to more developed islands such as New Providence and Grand Bahama. In general, there has been a constant population reduction on each island in regards to the national population. This phenomenon could be explained in part by internal migration due to the limited economic opportunities and inequality found in those islands.

SOCIAL SECTORS



Introduction

Prior to hurricane Joaquin the five affected islands had functioning health centres, main clinics and satellite clinics (Table 9). In general, a health centre offers ambulatory care laboratory services, x-ray services, specialised care (by a visiting specialist), maternal and child health care, and has the capacity to perform other diagnostics. A main clinic is a health facility with a resident/visiting Medical Officer or resident nurse, and has no overnight bed facility, and offers maternal and child health services and minimal emergency care. A satellite clinic is a small facility for visiting medical and nursing staff which is usually situated in a remote area. In the appendix of this chapter there is the situation of the health sector in each island before the disaster.

Table 9- Health clinics before the disaster

Island	Outpatient visits*	Health centre	Main Clinic	Satellite Clinic	Total Clinics
Acklins	624	1	0	3	4
Crooked Island	244	1	1		2
Long Island	789	2	1	3	6
Rum Cay	59			1	1
San Salvador	408	1			1
Total	**2,124**	**5**	**2**	**7**	**14**

Source: Source: Department of Public Health
***** Average number of Outpatient visits per month in 2013

1. Damage

This section describes the damage to the health facilities outlined per island due to hurricane Joaquin. The damage to a clinic is distinguished in three categories; destroyed and in need of reconstruction, serious damage which can be repaired, or as minor damage. The breakdown for the number of clinics damaged and the estimated damage by island is listed in Table 10 and Table 11, and a description follows.

Table 10- Damage to clinics

Island	Total number of clinics affected	Clinics destroyed	Clinics with serious damage	Clinics with minor damage
Acklins	4		2	2
Crooked Island	2		1	1
Long Island	6	1		5
Rum Cay	1			1
San Salvador	1			1
Total	**14**	**1**	**3**	**10**

Source: Estimations by disaster assessment team, 2015.

Table 11- Estimated damage to clinics by island

Island	Structural Damage	Damage to interior, equipment and inventory	Total
Acklins	273,065	58,971	332,036
Crooked Island	86,871	23,927	110,798
Long Island	1,047,331	50,589	1,097,920
Rum Cay	7,000	1,271	8,271
San Salvador	40,000	13,500	53,500
Total	**$1,454,267**	**$148,258**	**$1,602,525**

Source: Estimations by disaster assessment team, 2015.

Acklins

The health centre in Spring Point and the satellite clinic in Masons Bay incurred serious damage and the satellite clinics in Chester's Bay and Salina Point incurred minor damage.

Spring Point

The health centre is located close to the ocean (Figure 1) and as a result suffered from major flooding. The roof incurred damage because of high wind resulting in loss of shingles, causing leakages through the roof. The generator was destroyed because of water damage; and all vaccines and insulin were lost. The storage facility sustained major flooding, causing destruction of all medical supplies that were stored before the hurricane. The well water was contaminated with saltwater intrusion; however, there was no faecal contamination. Furthermore, the doctor's government residence sustained damage due to flooding.

Figure 1- Spring Point Medical Clinic

Source: Source: Disaster assessment team based on satellite imagery provided by ESRI and topographical data provided by the United States National Aeronautics and Space Administration (NASA).

Masons Bay (S) [13]

Masons Bay satellite clinic sustained major damage due to flooding of up to 3 feet and incurred roof damage causing additional leaks. The interior of the clinic is destroyed. The clinic is located in the community centre which has not been opened since the hurricane and electricity has not been restored (as of 20 November).

Chester's Bay (S)

The clinic sustained minor roof damage and no flooding as it is situated on a hill. There was no damage to the interior, medical equipment, supplies or medication.

Salina Point (S)

The building sustained minor water damage to furniture, some window screens are broken, and one door is damaged. None of the medical equipment, supplies, or medication was damaged.

Crooked Island

The health centre in Landrail Point sustained minor damage but the satellite clinic in Colonel Hill incurred serious damage.

Landrail Point

Despite the severe damage in the Landrail Point community, the Landrail Point clinic is in good condition and served as an emergency shelter to many persons in the aftermath of the hurricane. The clinic sustained minor damage as a result of the wind, such as broken windows and the ceiling in the bathrooms came down because of water damage due to shingles loss. Some furniture and equipment were damaged because

13. (S) Denotes satellite clinic

of flooding. A Bahamas Telecommunications Company (BTC) tower fell down about in close proximity to the clinic and landed on the old generator house where water tanks are stored, which was destroyed. The generator did not work during the hurricane, causing the loss of vaccines.

Colonel Hill (S)

Heavy winds during the hurricane caused serious further damage to the clinic's roof, which was already compromised, causing major damage to the ceiling and the interior. There was minor flooding, but most damage was as a result of the rain after the loss of the roof. The old generator house was destroyed but there was no generator in the clinic prior to the hurricane.

Long Island

On Long Island, the Clarence Town clinic was destroyed but all other clinics sustained only minor damage as a result of hurricane Joaquin.

Simms Community Clinic

Strong winds damaged the generator door and the utility room door and both are unable to lock. Rainwater caused the generator to stop working during the hurricane. As a result of loss of electricity and no generator, the cold chain was disrupted and all vaccines and some medication were lost. The generator has been repaired. Winds also caused minor roof damage resulting in leakages that caused minor damage to some furniture and equipment.

Deadman's Cay Community Clinic (S)

Deadman's Cay Community Clinic is situated on higher grounds and did not sustain flood damage. High winds caused minor roof damage and loss of some ceiling tiles. One of the vehicles stopped working because of flooding.

Clarence Town (S)

The Clarence Town clinic was destroyed. The building is divided into a clinic facility and a residence area that was used as general storage. The damage was mainly caused by strong winds. The roof of a nearby residence landed on the roof of the clinic. The roof was destroyed and as a result the interior, which included medical supplies, vaccines, medical files, furniture and the majority of the medical equipment was destroyed. The building structure also sustained major damage.

Roses (S)

Roses clinic sustained some minor damage due to high winds, causing some shingles to be lost and the ceiling fan to be broken. However, there has been neither water nor electricity after the hurricane (as of 19 November).

Rum Cay

The satellite clinic in Port Nelson sustained minor damage due to high winds. Missing shingles from the roof caused some leakages and minor interior damage.

San Salvador

The health centre in Cockburn Town sustained damage primarily caused by high winds. Approximately 70 per cent of roof shingles were lost, causing leakages inside and a crack in the wall. The ceilings in the laundry and storage areas collapsed. The front and back door sustained damage and water came in through the doors. Outside, light pole fittings are broken and the fence is collapsed. The generator is operating; however, the battery was damaged.

2. Losses

This section outlines the losses incurred in the health sector due to disrupted health services. The change in outpatient visits indicates the total number outpatient visits that could not occur in the regular health facility after hurricane Joaquin. This is based on the number of monthly outpatient visits and the period that health services were disrupted in that particular health facility (Table 12). These patients either had to access care from the nearest functioning clinic or received home visit medical care. Given that public health does not have market price, the losses were estimated using the remuneration to the factors.[14] Since these are non-profit facilities, it is equal to the wages to the medical doctor and nurses. The estimated total losses for the five affected islands is $20,260.

Table 12- Loss of outpatient visits by island

Island	Outpatient visits per month*	Change of outpatient visits **
Acklins	624	1977
Crooked Island	244	160
Long Island	789	932
Rum Cay	59	0
San Salvador	408	0
Total	**2,124**	**3,068**

Source: Estimations by disaster assessment team based on information from the Department of Public Health
* Average number of outpatient visits per month in 2013
** Total number of outpatient visits that could not occur in the regular health facility after hurricane Joaquin.

14. ECLAC. (2014). Handbook for Disaster Assessment LC/L.3691 2013-817. United Nations, Santiago, Chile

Acklins

Despite the serious damage to the Spring Point clinic, the clinic closed for approximately a week after the hurricane and subsequently has been operational until 1 p.m. Relief staff came to Acklins on a rotation. The other three satellite clinics have not been operational. The clinic in Masons Bay is severely damaged. This clinic was usually opened once a week by a nurse and once a month by doctor. The satellite clinics in Chester's and Salina Point only incurred minor damage but have remained unutilised due to lack of health personnel and transportation. The doctors' vehicle is damaged but whenever possible it is used by the relief staff, as all personal vehicles of nurses have been destroyed. Chester's Bay Clinic and Salina Point Clinic are usually open twice a week by the nurse and once a month by the physician. Both facilities have been opened at least once by the relief staff.

Both Chester's Bay Clinic and Salina Point Clinic are situated outside of the main settlement. Before the hurricane there was no public transport available to these clinics. Due to the hurricane many personal vehicles of residents and nurses were destroyed, which poses an additional challenge for health personnel or residents to reach these clinics. For the health sector in Acklins the estimated losses are $12,087.

Crooked Island

Colonel Hill Clinic was not operational for three weeks after the hurricane. Patients were referred to a make-shift clinic at the airport where the relief nurses and physicians operated. The Landrail Point health centre did not stop operations but many inhabitants were evacuated shortly after the hurricane. Despite the evacuation, the clinic saw a slight increase in number of patients. The nurse in charge was also coordinating distribution of relief goods and the clinic is still used as a shelter (as of 20 November). These activities slightly disrupt usual operations. The estimated losses in the health sector for Crooked Island are $3,120.

Long Island

The Main Clinic in Clarence Town has not been operational since the hurricane. Patients were initially referred to the temporary make-shift clinic at the community centre. Now that the temporary clinic is officially closed, patients are referred to the Roses satellite clinic further south, but many patients visit Deadman's Cay Community Centre because of its proximity and the presence of the local physician. Long Island suffered losses to the health sector estimated to be $5,053.

Rum Cay

The clinic received a generator shortly after the hurricane and operations of this satellite clinic were not disrupted.

San Salvador

Operations of the health centre were not disrupted.

3. Additional costs

This section describes any additional cost incurred in the health sector as a result of hurricane Joaquin. This includes costs related to temporary clinics, running generators, clean-up, emergency operating centres, satellite phones, and environmental health activities.

Environmental health visited all impacted islands and performed additional fogging for vector control and treatment of well water. All affected islands incurred costs for additional medication and vaccines, clean-up, and relief staff from New Providence, and Table 13 shows the estimated additional costs for the affected islands.

Table 13- Additional costs to Health Sector

Island	Additional costs
Acklins	83,142
Crooked Island	149,246
Long Island	117,638
Rum Cay	46,234
San Salvador	28,208
Total	**$424,468**

Source: Source: Estimations by disaster assessment team based on information from the Department of Public Health

Appendix

(1) Supporting information

Acklins

Relief teams conducted many home visits using resident physicians' vehicles while the satellite clinics remained closed. Every week a new nurse and every three days a relief doctor came to Acklins. Clean up of Spring Point Clinic took three weeks in total, during which the clinic was partly operational.

Crooked Island

Additional costs for Crooked Island include the cost for a makeshift clinic at the airport and the cost for the Royal Bahamas Defence Force disaster container for medical purposes. Because of the destruction of Colonel Hill Clinic, the majority of relief staff sent to Crooked Island operated from the makeshift clinic at the airport. On average there were

two doctors, two nurses and one psychologist doing weekly rotation. The makeshift clinic saw a vast increase in number of patients; the month following the hurricane the makeshift clinic saw more than 200 patients, nearly double the monthly average of Colonel Hill Clinic. Immediately following Joaquin, the British Navy came to Landrail Point and encouraged people to leave, and 46 persons were evacuated. Two months after the hurricane, approximately 50 per cent of evacuees had returned. Most of the relief staff assisted from the makeshift clinic, and the Landrail Point clinic received a relief physician for three days.

Royal Bahamas Defence Force – Disaster Container

The RBDF deployed disaster containers hosting a field kitchen, emergency power generators, a first-aid station, drinking water treatment facilities, and tools for carrying out repairs, amongst other things. One of these contains two examination rooms where an RBDF medic currently operates. The location of this facility was based on the requirement that it had to be within 20 meters of a sea bed and the main generator.

Long Island

Additional costs for Long Island include the cost for the makeshift clinic in Clarence Town Community Centre, which provided service until 16 November. Subsequently, patients are referred to Roses satellite clinic or Deadman's Cay Community Clinic.

Deadman's Cay health centre operated without electricity for 3 weeks and used a generator during this time.

Simms Clinic used a generator for three weeks in order to continue operations. The generator's pump was repaired but more work still needs to be done on it for it to be fully functional. A portable generator was donated after the hurricane.
As a result of the hurricane Roses Clinic lost electricity, therefore a generator is planned to be installed shortly to allow the clinic to operate.

Rum Cay

Rum Cay did not have electricity for approximately one month. Shortly after the hurricane a generator was utilised to continue clinic operations.

San Salvador

Cockburn Town received in-kind donations from Club Med, such as new towels and sheets, and from BTC, as well as fixed inside lights.

(2) Description of clinics

Acklins

There is one resident doctor and three resident nurses on Acklins who cover one health centre and three satellite clinics. The resident doctor usually also covers Crooked Island and Long Cay. There is no ambulance on Acklins, however the doctors' government vehicle is used for medical transportation and house visits.

Table 14- Acklins clinics

Clinic	Clinic Type	Outpatient visits	Personnel	Beds
Spring Point	Health centre	182 217	1 physician 3 nurses 1 nursing auxiliary	2 examination beds
Masons Bay	Satellite clinic	217		1 examination bed
Chester's Bay	Satellite clinic	0		1 examination bed
Salina Point	Satellite clinic	224		1 examination bed

Source: Disaster Assessment Team and Department of Public Health

The main health centre is located in Spring Point, which is in close proximity to the airport, along the coast. The clinic consists of a reception area, the doctor's office and the pharmacy from where the resident nurse operates. The doctor's residence is located adjacent to the clinic. There are two examination beds; one is located in the doctor's office and one in the reception area. Patients can be stabilised in the health centre but despite being a health centre the facility does not seem adequate for overnight care. The resident doctor and three nurses in Acklins alternate work shifts between Spring Point health centre and the three other satellite clinics on the island.

The clinic in Mason's Bay is a satellite clinic situated in the Mason's Bay Community Centre. Even though the clinic is classified as a satellite clinic, based on 2013 data the clinic receives more patients than the health centre in Spring Point. This small clinic consists of a small waiting area and the examination room with one examination bed. Pre-hurricane the clinic was usually open twice a week by the nurse and monthly a doctor would be present in the clinic. The clinic kept a small amount of medication and no vaccines, and did not have a generator prior to the hurricane.

The clinic in Chester's Bay is a satellite clinic located approximately three miles outside of Chester's Bay settlement and is located on a hill. Chester's Bay clinic is usually open twice a week. It is a relatively large satellite clinic and has more space than the health centre in Spring Point

because it also serves as an emergency shelter. The clinic consists of a large waiting area that served as an emergency shelter, a kitchen, and bathroom that includes a shower. There were no vaccines stored in the clinic but a reasonable amount of medication is kept in the clinic. There is one examination bed in the examination room.

The clinic in Salina Point is located approximately three miles outside of Salina Point Settlement, which is the largest settlement on the island, and approximately 52 miles away from Spring Point. The clinic serves a significant part of the population and is usually opened twice a week by the nurse and the doctor is present once a month. The clinic is built on higher ground and did not have a generator prior to the hurricane.

Crooked Island

There are two clinics on Crooked Island (Colonel Hill and Landrail Point) that are operated by two nurses. There is no resident physician on the island, and the doctor from Acklins visits on a monthly basis. Based on 2013 data, Landrail Point is classified as a health centre and Colonel Hill as a satellite clinic, but on an annual basis Colonel Hill receives more patients than Landrail Point. There is no ambulance, and the resident nurse's private vehicle is used for medical transportation and house visits.

Table 15- Acklins clinics

Clinic	Clinic Type	Outpatient visits*	Health Personnel	Beds
Landrail Point	Health centre	112	1 nurse 1 nursing auxiliary	1 examination bed
Colonel Hill	Main clinic	132	1 nurse	1 examination bed 1 regular bed

Source: Disaster Assessment Team and Department of Public Health
* Average number of outpatient visits per month in 2013

The Landrail Point clinic is a health centre located in the North West of Crooked Island in the largest settlement of the island. The clinic is operated by the resident nurse and auxiliary nurse, and the doctor from Acklins visits on a monthly basis. The clinic is a spacious facility offering a wide range of services and has two beds which can be used for overnight care. The clinic is situated on slightly higher ground and has a communications tower next to the building.

Colonel Hill is classified as a satellite clinic and is situated in the centre of the island. The clinic serves the centrally located settlements as well as residents from the southern part of the island and therefore receives more patients than the Landrail Point health centre. The resident nurse from Landrail Point operates two days a week from the Colonel Hill satellite clinic and the doctor from Acklins is present once a month. The clinic has been previously damaged from hurricane Irene and has not been adequately repaired since. The clinic did not have a generator prior to the hurricane.

Long Island

There are two health centres, one main clinic and three satellite clinics on Long Island. Based on the 2013 data, the two health centres serve the majority of patients on Long Island, and the physicians and nurses based in the health centres also cover the satellite clinics.[15] There are no ambulances on Long Island, so the physicians' vehicles are used for emergency transportation and house visits. The southern part of Long Island has a lower population density than the central and northern parts of Long Island.

Table 16- Acklins clinics

Clinic	Clinic type	Outpatient visits	Personnel	Beds
Simms Community Clinic (N)	Health centre	345	1 physician 3 nurses 1 nursing auxiliary	2 hospital beds; 1 delivery bed; 3 examination beds
Glentons (N)	Satellite clinic	0		
Seymour (N)	Satellite clinic	0		
Deadman's Cay Community Clinic (S)	Health centre	398	1 physician 3 nurses 1 nursing auxiliary	8 beds
Clarence Town (S)	Main clinic	47	1 nurse, 1 health aid worker	1 examination bed
Roses (S)	Satellite clinic	0		2 examination beds

Source: Disaster Assessment Team and Department of Public Health

Simms Community Clinic is classified as a health centre in the northern part of Long Island. The clinic is operated by one doctor and three nurses, of which one is a registered midwife and one nursing auxiliary. This is a large health centre with nine rooms, two hospital beds, one delivery bed and three examination beds and is in a generally good condition. The water source is mainly piped water from the Water and Sewage Corporation. The health centre had a generator prior to the hurricane. The physician and nurses from Simms Community Clinic also serve the satellite clinics in Glenton settlement and in Seymour located in the northern part of Long Island.

15. It is assumed that the outpatient visits in the satellite clinics are recorded under the number of outpatient visits in the health centre nearby.

Deadman's Cay Community Clinic is large a health centre and is operated by one physician, three nurses and one auxiliary worker. The facility has eight beds, a working generator and two water tanks. The water source is mainly pipe water and the clinic is located next to the water plant operated by Water and Sewage Corporation. There are two vehicles connected to the clinic of which one is the physician's vehicle mainly used for house visits, transportation to the satellite clinics, and if needed for emergency transportation. However, the vehicle does not allow recumbent patients to be transported, so they rely on large vehicles available in the community.

The Clarence Town clinic is classified as a main clinic and is operated by one nurse and a health aid worker. The resident physician from Deadman's Cay visits the main clinic every Tuesday. The main clinic keeps medication for chronic diseases and acute illnesses and has a refrigerator to keep insulin and a small amount of vaccines. The clinic uses well water and does not have a generator. The resident adjacent to the clinic is not in use by health personnel and instead is used as a storage facility.

The clinic in Roses is a satellite clinic. The clinic consists of a general waiting area, one examination room with two examination beds. There is no refrigerator or generator in the clinic. There are no vaccines or medication stored in the clinic, as the visiting physician and nurses bring vaccines and medicine on clinic days as required.

There is one satellite clinic located in Port Nelson which serves approximately 60 outpatient visits per month.

Only the health centre located in Cockburn Town is operational on San Salvador. The satellite clinic in United Estates was declared condemned in early 2015. The health centre is operated by one resident physician and three nurses. This is a large health centre offering a wide variety of services for the entire island of San Salvador. The health centre receives approximately 400 outpatient visits per month.[16] The clinic has seven beds in total and the capacity to keep patients overnight. There is no ambulance on the island and the physician vehicle is used for medical transportation and house visits. In the case of emergencies, patients can be stabilised in the health centre but will be airlifted to New Providence in absence of daily flights.

16. Source: Department of Public Health

(3) List of interviewees

Island	Name	Position	Contact Information
Acklins	Dr. Kolli Rao	Resident Doctor	
Acklins	Nurse Turner:	Nurse	(242)636-9831 (242)464-8763
Acklins	Mr. Roberts	administrator	(242)443-2939
Crooked Island	Nurse Carol	Nurse	(242)457-7037
Crooked Island/ New Providence	Michael Saunders	Medic RBDF	micolt711@gmail.com
Long Island	Ms. Buhler	administrator	(242)357-1100
Long Island	Nurse Sing	Nurse	(242)453-0155
Long Island	Dr.Yvette Carter	Resident Doctor	(242)558-5672(mobile) (242)337-0555 (home) (242) 337-1222 (clinic)
Long Island	Mikandrea Stubbs	(Head Nurse Simms Clinic	(242)338-8488 (Simms clinic) (242)338-8441 (Simms clinic fax)
San Salvador	Dr. Phyllis Darville	Resident Doctor	glocorabell@yahoo.com (242)452-8011
San Salvador	Mr. Cox	Administrator	(242)359-0958 (242)331-2040
New Providence	Ms. Cooper	DPH	peggycooper@bahamas.gov.bs
New Providence	Ms. Fox	DPH	deborahfox@bahamas.gov.bs
New Providence	Ms. Linden	DPH	andrea_cl@live.com
New Providence	Mr. Ellis	DPH	terrezellis@bahamas.gov.bs
New Providence	Tami Francis	NIB	tfrancis@nib-bahamas.com
New Providence	Shavonne Burrows	PHA	sburrows@pmh.phabahamas.org
New Providence	Marvin R. Smith	PHA	msmith@phabahamas.org
New Providence	Gina Carey	DPH	ginacarey102@hotmail.com
New Providence	Ruth Bastian	DPH	ruthbastian@bahamas.gov.bs
New Providence	Ms. Bain	DPH	charba60@hotmail.com
New Providence	Hilary Hall	Post Supplies	hilary@portsintl.com

Education

Introduction

Between 2007 and 2013, the Government of The Bahamas spent, on average, 2.8 per cent of the country's GDP on education per year.[17] According to the Human Development Indicators (HDI),[18] the expected years of schooling in The Bahamas is 12.6, and the mean years for schooling is 10.94.

According to the Ministry of Education, Science and Technology, national enrolment is 44,181 students and it is verified three times a year (as of 26 November). Gross enrolment is high for both female and male students. Primary education net enrolment averages over 95 per cent, while the net secondary education enrolment ratio has been between 79 and 87 per cent.[19]

Education levels and school ages are organised as follows:

Pre- school	3 to 5 years
Primary	5 to 11+ years
Junior High	11+ to 14+ years
Senior High	14+ to 16+ years
All age	5 to 16+ years
Special schools	All ages, students with severe learning disabilities

School calendar is organised from August to June, and students normally attend school from 08:45 to 15:00 hours, students should receive 180 days of education per year.

Even though 70 per cent of schools are located in the Family Islands, they only account for 37 per cent of the students and 41 per cent of the teachers in The Bahamas.20 There are sixteen education facilities in the affected islands: ten primary schools, five high schools and one all

age school. There are no specialised facilities for students with special needs. Additionally, there is one resource centre in Long Island.

The combined enrolment in the five islands is 924 students, 50.86 per cent male and 49.13 per cent female.

17. United Nations Educational, Scientific and Cultural Organization (UNESCO). (2015). Country profile: The Bahamas. Accessed 5 December. Available at: http://en.unesco.org/countries/bahamas
18. United Nations Development Program (UNDP). (2015). Human Development Reports: Mean years of schooling. Accessed 5 December. Available at: http://hdr.undp.org/sites/all/themes/hdr_theme/country-notes/BHS.pdf
19. UNESCO. (2015). Country profile: The Bahamas. Accessed 5 December. Available at: http://www.uis.unesco.org/DataCentre/Pages/country-profile.aspx?code=BHS
20. Government of The Bahamas. (2015). Vision 2040. National Development Plan. State of the Nation: Human Capital.

Table 17- Education facilities and enrolment by island

Facility	Affected island	Teachers	Boys	Girls	Total
Salina Point Primary	Acklins	2	17	14	31
Lovely Bay Primary	Acklins	2	9	9	18
Snug Corner Primary	Acklins	2	3	3	6
Acklins Central High	Acklins	12	41	21	62
Ulric H. Ferguson Primary	Crooked Island	2	12	10	22
Crooked Island High	Crooked Island	9	12	14	26
Glinton's Primary	Long Island	3	15	12	27
Lower Deadman's Cay Primary	Long Island	7	46	34	80
Mangrove Bush Primary	Long Island	9	41	37	78
Morrisville Primary	Long Island	3	8	13	21
Simms Primary	Long Island	9	29	37	66
NGM Major High	Long Island	21	85	105	190
North Long Island High	Long Island	20	53	49	102
Rum Cay All- Age School	Rum Cay	1	6	4	10
San Salvador Primary	San Salvador	7	43	42	85
San Salvador High	San Salvador	13	50	50	100
Total		**122**	**470**	**454**	**924**

Source: Department of Education, The Bahamas (2015)

According to an agreement between the Ministry of Education, Science and Technology and the Bahamas Union of Teachers, for each teacher there should be approximately 25 primary school students or 35 high school students per class; in the case of vocational education and students with special needs, the ratio is 15 to one. However, in some of the affected islands the ratio is lower as there are fewer students. There are 122 teachers on the islands, with an average ratio of 8 students per professor.

Migration from the Family Islands to New Providence has been steady due to limited employment and growth opportunities; and the archipelagic characteristic of the country challenges the government's ability to provide equitable access to quality education throughout the islands. It is estimated that only 50 per cent of public high school students obtain a high school diploma.[21]

21. Government of The Bahamas. (2015). Vision 2040. National Development Plan. State of the Nation: Human Capital.

1. Damage

According to information provided by the Department of Education, no structure was completely destroyed; however, the sixteen facilities were damaged by hurricane Joaquin in varying degrees. The total estimated cost of damage to schools on the five islands is $1,161,853.

Table 18- Estimated damage to education facilities by island

Island	Total facilities	Facilities damaged	Total damage
Acklins	4	4	104,000
Crooked Island	2	2	322,378
Long Island	8[1]	8	558,275
Rum Cay	1	0	0
San Salvador	2 17	2	177,200
Total	**17**	**17**	**$1,161,853**

[1] Seven schools and one resource centre
Source: Estimations by disaster assessment team, information provided by field visits and the National Recovery and Reconstruction Unit, 2015

Most of the damage sustained by the structures was to roofs and ceilings due to strong winds, and the subsequent damage caused to furniture and equipment by water penetration. Some facilities were also affected by storm surge. However, neither of the inspected schools presented structural damage.

The total cost of the damage suffered by the schools in Acklins is estimated at $104,000. The four schools in the island suffered minor to moderate damage mostly due to shingle loss. Lovely Bay Primary and Acklins Central High were also affected by mould caused by considerable water ingress. Salina Point Primary, Snug Corner Primary and Acklins Central High remained closed for approximately two weeks, while Lovely Bay Primary remains closed (as of 20 November).

Additionally, according to the Department of Education, many students lost their homes and had to relocate temporarily to New Providence. There are 12 students still attending school in New Providence (as of 26 November). The most affected students were those from the Lovely Bay settlement; most of their dwellings were destroyed or severely damaged, and only 7 out of 18 students have returned to the island. There are eighteen teachers in Acklins and they have all returned to the island, except three: two lost their home and one is currently receiving psychosocial counselling, they remain in New Providence.

The estimated cost of the damage caused by the disaster in Crooked Island is $322,378. Both schools in Crooked Island were substantially affected; but damage in Crooked Island High was more severe, and the facility also lost most of its furniture and equipment, such as printers and computers. Additionally, a covered walkway at the entrance of the school collapsed, this showed structural weaknesses in the construction process. In this regard, it is worth noting that the reconstruction of critical public infrastructure must be done according to the country's building code, and supervised carefully by the Ministry of Public Works and Transport in order to prevent harm to such an important population.

Even though access to power was still limited in the island, both schools reopened on 23 November. However, as in Acklins, many students are still living temporarily in New Providence. Of the total enrolment of 48 students, fourteen from primary school and six from high school are attending school in New Providence (as of 26 November). The eleven teachers have returned to the island supported by the Bahamas Union of Teachers.

There are seven education facilities and one resource centre in Long Island, all the structures were damaged by the hurricane. The total damage to infrastructure, furniture and equipment is estimated at $558,275. Even though most schools suffered minor damage, they were all affected by strong winds that damaged roofs and ceilings, and then allowed water penetration. The Mangrove Bush Primary school was additionally flooded by approximately 3 feet of water due to storm surge; Morrisville Primary was also flooded as a result of water ingress due to severely damaged roof and ceiling.

Most of the schools remained closed for two to three weeks. Mangrove Bush Primary and Morrisville Primary remain closed (as of 19 November), it is expected that they will open in January, after the Christmas break.

Students from Mangrove Bush Primary and Morrisville Primary were temporarily transferred to Lower Deadman's Cay Primary. Also, approximately 25 per cent of the students from Mangrove Primary were temporarily relocated to schools in New Providence, along with one preschool and nine high school students. There are 72 teachers in the island, most of them either stayed or have already returned. Only two teachers remain in New Providence, one lost his/her home and one is receiving psychosocial attention.

Rum Cay All-Age School is a one- room school with 10 students and one teacher. There are six students in primary (2 in first grade, 2 in fifth grade and 2 in sixth grade), and four students in secondary (4 in eighth grade). The students have temporarily relocated to the Bahamas Telecommunications Company while works in their facility are completed; students are expected to return to their school after Christmas break (4 January 2016).

Both schools in San Salvador were partially damaged, and the total cost is estimated at $ 177,200. Damage was mostly due to roof damage and subsequent water penetration, as well as broken windows and glass shutters.

San Salvador High is safely located on a hill, and therefore damage was minor. However, the computer laboratory was severely damaged due to water ingress and fourteen computers were destroyed. The students received a donation of 6 laptops from a private company.

The schools remained closed for approximately three weeks. Additionally, one student from primary school and eight from high school were relocated temporarily to New Providence. The twenty teachers are in the island.

2. Losses

Losses in this sector refer to the affected flows such as a reduction in output, measured in terms of the number of hours or days of classes taught. Schools throughout The Bahamas were closed before and after the hurricane for precautionary reasons. However, in the affected islands these closures were more extended due to damage to school facilities, extending the amount of hours of education lost (Table 19).

In addition, students who relocated to New Providence or transferred to other schools within their island had to manage the stress caused by the disaster, as well as adapting to a new environment. This could affect their behaviour and ability to learn, affecting the quality of the education output.

Table 19- School closures

Name of school	Date school closed	Date school reopened	Number of students	Number of teachers
Acklins				
Lovely Bay Primary	30 September	Still closed on 20 November	18	2
Snug Corner Primary	30 September	19 October	6	2
Salina Point Primary	1 October	19 October	31	2
Acklins Central High	30 September	9 November	62	12
Crooked Island				
Crooked Island High	30 September	23 November	26	9
Ulric H. Ferguson Primary	1 October	23 November	22	2
Crooked Island				
Glinton's Primary	30 September	14 October	27	3
Simms Primary	30 September	21 October	66	9
Morrisville Primary[1]	30 September	Still closed on 19 November	21	3
Mangrove Bush Primary[1]	30 September	Still closed on 19 November	78	9
Lower Deadman's Cay Primary	30 September	21 October	80	7
NGM Major High	30 September	19 October	190	21
North Long Island High	30 September	14 October	102	20
Rum Cay				
Rum Cay All-Age[2]	30 September	Still closed on 26 November	10	1
San Salvador				
United Estates Primary	30 September	21 October	80	7
(San Salvador)	30 September	21 October	85	7

[1] Students from Morrisville Primary and Mangrove Bush Primary were temporarily transferred to Lower Deadman's Cay Primary.
[2] Students from Rum Cay All- Age are attending school in the facility of the Bahamas Telecommunications Company.
Source: Department of Education, The Bahamas and disaster assessment team field visits, 2015

Losses were estimated in light of the number of hours of education lost, and based on a school calendar of 180 days per year and a schedule of 8:45 to 15:00 hours. Given that public education does not have market price, the losses were estimated using the remuneration to the factors.[22] It is estimated that the losses of the sector are $300,686. The majority, 61 per cent, of those losses took place in Long Island, and 14.3 per cent in Acklins.

Public schools throughout The Bahamas –including within the affected islands- received students from settlements or facilities that were severely affected by the hurricane. Private schools also welcomed the students at no cost to the families or to the Ministry of Education, Science and Technology. It is estimated that the contribution of private schools through scholarships was $44,665.

In total, 70 students were temporarily relocated to New Providence. The majority of students (48) are attending five private schools, and 22 have been placed in ten public schools. There are 38 students attending primary school, 30 are in secondary school and two children have been placed in preschool.

22 ECLAC. (2014). Handbook for Disaster Assessment LC/L.3691 2013-817. United Nations, Santiago, Chile

The Red Cross, NEMA, and other donors contributed with clothing, textbooks and food. However, other costs had to be covered by the students' families. This situation highlighted existing disparities, which limited the ability of students without connections in New Providence or with limited economic resources to transfer to New Providence, even if tuition fees were waived.

Table 20- Students transferring from hurricane affected areas to New Providence

School name	Private/ public	Number of students
A.F. Adderley High	Public	2
Anatol Rodgers High	Public	4
C.H. Reeves Jr. High	Public	1
Doris Johnson Senior High	Public	3
Garvin Tynes Primary	Public	2
Gerald Cash Primary	Public	4
R.M. Bailey Sr. High	Public	1
Sandilands Primary	Public	2
Sybil Strachan Primary	Public	2
Willard Patton Preschool	Public	1
Aquinas College	Private	1
Claridge Primary	Private	1
St Annes School	Private	4
St. Johns College	Private	41
St. Thomas Moore	Private	1
Total		**70**

Source: Department of Education, The Bahamas (2015)

The most important task of public institutions after a disaster is to try to restore a sense of normalcy in the affected communities. In the case of the education sector, this was rapidly accomplished by transferring students to neighbouring facilities or to New Providence. Even though access to education is a top priority for parents and educators, it is also worth noting that relocation (permanent or temporary) has emotional consequences for the students. Children and teenagers had to manage the stress brought about by the damage or destruction of their homes, schools, and settlements in general; while at the same time they had to adapt to a new school in a different island. Recipient schools offered a new school setting, but also a specific ethnic and religious makeup.

Additionally, as it was mentioned, there are important development disparities between New Providence and the affected Family Islands, which means that students had to manage the differences between schools in terms of educational approach, type of education (public or private), access to resources (textbooks, internet, multimedia), as well as other cultural and social differences. This adaptation is expected to have effects on the students' emotions, behaviour and ability to learn, both when relocating to New Providence and returning to their home islands.

3. Additional costs

The total estimate for additional costs is $56,215. These costs consider removal of rubble, clean-up activities, and any other expenses undertaken in order to restore the education service promptly.

It is worth noting that, in many cases, teachers and parents assumed the task of cleaning the facilities in their communities. In terms of restoring the education service, it is also important to mention that the Ministry of Education, Science and Technology did not use schools as shelters, which normally interrupts the school cycle for several days or weeks. The public schools that welcomed students from affected areas did it on their normal school hours; therefore, no double shifts or extra time had to be included in the additional costs.

Housing and Public Buildings

Introduction

This section considers the damage, losses and additional costs caused by hurricane Joaquin on dwellings, as well as their furnishings and equipment. The chapter also estimates the effects of the disaster on public buildings, which are analysed separately. The National Recovery and Reconstruction Unit of the Government of The Bahamas provided critical information to estimate the effects of the disaster on this sector.

There are approximately 102,758 private dwellings in The Bahamas. The country's tenure profile is as follows: 58.9 per cent own (fully or mortgaged), 34.8 per cent rent, 5.5 per cent rent free, 0.25 per cent lease and 0.01 per cent falls under other categories.

Table 21- Students transferring from hurricane affected areas to New Providence

Island	Total	Type of tenure					
		Own fully	Own (mortgage)	Rent	Rent free	Lease	Other
Acklins	209	144	1	27	36	0	1
Crooked Island	124	86	2	15	21	0	0
Long Island	1,119	820	95	143	50	1	10
Rum Cay & San Salvador	3821	201	26	83	69	1	2
Total	**1,834**	**1,251**	**124**	**268**	**176**	**2**	**13**

1 Total 382: 40 in Rum Cay and 342 in San Salvador
Source: Department of Statistics of the Bahamas, Census 2010.

In the islands under analysis this profile varies in terms of ownership. Approximately 75 per cent of the homes are owned (fully or mortgage), 14.6 per cent are rented and the remaining 10.4 per cent are classified under other categories. In this regard, it is also worth mentioning that it is estimated that most homes are not insured. This is particularly relevant in a country located in the Atlantic hurricane belt, and that has been affected by hurricanes and storms every four to five years in the past years.

23. Considering that not all dwellings were assessed, the costs presented in this section are estimates based on information provided by the National Reconstruction and Recovery Unit, and field visits to Acklins, Crooked Island, Long Island and San Salvador.
24. Rent: the dwelling does not belong to any member of the household and payments are made monthly for occupancy of the dwelling unit. Rent free: no member of the household pays rent for occupancy of the dwelling. The dwelling is provided free of charges, whether or not in return for services rendered e.g. parsonage or government housing. Lease: a contract in which a dwelling is being used or occupied; an option of buying may or may not exist. Usually, the total sum and time period are stipulated in the contract. Other: any other type of tenure not listed above. An example is "squatting" wherein households were found occupying a dwelling unit without permission of the owner and without any rights to the dwelling. Department of Statistics, 2010 Census.

Another issue to consider regarding housing is the age of a dwelling unit, which has implications in the quality and vulnerability of the housing stock. In 2000, thirty-two per cent of the nation's housing stock was more than thirty years old (built before 1970), while 21.7 per cent of the units were built between 1990 and 2000.[25] In the Family Islands 23.8 per cent of the dwellings were built between 1990 and 2000.

The percentage of dwelling units more than thirty years old ranged as follows for each of the affected islands: Acklins 44.7 per cent, Crooked Island 67.4 per cent, Long Island 49.1 per cent, Rum Cay and San Salvador 34.6 per cent.

In terms of materials used, in 2000 more than 75 per cent of the dwelling units in The Bahamas were made of some type of masonry, such as concrete block and cement. Wooden houses accounted for 15.2 per cent, showing a decrease since previous censuses: 23.0 per cent in 1990 and 32.3 per cent in 1980.[26]

It is also worth noting that The Bahamas was the first Commonwealth Caribbean country to introduce a mandatory building code, which incorporated modern standards. The first building code was enacted in 1971 under the Building Regulations Act. The present code was issued in 2003 and its use is mandatory for the design and construction of all buildings in the country, including private dwellings and public buildings.[27] It is estimated that 31.3 per cent of the dwellings in Acklins and 28.7 per cent in Crooked Island were built between 1971 and 2000. In Long Island this estimate is higher, 44.3 per cent; this suggests that an important percentage of homes should have been built according to the country's building code.

During the field visits to the affected islands, it was observed that most of the houses are reinforced masonry structures with reinforced concrete columns and tie beams. The most common roofing used is made of wood and asphalt shingles. Wood and timber constructions are in use as well. Most of the inspected wooden houses tend to be older and in inferior conditions than those made of reinforced masonry. There are also old stone dwellings, most of them currently abandoned and severely damaged as the result of Joaquin or previous events. This type of traditional construction (locally called "Tabby"), based on the use of structural resistant walls of limestone and mortar is no longer being employed to build new houses.

25. Department of Statistics, 2000 Census.
26. CARICOM Capacity Development Program (CCDP). (2000). Round of Population and Housing Census Data Analysis Sub-Project. National Census report, The Bahamas, The Regional Statistics Sub-Program, Caribbean Community Secretariat
27. The third edition of The Bahamas building code was enacted in 2003 using the Miami-Dade building code as a technical support. While the last version of the Bahamian code dates of 2003, the Miami-Dade code has been updated in 2001, 2004, 2007, 2010 and 2014. Building codes are normally updated every 5 years in Latin America, and most of them have been released in the last 5 years.

1. Damage

Hurricane Joaquin reached maximum sustained wind speeds of more than 130 mph (210 km/h) and remained over some islands more than 36 hours. The strong wind forces tore off roofs, and damaged ceilings, windows and doors, which then allowed water penetration. The hurricane also caused important storm surge. This combination resulted in widespread damage to dwellings, equipment and furniture, as well as damage to septic tanks in the flooded areas. Furthermore, some of the affected settlements remained flooded or isolated for several weeks, exposing assets to even more deterioration.

A significant proportion of the wood/ timber dwellings was either destroyed or suffered severe damage. It is important to mention that reconstruction of these non-reinforced structures is not advisable as they do not fulfil lateral strength and structural behaviour requirements established in the code in order to withstand wind forces. In contrast, the dwellings that met the code's standards suffered minor to no damage after the hurricane.

Table 22- Number of damaged and destroyed dwellings by island

Island	Total occupied dwellings[1]	Total assessed dwellings[2]	Destroyed dwellings	% of destroyed dwellings	Damaged dwellings	% of damaged dwellings	% of destroyed and damaged dwellings
Acklins	209	109	7	3.35	102	48.80	52.15
Crooked Is.	124	70	8	6.45	62	50.00	56.45
Long Island	1,119	677	24	2.14	653	58.36	60.50
Rum Cay	40	32	3	7.50	29	72.50	80.00
San Salvador	342	254	6	1.75	248	72.51	74.27
Total	**1,834**	**1,142**	**48**	**2.62**	**1,094**	**59.65**	**62.26**

[1]**Source:** Department of Statistics, 2010 Census
[2] Number of dwellings assessed by 23 November
Source: Elaborated with information compiled by the National Recovery and Reconstruction Unit

Based on the assessment of 1,142 dwellings, it is estimated that 2.6 per cent of the inhabited dwellings in the affected islands were destroyed and 59.6 per cent were damaged. This resulted in a total estimated damage of $32,877,400 for the five islands under analysis (Table 23).[28]

All the islands were affected by strong winds which caused widespread damage to shingles, roofs and windows. Subsequently, damaged roofs allowed water penetration, affecting ceilings, walls, furniture and equipment due to flooding. Additionally, they were also affected by storm surge to varying degrees. Most settlements located close to bodies of water withstood severe flooding of up to 4 feet for several days or weeks.

28. The recovery costs were estimated using data provided by the National Recovery and Reconstruction Unit and NEMA. As suggested by official sources, taxes, transportation, logistics, contingences and labour wages have been considered. Damage to furniture was also taken into account.

In general, structures located in flood prone areas, close to bodies of water and seashore, and that lacked elevation, sustained increased damage, highlighting the importance of territorial planning, especially considering the country's susceptibility to disasters and to the effects of climate change.

Table 23- Estimated damage to dwellings by island

Island	Total occupied dwellings[1]	Estimated cost of new dwellings	Estimated cost of new dwellings and repairs	Estimated damage to furniture and equipment	Total damage
Acklins	109	525,000	2,769,000	159,900	3,453,900
Crooked Is.	70	600,000	1,964,000	111,800	2,675,800
Long Island	677	1,800,000	16,166,000	942,500	18,908,500
Rum Cay	32	225,000	863,000	49,400	1,137,400
San Salvador	254	450,000	5,906,000	345,800	6,701,800
Total	**1,201**	**$3,600,000**	**$27,668,000**	**$1,609,400**	**$32,877,400**

[1] Number of dwellings assessed by 23 November
Source: Elaborated with data provided by the National Recovery and Reconstruction Unit

In **Acklins**, significant destruction was observed mainly in Chester's, Lovely Bay, Masons Bay and Snug Corner. It is estimated that 52.1 per cent of the total occupied dwellings were damaged (48.8 per cent) or destroyed (3.35 per cent). The total cost of damage to dwellings, furniture and equipment is estimated at $3,453,900.

Some of these settlements remained under 4 feet or more of storm surge for several days due to their proximity to bodies of water. This situation resulted in damage to buildings, furniture, equipment, water pumps, septic tanks and vehicles. The bridge and road to Lovely Bay were destroyed and the settlement was isolated for several days, which complicated relief and recovery efforts.

In contrast, Hard Hill and Pine Field suffered minor wind damage, but they were the least affected settlements in Acklins as a result of their location in the highest point of the island. Dwellings in these settlements sustained minor roof damage and shingles loss.

In **Crooked Island** hurricane conditions remained for approximately 36 hours, intensifying the damage caused by strong winds and storm surge. Insufficient reinforcement between columns, tie beams and weak anchorage of roofs were the main cause of damage. Flooding and stagnant water also resulted in significant amounts of mould.

Approximately 6.45 per cent of the homes were destroyed, and 50 per cent suffered partial damage. Damage is estimated at $2,675,800.

The southern part of **Long Island** was more affected than the northern section, particularly the settlements of Clarence Town, Dunmore, Morrisville, Mortimers and Roses. In general, the northern portion suffered primarily wind damage and water penetration; while in the south, dwellings were affected by both strong winds and storm surge.

In the island, 677 dwellings were assessed, 653 were damaged and 24 homes were destroyed. This resulted in an estimated total damage of $18,908,500.

Rum Cay has approximately 40 dwellings of which 32 were assessed: 72.5 per cent suffered varying degrees of damage and 7.5 per cent were destroyed. Total damage is estimated at $1,137,400.

San Salvador was affected by the same conditions, 72.5 per cent of the occupied dwellings were affected and 1.75 per cent were destroyed, 248 and 6 homes respectively. This resulted in an estimated cost of $6,701,800.

2. Losses

Losses in the housing sector relate to the interruption of accommodation services due to severe damage or destruction of the housing stock, making it temporarily or permanently uninhabitable. Estimates focus on the interruption of the service regardless of the type of tenure.

Based on the extent of severely damaged and destroyed dwellings, it is possible to estimate the number of homes that were deemed uninhabitable after the hurricane and that, subsequently, cannot provide the accommodation service.[29] Repairs and reconstruction are expected to last between 6 and 12 months; however, estimates are presented in Table 24 for the year 2015.[30] Estimates are based on an implicit rent of $750 per month.[31]

Table 24- Estimated losses in the housing sector by island

Island	Losses
Acklins	261,000
Crooked Island	175,500
Long Island	1,577,250
Rum Cay	78,750
San Salvador	585,000
Total	**$2,677,500**

Source: Estimations by disaster assessment team, 2015

29. ECLAC. (2014). Handbook for Disaster Assessment LC/L.3691 2013-817. United Nations, Santiago, Chile
30. Losses for the year 2016 are estimated at $2,922,435.
31. The implicit rent was calculated based on interviews with local inhabitants of the islands.

Losses are estimated at $2,677,500 for the five islands. It is worth mentioning that a fast recovery and reconstruction will allow inhabitants to move back to their homes sooner; in turn, this could reduce upcoming losses.

3. Additional costs

The Ministry of Social Services and Community Development provided temporary housing arrangements for vulnerable families in the affected islands. Temporary accommodations were provided in Acklins (1), Crooked Island (6) and Long Island (1) for a total cost of $6,930. Families also received rental allowance in Acklins (3), Crooked Island (3) and Long Island (2), at an estimated cost of $15,660.

Additional costs also considered several other activities, such as removal of rubble, cleaning of debris, and cleaning and recovery of septic tanks. It also incorporates purchasing of trailers and shipping costs. These costs are estimated at $1,809,110.

Table 25- Estimated additional costs in the housing sector

Description	Estimated cost
Trailers (including shipping)	291,000
Staff services	20,000
Cleaning and removal of rubble	641,520
Precast septic tanks	240,000
Cleaning of septic tanks	594,000
Social assistance	22,590
Total	**$1,809,110**

Source: Estimations by disaster assessment team, 2015

Public Buildings

Introduction

This section considers government buildings in the affected islands. It should be noted that education, health, power and telecommunication facilities are analysed separately in their respective sectors.

Public buildings are important in three senses. First, local governments employ important number of workers in the analysed islands. In general, their damage or destruction will not lead to layoffs, but will interrupt other productive activities. Second, public institutions should be in charge of guiding their communities in times of emergency. Third, some buildings such as the Spring Point Community Centre, also function as storm shelters. If public institutions are not operating, it could give citizens a sense of institutional vacuum, undermining the efforts to restore normalcy.

Most of the government buildings in the islands are reinforced masonry structures with reinforced concrete elements; fewer and older buildings have wooden structures. The most commonly employed roof systems are made of wood and asphalt shingles. Most of them do not have window shutters or flood barriers.

Some reinforced masonry and concrete structures showed cracks due to corrosion. The extent of the corrosion must be assessed in order to verify the resistance of the structures. The observed corrosion is previous to the hurricane and could have increased the vulnerability of some of the structures.

1. Damage

It is estimated that the total cost for damage to public buildings is $2,649,888. This includes shipping, logistics, contingences, labour and furniture.

Similar to the housing sector, public buildings were generally affected by strong winds and storm surge. The most widespread damage was to roofs, ceilings, windows and walls; as well as furniture and equipment due to flooding and water ingress. Also similar to housing, the buildings that suffered the most severe damage were those located in risk areas.

Table 26- Estimated damage to public buildings by island

Island	Estimated cost
Acklins	406,669
Crooked Island	135,705
Long Island	305,599
Rum Cay	1,000,000
San Salvador	480,000
Total	**$2,327,973**

Source: Estimations by disaster assessment team, 2015

Some areas of Acklins were covered in up to 4 feet of water, and the affected buildings are located very close to the seashore. Therefore, damage is mainly due to flooding and storm surge. Total damage is estimated at $406,669.

The administrative complex in Masons Bay is key as it includes the post office, the court and the office of the Administrator. This complex was not built to withstand the action of a hurricane with the magnitude of hurricane Joaquin and its effects: water surge, wave action, flood and wind. No drainage was included in the infrastructure, the sea wall was made of unreinforced masonry and was destroyed by the water surge, and the soil surrounding the buildings was eroded. The Administrator's office accounts for 30.7 per cent of the total damage on public buildings in Acklins. The sea wall that protected the complex was also destroyed and its recovery is equivalent to 24.6 per cent of the total damage.

In **Crooked Island** the two most damaged public buildings were the Administrator's office and the Administrator's residence, which account for 82 per cent of the total damage. The Social Services and the Department of Environmental Health Services buildings also sustained damage. The total cost is estimated at $135,705.

Damage to public buildings in **Long Island** is concentrated in two locations: Clarence Town and Deadman's Cay. The total cost of damage to public buildings is estimated at $305,599.

In Clarence Town, the most affected buildings were the Administration complex, the police station, the community centre, the Department of Agriculture and Fisheries, and the Administrator's residence. In Deadman's Cay the library, museum and community centre were damaged.

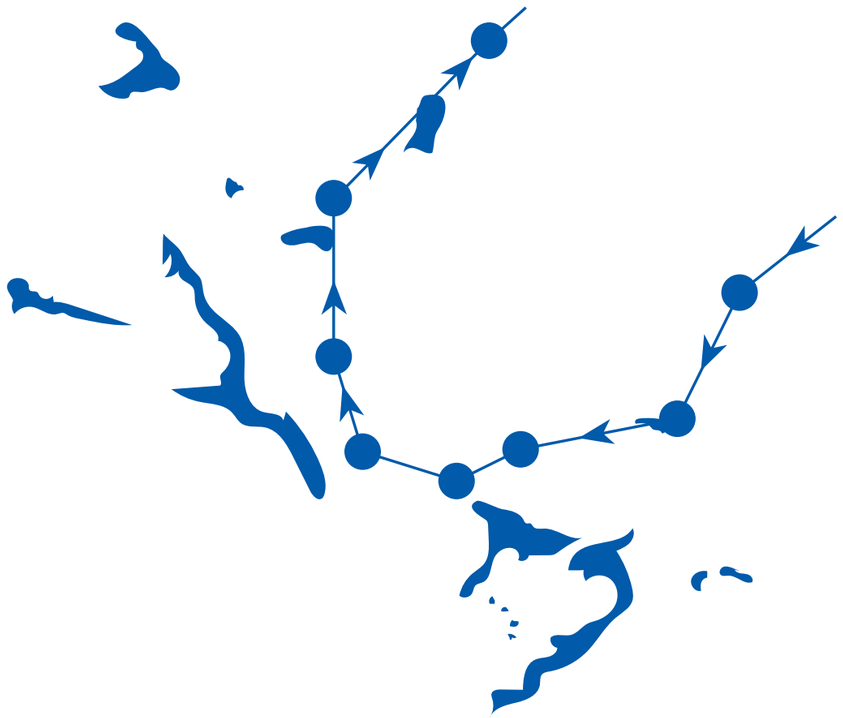
Rum Cay was not visited. However, two buildings were reported to have sustained severe damage, the Administrator's office and the island's shelter. Costs have been estimated at $1,000,000.

Most of the damage in **San Salvador** was sustained by the Administrator's residence and in Graham's harbour. In Graham's harbour, the fragile wooden structure of the Fish Fry was destroyed together with the recreational facility. Damage is estimated at $480,000.

2. Additional costs

The additional costs are estimated at $53,000. These costs include rubble removal and cleaning, rehabilitation of septic, temporary power generation and diesel supply when needed.

INFRASTRUCTURE SECTORS



Roads, Airports, and Docks

Introduction

This chapter analyses the effects of the disaster on roads, docks and airports.[32] Transportation infrastructure is critical for three main reasons. First, it supports both internal and external productive activities of communities and islands. Second, it allows the movement of persons within and between islands, with special emphasis on their ability to access critical public and private services. Additionally, it plays a vital role during an emergency, as it could affect the ability to respond in a timely manner.

As it has been mentioned, the archipelagic nature of The Bahamas has hindered the government's ability to provide equitable access to quality services and infrastructure, highlighting the disparities between New Providence (and Grand Bahama) and the Family Islands –particularly those affected by hurricane Joaquin. The topography of each island's terrain and their distance from New Providence result in high per capita costs for infrastructure development and maintenance. This challenge is exacerbated in the five islands assessed given the small size and dispersion of each settlement. Therefore, large investments are required to build long stretches of roads to connect low populated, scattered settlements throughout the islands.

1. Damage

The infrastructure analysed herein show deterioration and damage preceding the hurricane due to prior use, insufficient maintenance and lack of damage repair caused by previous weather events (such as hurricane Irene) and annual rains.

All the infrastructure repair and recovery projects from damage add a total cost of more than $55,592,473. This is an important effort and justifies a global investment plan, or master plan, as a part of a National Development Plan. This master plan should consider the vulnerability of the islands against natural hazards such as floods, hurricanes, rise of sea level related to climate change, and the need to increase resilience.

32. Estimations of the effects of the disaster in this sector were based on information compiled by the National Recovery and Reconstruction Unit, and on field visits to Acklins, Crooked Island, Long Island and San Salvador.

Table 27- Estimated damage to transportation infrastructure by island

Island	Roads	Damage Airports	Docks	Total
Acklins	16,909,015	663,630	1,388,136	18,960,781
Crooked Island	4,995,737	121,392	1,317,186	6,434,315
Long Island	2,052,993	165,199	1,002,571	3,220,763
Rum Cay	-	-	1,321,384	1,321,384
San Salvador	588,309	821,743	739,299	2,149,351
Total	**24,546,054**	**1,771,964**	**5,768,576**	**$32,086,594**

Source: Estimations by disaster assessment team, 2015

1.1 Roads

Road conditions in the islands were suboptimal before the occurrence of the disaster. The hurricane caused important damage that compromised and, in some cases, interrupted the functionality of the roads. The presented figures show estimates that allow the repair of the main damage in order to restore communication and the functionality of the roads.

Some of the roads are located very close to the seashore or other bodies of water, making them vulnerable to surges and flooding. The relocation and the rise of certain parts of the roads should be analysed as a part of a master plan.

The suboptimal road conditions prior to the hurricane could be attributed to:

- Insufficient maintenance
- Inadequate construction and design characteristics, such as insufficient elevation of roads in low and flooding areas
- Inadequate or nonexistent drainage structures
- Nonexistent or insufficient signage
- Normal wear
- Unrepaired damage inflicted by previous events.

Damage to roads was reported in Acklins, Crooked Island, Long Island, and San Salvador. There were no reports of damage to roads in Rum Cay. The total cost of damage to roads is estimated at $24,546,054. These constitute preliminary estimates which should be complemented with further studies and engineering designs.

The main observable damage was:[33]

- Flooding, due to the nonexistence of drainage systems and insufficient elevation of the constructed roadways.

- Deterioration of sand seal surface materials, due to normal traffic over time and ponding of water from rainfall and storm surges.

33. Estimations of the effects of the disaster in this sector were based on information compiled by the National Recovery and Reconstruction Unit, and on field visits to Acklins, Crooked Island, Long Island and San Salvador.

- Sections of roadways with the base material exposed and deteriorated.

- Pothole formation due to normal traffic, ponding of water, or storm surges.

- Rutting of pavement edges, typically due to tires driven on the edges of the road and water ponding.

- Failures of the road edges were also observed in places close to the seashore; some of them could be previous to the hurricane.

- Complete destruction of sections of roadway was observed in certain locations.

Table 28- Estimated damage to roads by island

Island	Total cost
Acklins	16,909,015
Crooked Island	4,995,737
Long Island	2,052,993
San Salvador	588,309
Total	**$24,546,054**

Source: Estimations by disaster assessment team, 2015

The two islands with the most affected roads were Acklins and Crooked Island. The costs included herein are related to the recovery of functionality of the roads. Further investments would be required in order to improve the quality, security and resilience of the main roads.

The damaged roads and the recovery costs for each island are presented as follows:

Acklins road damage is approximately 65 per cent of the total road damage. Total damage is estimated at $16,909,015, of which 80 per cent is associated to Queen's highway North and South (Table 28).

The passage to Lovely Bay on Queen's highway north was destroyed in three sections. These segments require reconstruction from the embankment/subbase and base levels, and seawalls should be considered to protect the road. Edge reconstruction is also required for other portions of roadway. Appropriate drainage infrastructure should be installed in required sections. The construction of a temporary road to Lovely Bay is included in the estimates.

Queen's Highway south from the Spring Airport intersection to the end of Salina Point was destroyed in sections. In some cases, it was reduced to bare earth with no proper driving surface. Potholes and flooding were frequent.

Other roads are included in the recovery estimates, the road to Camel Point, Spring Point Clinic road, Chester's road, and the road to Salina Point, which is a secondary unpaved road. These four roads represent 14 per cent of the damage estimates for Acklins.

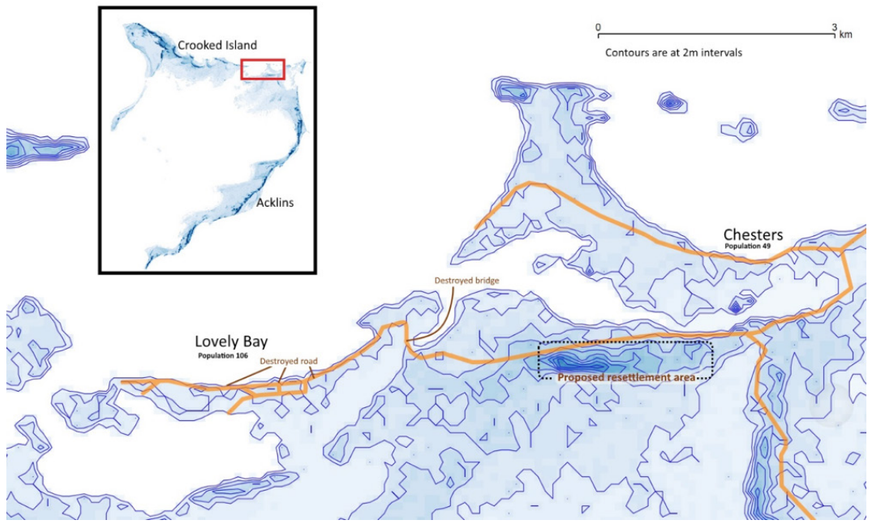
Table 29- Estimated road damage to Acklins

Road	Length in miles	Damage
Queen's highway north	29.7	9,459,840
Lovely Bay temporary road	1.1	960,189
Queen's highway south	27.8	4,090,017
Camel Point road	0.8	473,423
Spring Point (clinic road)	2.9	345,387
Chester's road	2.9	1,156,522
Salina Point (secondary road)	1.2	423,637
Total	**66.5**	**$16,909,015**

Source: Estimations by disaster assessment team, 2015

A new design and reconstruction of Queen's highway that fulfils all technical requirements would require its rise to appropriate elevations above the flood levels in most of its length and implementing a new alignment. The proximity to certain settlements such as Salina Point, Snug Corner and Lovely Bay would prevent the rise of Queen's highway along its length. This more complex solution requires further analysis and could be related to proposals for relocations of some settlements as part of a more comprehensive disaster risk management strategy.

Figure 2- Lovely Bay road map



Source: Disaster assessment team based on data provided by the United States National Aeronautics and Space Administration (NASA)

Roads on **Crooked Island** were severely affected for an estimated cost of $4,995,737. The cost of replacing the damaged assets represents 21 per cent of the total estimate of recovery for the roads of the five analysed islands.

The island has one main road from Cove in the south to Landrail Point in the north. It suffered severe floods and presents potholes. Several sections of the road were destroyed. Lagoons and swamps cover most of the inner territory of the island, and in some places they contributed to its flooding. The road at Winding Bay was completely washed away by the hurricane.

Table 30 includes all roads and settlements considered in the recovery. The last mentioned road is Pitts Town carriageway. This road serves a touristic and secondary home settlement and has an economic importance in the island. Its total reconstruction should be considered within a comprehensive master plan. The present estimate only considers its functional recovery.

Table 30- Estimated road damage to Crooked Island

Road	Description	Damage
Major Hill settlement Section 1	Approx. 400 ft. (244 m) carriageway reconstruction	137,453
Major Hill settlement Section 2	Approx. 100 ft. (31 m) carriageway reconstruction with cast-in-place seawall	169,304
Major Hill settlement Section 3	Approx. 400 ft. (122 m) carriageway reconstruction with pre-cast box culverts	808,806
Seaview settlement	Approx. 800 ft. (244 m) carriageway reconstruction with cast-in-place seawall	887,223
Main carriageway	Approx. 3 miles (4.8 km) carriageway reconstruction	1,897,924
Landrail Point settlement	Approx. 70 ft. (21.3m) carriageway reconstruction with pre-cast concrete box culverts	145,027
Pitts Town	Approx. 4 miles (6.4km) carriageway reconstruction	950,000
Total		**$4,995,737**

Source: Estimations by disaster assessment team, 2015

The roads of **Long Island** were less affected than the roads of Acklins and Crooked Island. The cost of the damage to roads in Long Island is estimated at $2,052,993.

The main road runs from Cape Santa Maria in the north to Gordons in the south. Some sections of the road pass through wetlands, so vegetation intrusion and lack of drainages were observed. Part of the road surface was missing near Dunmore.

Seawalls protect roads from the effects of sea floods that can destroy their base. Some of the existing seawalls along the roads did not withstand the effects of hurricane Joaquin and show severe damage. Most of the seawalls show inadequate design, and lack of reinforcement. They require reconstruction in order to restore the functionality of the main roads.

A new design and reconstruction of the main road that would fulfil all the technical provisions requires its rise to appropriate elevations above the flood levels in several sections. The relocation of the road might also be considered at the most vulnerable sections close to the seashore. This more complex solution requires further analysis as part of a master plan.

Table 31- Estimated road damage to Long Island

Road	Description	Damage
Highway Signage Gordons to Seymour (whole island)	Signage collocation	14,631
Seawall Buckleys Scrub Hill to Buckleys: 300ft + 700ft	Road repair	480,837
Seawall Greys to Salt Pond three separate locations, 700 ft. total	Road repair	512,639
Seawall Salt Pond to Simms three separate locations: 100ft + 300ft + 350ft, total=750 ft.	Road repair	541,026
Seawall Simms to Millerton, 400ft	Road repair	309,085
Rehabilitation of various roads	Road recovery	194,775
Total		**$2,052,993**

Source: Estimations by disaster assessment team, 2015

The Queen's highway is the main road in San Salvador and it encircles the island. The road suffered minor damage, and the main reconstruction required corresponds to the Hall's Landing sea wall. The total amount of the recovery costs of the roads of San Salvador represents 2.4 per cent of the total of all five islands.

Table 32- Estimated road damage to San Salvador

Work	Description	Damage
Reparation of roads	4,652 yds. of roadway	168,165
Hall's Landing	Sea wall repair	420,144
Total		**$588,309**

Source: Estimations by disaster assessment team, 2015

1.2 Airports

Airports are crucial for the social and economic activity of The Bahamas. They were affected due to the flooding of runways and other access surfaces, and by strong winds that affected the terminal buildings.

The terminal buildings located in Acklins, Crooked Island, Long Island (Deadman's Cay) and San Salvador are all similar, airports consist of a runway and neither have guidance or communication systems. The terminals are single-story structures of reinforced concrete and masonry. The hurricane produced damage in all terminal buildings, but they are partially recovered and all presently functioning. In Rum Cay there was no building terminal.

Photo 1- San Salvador Airport

Photo courtesy of: Carlos Genatios y Marianela Lafuente

Runways of all five airports inspected are clear of debris and functioning, but require repairs. They show insufficient previous maintenance unrelated to hurricane Joaquin. The costs of these repairs have not been estimated due to lack of information regarding their design parameters and their estimation could be part of a comprehensive infrastructure development master plan. The total damage to airports in Acklins, Crooked Island, Long Island and San Salvador is estimated at $1,771,964.

Table 33- Estimated damage to airports by island

Island	Total cost
Acklins	663,630
Crooked Island	121,392
Long Island	165,199
San Salvador	821,743
Total	**$1,771,964**

Source: Estimations by disaster assessment team, 2015

The Acklins terminal suffered damage to the roof, windows and doors. Water penetration caused damage inside the building to ceilings, walls, furniture, lights, appliances and doors. Outdoors, the landscape and fences were also affected.

The airport access (of approximately 100 feet) and the parking lot (150' x 280') showed damaged pavement. The airport apron and the taxiway also require repairs. Vegetation should be removed from the runway.

The Crooked Island terminal building suffered damage due to wind and to water penetration. Observed damage included loss of shingles, damaged plywood, masonry walls that must be cleaned and painted, broken or missing windows and shutters, ceiling leaks, broken exterior fences, light fixtures, and restrooms damaged. Part of the furniture and appliances must be replaced. Vegetation should also be removed from the runway.

Damage observed at the Deadman's Cay Terminal on Long Island were due to wind and to water penetration. They include loss of roof shingles, damage to roof and ceiling, as well as windows, lights, shutters, and masonry walls. Part of the furniture and appliances must be replaced. Exterior fences and landscaping were affected. Vegetation should be removed from the runway.

There is no airport terminal in Rum Cay. A fence that limits and protects the entrance to the airport was torn down by the hurricane. The runway is functioning but needs to be repaired.

The San Salvador airport terminal suffered damage due to wind and water penetration. Extensive damage occurred at the roof, masonry walls, windows and shutters, and light fixtures. The ceiling fell down in part of the building (approximately 60 per cent), and the X-Ray baggage screening office was also affected. Repairs should include lattice screens for corridors, shingles, roofs, windows, walls, ceiling, light fixtures, doors, walls, corridors, electrical repairs, plumbing, landscaping, furnishing, and baggage processing.

1.3 Docks

Docks are important infrastructures that promote economic growth, as they are vital for the development of all activities. They assure connectivity between islands and facilitate vital activities such as fishing, agriculture and tourism. Even if their capacities are limited, they support economic activities in the islands. As examples, the total custom's receipts in San Salvador were $1,029,640 with 561 entries in 2014, while in Stella Maris (Long Island) the total custom's receipt was $789,431 with 1,261 total entries. On the other hand, the conditions of the dock of San Salvador (MLW 6 ft.) show limited manoeuvrability, hazardous access, lack of appropriate security and unpaved surface.[34]

34. The Bahamas Chamber of Commerce and Employers' Confederation. (2015). "Family Island Port Development: Bahamas Business Outlook" Available at: http://thebahamaschamber.com/bahamas-business-outlook-family-island-port-development/

Table 34- Estimated damage to docks by island

Island	Damage
Acklins	1,388,136
Crooked Island	1,317,186
Long Island	1,002,571
Rum Cay	1,321,384
San Salvador	739,299
Total	**$5,768,576**

Source: Estimations by disaster assessment team, 2015

Dock structures showed important damage before the hurricane due to insufficient maintenance and to previous disasters. The structure of docks is comprised of wooden piles with concrete and wood platforms. Some docks were destroyed or severely damaged and cannot be utilised. Their repair must be carried out as soon as possible given their importance as support infrastructure for the reconstruction process; as well as a means to recover the economic activities of the islands. Photo 2 shows how extensively docks were damaged.

Photo 2- Damage to a dock on Long Island

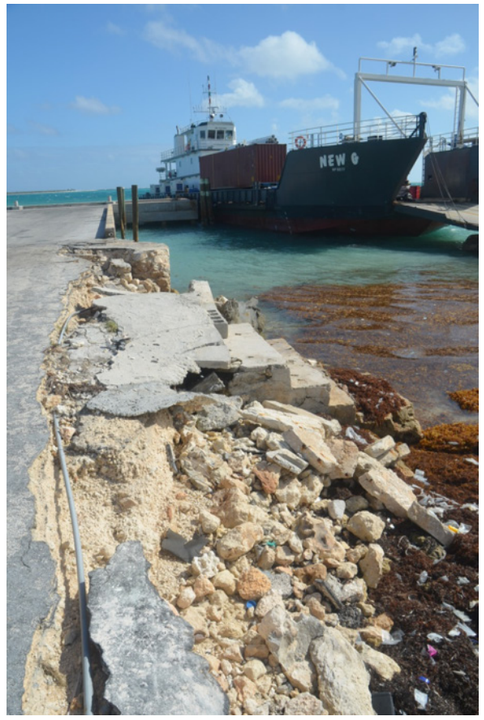


Photo courtesy of: Carlos Genatios y Marianela Lafuente

A larger effort should be made in order to assure adequate port infrastructure and port security. The quality of the port infrastructure is required in order to reduce transportation and operation costs.

2. Additional Costs

Additional costs for roads, airports and docks include removal of rubble, cleaning and any other actions required to restore the normal operation of the infrastructure.

Table 35- Estimated additional costs for transportation infrastructure

Infrastructure	Cost
Roads	95,225
Airports	19,500
Total	**$114,725**

Source: Estimations by disaster assessment team, 2015

Power

Introduction

Power on the affected islands is provided by The Bahamas Electricity Corporation (BEC), which operates diesel generators and owns the utility poles on each island.

The number of customers on each island is as follows. The values for Acklins and Long Island are estimated, while the quantities for other islands have been collected from statements attributed to BEC.

Table 36- Number of power customers

Island	Customers
Acklins	376
Crooked Island	253
Long Island	2,014
Rum Cay	87
San Salvador	570
Total	**3,300**

Source: BEC and estimations by disaster assessment team

Each of these islands is served by diesel generating stations, which together consume, by ECLAC estimates, over 4,000 gallons of diesel per day. Renewable energy sources, such as wind and solar, are not used for commercial electricity generation, and plans to incorporate residential renewable feed-ins for the Family Islands have recently been delayed.

In general, the bulk of the damage was to overhead power lines, utility poles, and transformers. However, the power stations in Crooked Island and San Salvador also sustained serious damage.

In conducting repairs, BEC was assisted by Caribbean Electric Utility Services Corporation (CARILEC), which is a membership organisation of regional electric utilities. CARILEC, under its mutual aid program, coordinated efforts by its member utilities to support BEC in recovery efforts. As part of this effort, repair crews were sent from Grand Bahama Power Company, British Virgin Islands Electricity Corporation, US Virgin Islands Water and Power Authority and the Jamaica Public Service Company. These crews were present in San Salvador, Rum Cay, and Long Island.

1. Damage

Different assets of this sector such as utility poles, wires, and power generators were damaged due to wind, and/or storm surge. A monetary estimate of the total damage in the power sector is presented in Table 37.

Table 37- Damage to power sector, by island

Island	Damage
Acklins	30,450
Crooked Island	651,100
Long Island	946,050
Rum Cay	26,500
San Salvador	326,500
Total	**$1,980,600**

Source: Estimates by disaster assessment team, 2015

The 1300 kW Salina Power Station in **Acklins** survived the storm without damage. The station is located on the far south end of the island, and was thus not subjected to the strongest winds of the storm. A secondary, 90 kW unit at Spring Point was inundated by storm surge, necessitating repair.

While overhead lines were down all over Acklins, there was very limited damage to utility poles, even in the areas hardest hit by wind and storm surge. Only one pole on the island was broken. This was in part due to the larger, stronger poles that were used in Acklins, as compared to other affected islands.

Power distribution was restored to all parts of Acklins by 10 October. Generators were not widely used prior to power restoration, as very few exist of the island.

In **Crooked Island**, the Landrail Point Power Station experienced storm surge in excess of two meters. The generator storage shed was damaged, and the island's two main generators spent an extended period of time under water. They were found to be non-repairable, and were removed and shipped to Nassau. Two 400 kW generators were shipped in, which may become the long-term source of power for the islands. They represent a reduction in capacity from the 1275 kW that was available prior to the storm, but demand on the island has also been reduced, as many people have left. These generators are attached to trailers, and so it is possible that, in the event of another storm, they could be moved out of the way of potential storm surge.

Another effect of the storm surge on the Landrail Point Power Station was the dislocation of two 25,000 gallon tanks used for the storage of diesel. The tanks were ripped from their concrete bases, and an estimated 7,000 to 10,000 gallons of diesel leaked out through a pipe that had become disconnected. Soil sampled from a drainage area nearby the tank was found to be contaminated with diesel, as evidenced by the presence of strong fumes which were noted by the disaster assessment team. This spill warrants further investigation, to determine the extent of soil contamination, possible options for remediation, and potential danger to the water table. The tanks themselves are salvageable, but will require a crane to be put back into place.

Photo 3- Damage to fuel tanks

Photo courtesy of: Robert Williams

There was extensive damage to power lines and transformers, and at least 67 utility poles were destroyed. Work to restore electrical services proceeded slowly in the initial weeks after the storm, due in part to the difficulty in traversing the roads, which were damaged and, in some areas, blocked by standing water. Initially, ten BEC personnel were assigned to perform the repairs to the power grid; this was increased to 14 in mid-November. Reconstruction of the power grid was quite expected to continue through January.

As a result of the intrusion of salinity into aquifers following the storm, it is likely that the current well field that provides water to the island will be replaced by a desalination system. The increased power needs of this desalination system will need to be considered when planning for the long-term energy future of the island.

Due to the extended power outage on the island, there was extensive use made of small and medium-sized generators to provide electricity to individuals and public institutions. A significant number of generators were donated to the island, including to the medical clinics. However, the 90 kW generators donated to the clinics could not be put to immediate use, as it was necessary to pour concrete pads on which to situate them. Thus, while these generators were not able to provide relief to immediate, short-term needs, their presence will help to assure the resilience of medical clinics to power outages in future storms.

Power was restored on Long Cay, including to the desalination plant, on 10 October.

Long Island suffered significant damage to its power transmission and distribution network, especially in the southern part of the island, where 367 damaged utility poles were documented in the area south of Clarence Town alone.[35] The area closest to the power generation station in Millers, in the north-central part of the island, was the first part of the island to have electricity restored, and power was restored to the northern portion of the island by 13 October. Work to restore power to the southern section of the island entailed a total reconstruction of the transmission and distribution networks, and this work lasted through late November.

In the absence of power, citizens and institutions relied on generator power, although these were not available to all sectors of society, and the cost of fuel was very expensive. One resident indicated that she was spending $25 per day to fuel a generator for 10 hours a day, which was enough to run the lights and refrigerator, but not the air conditioning. Bahamas Telecommunications Company (BTC) cellular towers also went offline for the lack of commercial power, and portable generators were brought in to provide electricity to them on an interim basis. The desalination plant at Deadman's Cay also lost commercial power, but was able to restore operations soon after the storm (October 5), through the use of a standby generator.

Though there was damage to the generator building, with garage doors blown in and extensive debris that needed to be cleared, the power station at Rum Cay was restored to service by 9 October. There was significant damage to the power distribution system, with wires down and 20

35. This number was documented by the Pathfinders Task Force, a private disaster response organization. Available at: http://www.ewfrelief.org/assets/PTF-Hurricane-Joaquin-AAR.pdf, chapter 8.

utility poles destroyed. Restoration of the distribution system was delayed until crews arrived on the island starting 17 October. Prior to that, because the dock at Rum Cay had been damaged, it had not been possible to land materials and equipment needed for repairs. In the interim, at the initiative of the island's head linesman, residents were invited to bring their freezers and refrigerated items to the BEC facility, so that ice could be made and food would not be spoiled.[36]

The roof of **San Salvador's** 3870 kW power station in Cockburn Town blew off. As a result, rainwater damaged the generators and the inventory of spare parts. A temporary generator was used while the damaged generators were dried out. Additionally, the Water and Sewerage Corporation brought in a 400 kW generator to provide power to desalination facilities.

There was significant damage to the overhead infrastructure for power transmission and distribution, and an estimated 50 utility poles were destroyed. Power was restored to 80 per cent of the residents on the island by 22 October, with the remainder being restored by the end of the month. The community of United Estates was the last to have power restored, being located on the far side of the island from Cockburn Town.

2. Losses

Table 38 presents an estimate of the total losses in the power sector, by island. It was calculated using historical data for electricity usage, the electricity tariff schedule for October 2015, and an estimate of the average time without electricity per customer, per island. The losses on San Salvador are split between losses related to the sale of electricity to Club Med, and losses base on sales to the rest of the island. This is to account for the electricity sales to Club Med that were forgone as a result of its late opening. Additionally, the loss is divided as to separate the base price element of the electricity tariff from the fuel surcharge.

Table 38- Losses in the power sector, by island

Island	Loss (base)	Loss (fuel)	Total
Acklins	2,954	3,619	6,573
Crooked Island	37,009	45,343	82,352
Long Island	127,219	155,868	283,087
Rum Cay	4,657	5,706	10,364
San Salvador (Club Med)	127,979	114,464	242,444
San Salvador (Rest of island)	12,740	15,609	28,349
Total	**$312,558**	**$340,610**	**$653,167**

Source: Estimates by disaster assessment team, 2015

36. Available at: https://www.youtube.com/watch?v=7seJ_GYlh6k&feature=youtu.be

3. Additional Costs

Table 39 presents additional costs for the power sector. These costs include labour, transportation, room and board, shipment of equipment, and fuel burned as a result of the use of emergency generators.

Table 39- Additional costs to the power sector, by island

Island	Additional Costs
Acklins	16,275
Crooked Island	281,100
Long Island	327,700
Rum Cay	31,250
San Salvador	49,600
Total	**$700,225**

Source: Estimates by disaster assessment team, 2015

Telecommunications

Introduction

The Bahamas is served by The Bahamas Telecommunications Corporation (BTC), which provides cellular, telephone, and broadband services and Cable Bahamas, which provides cable and broadcast television to the islands.

The following table provides an estimated number of customers for each service. These figures are based on numbers provided by BTC and Cable Bahamas in the respective areas of fixed telephone and cable television, and are otherwise estimated using census figures and national statistics on mobile and broadband penetration.

Table 40- Breakdown for telecommunications services by island

Island	Mobile	Broadband	Fixed Telephone	Cable
Acklins	484	118	155	0
Crooked Island	279	68	168	0
Long Island	2616	637	1535	855
Rum Cay	86	21	36	0
San Salvador	804	196	408	379

Source: Estimates by disaster assessment team, 2015

There are 27 cellular base stations on the affected islands, including 6 on Acklins, 5 on Crooked Island, and 11 on Long Island. Additionally, while Long Island, Rum Cay, and San Salvador are served by fixed broadband networks, wireless broadband is provided through WiMAX networks on Acklins and Crooked Island.

Long Island and San Salvador both have cable television systems offering 30 channels. Acklins, Crooked Island, and Rum Cay each have broadcast television facilities, offering 6 over-the-air channels.

1. Damage

The telecommunications network on **Acklins** was affected by dropped wires, though only a single utility pole on the island was destroyed. This was in part due to the use of a stronger class of pole on that island, as compared to other islands that had a higher level of utility pole destruction.

The main BTC facility in Acklins was severely damaged by wind and storm surge. It was in a particularly vulnerable location for storm surge, being situated directly across the street from the ocean. The building was flooded, causing interior damage to furniture and retail inventory. The generator building, though elevated one meter above grade, was nonetheless affected by storm surge and water damage. This caused the generator cut-off switch to fail. Thus, when commercial power was restored, electrical equipment in the base station and tower became overloaded and was damaged or destroyed.

The six cellular sites on the island, as well as the WiMAX wireless internet infrastructure, were repaired in relatively short order. However, these services were not restored until early November, because they were dependent on a microwave link to a facility on Crooked Island, and the microwave dish on Crooked Island was out of commission. In the absence of telecommunications services, BTC provided local residents with free outbound satellite phone calls from their central office; this service was also offered on other affected islands. The Cable Bahamas over-the-air broadcast facility was out-of-service through early December.

The telecommunications network on **Crooked Island** suffered a high level of damage due to fallen lines and utility poles. It was further affected by the island-wide loss of commercial power caused by flood damage to the Landrail Point Power Station.

There was extensive damage to the central BTC facility at Colonial Hill, including wind damage to the roofs of the retail store, technical building, and generator house. As a result of the compromised roofs, there was significant water damage to interiors, including furniture and inventory. Tower equipment was also damaged, including microwave dishes used to provide telecommunications services to Acklins and Long Cay. As of the end of November, the microwave link to Acklins was back on line, but the link to Long Cay was not.

Additionally, two of BTC's cellular communications towers were snapped off at the base. This was likely as a result of metal fatigue caused by a prolonged period of swaying in high winds. As several other towers in the affected islands share the same 120-foot monopole design, and have likely also sustained a high level of metal fatigue, these may also require replacement as a result of the storm. Pending replacement of the cellular tower at Landrail Point, a COW unit was used to provide temporary cell service, albeit at a reduced signal strength. Two of the four cellular base stations on the island, as well as the station on Long Cay, remained out of commission as of the end of November.

The ARCOS-1 fibre optic undersea cable landing station in Landrail Point suffered roof damage to its generator shed, and the ensuing entry of water caused the generator to automatically shut off. As a result, the local section of the cable went dark. This may have affected the quality

of internet service to other locations with connections to that cable, including Turks and Caicos and the Dominican Republic. WiMAX equipment was also affected by the lack of commercial power and damage to fibre networks, which are used to connect the WiMAX base stations to the central exchange. The Cable Bahamas over-the-air broadcast system was out of service until 12 November.

On **Long Island**, telecommunications customers were affected by extensive loss of cellular, fixed telephone, internet and cable services. Wired services were affected by the large number of downed cables and broken utility poles. This resulted in direct damage to telecommunications networks, as well as a secondary impact caused by the loss of electrical power to both telecommunications facilities and end users. Cellular networks were also affected by the loss of electrical power, as well as by damage to cellular towers and their associated equipment.

The Cable Bahamas "headend" building in Deadman's Cay was flooded with 18 inches of water, causing damage to wiring and electrical equipment. BTC's main exchange at Deadman's Cay was flooded as well, resulting in the loss of equipment used to distribute communications traffic on the island's network. In Hamilton, a cellular tower broke in half, and in Clarence Town, an array of cellular antennas was knocked off of a tower by the force of wind. Several other cellular installations also suffered antenna damage. In Roses, and at towers service other settlements in the south, power was unavailable for an extended period of time. In some cases, backup power generation systems were lost as well. In total, eleven cellular base stations on the island were affected. Three fibre optic distribution cabinets (ODCs) were damaged beyond repair.

Telecommunications services were restored to the island over several weeks. Wired services were restored to the northern part of the island within three weeks after the storm, as the utility pole infrastructure was largely intact. However, in large portions of the southern part of the island, the utility poles had been almost completely destroyed, and so telecommunications companies had to await their restoration by the electric utility, which owns the poles.

Restoration of cellular services was also accomplished within two weeks on the northern portion of the island, aided by the lesser amount of damage to the power infrastructure. In other areas, restoration was dependent on the arrival of equipment shipped in by boat - such as the replacement generator needed for the base station at Roses, or cellular on wheels (COW) equipment that was used as a temporary replacement for the cellular tower that had fallen at Hamilton. By 19 October, 9 of the 11 cellular sites on the island were at least partially functional.

The loss of telecommunications services impacted customers at a crucial time of need. For example, one resident of Roses reported that, before

service had been restored to that area, she had been driving 15 km to Clarence Town in order to get the cellular reception. A resident of Dunmore reported that she was not a cellular phone user, but that family members who were had been unable to get service in that community for an extended period, and this may have contributed to the lack of information she had about the aid that her family would be eligible to receive.

A hotel that had suffered heavy storm surge damage reported that fixed internet had been restored approximately one month following the storm.

Cable television service was restored to all customers by 24 November, though service had first returned to customers in Deadman's Cay and some neighbourhoods to the north over a month earlier. Billing of Cable Bahamas customers was suspended as a result of the prolonged service outage, with free service being offered through 31 December 2015.

On **San Salvador** the disruption to telecommunications services occurred as a result of loss of utility pole infrastructure, damage to equipment, and commercial power outage related to the flooding of the power station. The roof of a BTC building in Cockburn Town suffered moderate damage. Three satellite dishes used by Cable Bahamas were damaged, and replacements had to be shipped in from Nassau.

Service to the main cellular tower in Cockburn Town was restored within one week. Though other cellular stations were turned off for a more extended period of time, most of the island was able to have cellular reception through the Cockburn Town tower, though with a diminished signal strength in some areas.

Cable television service was restored to all customers by 18 November, though in some cases was at first limited to a restricted set of channels due to the damage to satellite equipment. As on Long Island, the billing of Cable Bahamas customers was suspended, with free service being offered through 31 December 2015.

Rum Cay suffered an island-wide loss of both mobile and wired services due to the loss of commercial power and significant damage to fibre and copper cables and to utility poles. The broadcast television station was also knocked off-air.

There was minor damage to the roof of the BTC central office building. Following the storm, this building was repaired and used as a temporary school for the ten students of the local school.

The Cable Bahamas over-the-air broadcast facility was out-of-service until 3 November.

Damage was reported as an aggregation across islands by BTC, and on an individual island basis by Cable Bahamas, as shown by Table 41. BTC reported a total of $20,072,000 in damage across the islands, of which there were $13,452,000 in damage to wireless networks, $5,825,000 in damage to wired networks, and $768,000 in other damage, such as damage to buildings.

Cable Bahamas reported $603,279 in total damages, of which $117,651 were on Acklins, $107,181 were on Crooked Island, $112,128 were on Long Island, $185,360 were on Rum Cay, and $80,959 were on San Salvador.

Table 41- Estimated damage to telecommunications by island

Island	Damage
Acklins	2,101,291
Crooked Island	7,558,461
Long Island	8,703,088
Rum Cay	896,880
San Salvador	1,415,559
Total	**$20,675,279**

Source: Estimations by disaster assessment team based on figures provided by BTC and Cable Bahamas, 2015

2. Losses

Losses were estimated based on the number of customers for each service, average revenue per user of the various services, which was based on annual reports from the 2014 calendar year, and an estimate of the average length of outage per-user per-island, which was based on reports of when service was restored to various areas.

Table 42- Estimated losses in the telecommunications sector[1]

Island	Mobile	Broadband	Fixed Telephone	Cable	Total
Acklins	44,541	9,075	9,347	-	62,962
Crooked Island	17,127	9,306	18,010	-	44,442
Long Island	112,242	54,451	102,845	150,561	420,099
Rum Cay	6,999	2,496	3,377	-	12,872
San Salvador	16,438	13,397	21,869	66,740	118,443
Total	**$197,347**	**$88,724**	**$155,447**	**$217,300**	**$658,818**

[1]Note that losses associated with the outage of broadcast television were not estimated.
Source: Estimations by disaster assessment team, 2015

3. Additional Costs

BTC reported a total of $1,500,000 in additional costs across all islands. Cable Bahamas reported $169,955 in additional costs, consisting of labour, airfare, shipping, and accommodations.

Table 43- Estimated additional costs in the telecommunications sector by island

Island	Additional costs
Acklins	248,250
Crooked Island	473,000
Long Island	480,385
Rum Cay	121,250
San Salvador	347,070
Total	**$1,669,955**

Source: Estimations by disaster assessment team, 2015

Summary

Note that, as BTC reported damages and additional costs in aggregate, these values were allocated among the islands based on estimation. Thus, the per-island totals for damage and additional costs, while providing general guidance, should be considered as less accurate than the overall total.

Water and Sewerage

Introduction

The Caribbean subregion faces important challenges in terms of access to quality water. The Bahamas has the lowest proportion of fresh water per capita compared to all Latin American and Caribbean countries, with an average of less than 0.1 per cent of the regional average.[37] The total freshwater reserve is estimated at 7.7 x 109 m3 and is scattered throughout the country.[38] Additionally, precipitation is unevenly distributed between its islands.

Table 44- Water production and consumption in The Bahamas

	2011	2012	2013
Water production	4,029	4,306	4,368
Water consumption	1,781	1,762	2,044

Source: Department of Statistics (2013), "The Bahamas in figures"

The water production and the water consumption in the Commonwealth of the Bahamas has increased in the last years, shown in Table 44. Between 2011 and 2012, production grew by 6.8 per cent, while consumption decreased by 1 per cent. However, between 2012 and 2013, production grew 1.4 per cent, and consumption also increased but by 16 per cent. Natural water scarcity in The Bahamas, is then exacerbated by exhausted and contaminated underground water sources.

The Water and Sewerage Corporation (WSC) was created on 14 July, 1976 to improve the quality of water supply. It raised its production from about 1 million gallons per day in 1976 to about 16 million gallons per day in 2012 throughout the country.[39] Approximately 93 per cent of the population has access to piped water (61.74 per cent public sector and 30.91 per cent private sector). Only 1 per cent of the population uses rain water systems.

37. Inter-American Development Bank. (2011). "The Bahamas will improve access to drinking water with help from the IDB" Available at: http://www11.iadb.org/en/news/news-releases/2011-11-22/the-bahamas-will-improve-access-to-drinking-water,9701.html
38. Organisation of American States. (2015) "The Bahamas National Report. Integrating Management of Watersheds and Coastal Areas in Small Island Developing States (SIDS) of the Caribbean" Available at: http://www.oas.org/reia/IWCAM/pdf/bahamas/Bahamas%20Report.PDF
39. Water and Sewerage Corporation. (2012). Available at: www.wsc.com.bs

Table 45- Water supply in private dwellings, The Bahamas

Type of water supply	Number of dwellings	%
Public piped	63,438	61.74
Public piped into yard	1,749	1.70
Private piped into dwellings	31,763	30.91
Private not piped	2,920	2.84
Public stand pipe	1,036	1.01
Public well or tank	93	0.09
Rain water system	1,111	1.08
Other	648	0.63
Total	**102,758**	**100.00%**

Source: Department of Statistics of the Bahamas, Census 2010

However, many households do not rely on WSC, and use wells, cisterns or other private provisions. Most of the piped system serves New Providence, while islands such as Bimini, Crooked Island, Inagua and Mayaguana rely more heavily on private sources to provide running water piped into their homes. Nationwide, only 13.7 per cent of the homes did not have water piped into them.[40]

The main water supply facilities in the islands before the occurrence of the hurricane are described in the following table.

Table 46- Water supply facilities per island

Location	Water supply source	Facilities	Average daily production (IGPD)	Storage capacity (USG)	Storage (days)
Acklins	Lovely Bay Wells Field	Pumping station Storage tank	10,000 (12,000 USG)	33,000	2.75
	Snug Corner Wells Field	Pumping station			
	Snug Corner Reverse osmosis plant	Pumping station Storage tank	8,000 (9,600 USG)	40,000	4.17
	Salina Point Reverse osmosis plant	Pumping station Storage tank	6,000 (7,200 USG)	30,000	4.17
	Hard Hill Tanker from reverse osmosis plant				
	Pompey Bay Wells Fields	Pumping station			
	Total		24,000 (28,800 USG)	103,000	

40. CARICOM Capacity Development Program (CCDP). (2000). "Round of population and housing census data analysis sub-project. National Census report, The Bahamas" Available at: http://www.caricomstats.org/Files/Publications/NCR%20Reports/The%20Bahamas.pdf

Crooked Island	Colonel Hill Well Fields	Pumping station Storage tank	4,000 (4,800 USG)	5,800	1.21
Long Island	2 Reverse osmosis plants (Simms and Deadman's Cay)	Pumping station Pressure & storage tanks	7,000 (8,400 US G)	30,000	3.57
		Pumping station Storage tanks	121,000 (145,200 USG)	300,000	2.07
			Total: 128,000 **(153,600 USG)**	Total: 330,000	
Rum Cay	Well Fields				
San Salvador	Reverse osmosis plant (Cockburn Town)	Pumping station Storage tanks	68,000 (81,600 USG)	290,000	3.55
	Well fields				

Notes:
1 US gallon = 0.832674188148 IG
1 IG = 1.20094992043 USG
Source: Disaster assessment team based on the information provided by WSC

In relation to the sanitation and sewerage systems, the figures presented by the 2010 census show that 83.6 per cent of the population relies on septic tanks and only 12.99 per cent depends on the sewerage system. WSC has coverage of 15 to 20 per cent in New Providence, while in the Family Islands is almost nonexistent.

Table 47- Sanitation dependence in private dwellings

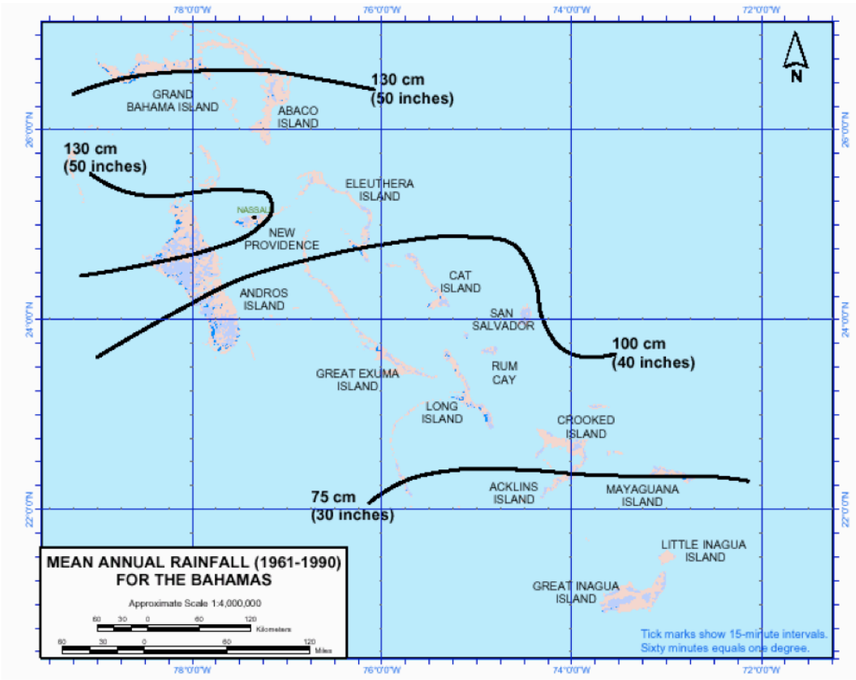
System	Number of houses	%
Sewerage	13,347	12.99
Septic tank	85,903	83.60
Pit latrines	2,191	2.13
Other	1,117	1.09
None	200	0.19
Total	**102,758**	**100.00%**

Source: Department of Statistics of the Bahamas, Census 2010

The private character of both access to water and wastewater management have resulted in wells contaminated by seepage from septic tanks, but also due to saltwater intrusion, rendering already scarce groundwater unfit for human consumption. This also poses issues of public health and adequate wastewater management.

WSC is in the process of replacing ancient well fields by new reverse osmosis desalination facilities operated by the private sector, which in turn sells the final product to WSC. Reverse osmosis is costly both in terms of the process itself, and diseconomies of scale. In regards to the affected islands, southern islands receive up to 40 per cent less precipitation than those in the north. The pollution of wells and groundwater combined with this dry nature, make them rely increasingly on desalinated water. Besides having important environmental impacts, desalination consumes large amounts of energy, which is already a challenge for The Bahamas. Reverse osmosis cost is six to eight times higher than groundwater extraction.[41] Provision of public utilities is therefore very costly due to the large investments required to provide small and scattered populations with the service, as well as its operation.

Figure 3- Map of mean annual rainfall, The Bahamas



Source: US Army Corps of Engineers (2004), Water Resources Assessment of The Bahamas.

Additionally, water tariffs have not been adjusted since 1999. Since the corporation operates below recovery tariffs, the government subsidises its operation for approximately $30 million a year.[42]

Infrastructure is another challenge that contributes to the increasing operational losses of WSC. Infrastructure is outdated and maintenance has not been prioritised, resulting in a water loss rate of 56 per cent.[43]

41. US Army Corps of Engineers. (2004). "Water Resources Assessment of The Bahamas"
42. Interview with Mr. Glen Laville, General Manager, Water and Sewerage Corporation, 17 November, 2015.
43. Government of The Bahamas. (2015). Vision 2040. National Development Plan. State of the Nation: Infrastructure and Environment

1. Damage

Water infrastructure did not suffer substantial damage in the islands assessed, except some specific cases in which distribution lines were destroyed or showed leaks. Water distribution remains interrupted in some places as a result of broken pipes and road destruction, mainly in Acklins and Crooked Island.

WSC informed the team that desalination facilities are designed to withstand winds of up to 150 mph. Therefore, storage tanks did not suffer damage either. Most pumping stations are located in elevated areas and they did not suffer damage from flooding. The corporation's administrative offices endured minor damage caused by strong winds (mainly minor roof damage and loss of shingles). The total damage is estimated at $850,000, of which approximately $100,000 was destined for minor repairs.

Most plants had enough storage capacity for approximately 3 days. However, every island faced water outages due to an interruption in the supply of power to well fields and reverse osmosis plants.

Acklins suffered the interruption of water production for 5 days. The report of the Pan American Health Organisation (PAHO) states that "residents must use bottled water for drinking purposes and wells or rain collection for other uses such as washing." [44]

The hurricane cut approximately one mile of distribution pipes in Lovely Bay in two sections. The treatment plant in Salina point was not operational due to lack of electricity. Stored water was distributed to 60 households for drinking water, and 1 bottled water plant in Spring Point provided water for the entire island.[45] The estimated damage is $ 500,000.

The sanitation situation is quite complex due the flooding. Storm surge may have flooded septic tanks, causing contamination in individual wells. The solid waste disposal site is in an elevated location and only suffered the effects of the wind. This location is used only for waste disposal, not as a sanitary land fill.

Crooked Island suffered significant long-lasting floods. Several places were still flooded at the time of the field visit. No desalination plants were available on the island before the disaster as this island depended mostly on ground water, which was contaminated after the hurricane by flooded septic tanks. Some pipelines were also deteriorated due to normal use or previous events, and should be renewed.

The Colonel Hill station suffered minor damage due to flooding that affected electrical switchgear. WSC decided to procure a desalination plant to be installed in Colonel Hill. Damage is estimated at $ 250,000.

44. Pan American Health Organization. (2015). "PAHO/WHO Assists The Bahamas To Cope With Health Impact of Hurricane Joaquin" Available at: http://www.paho.org/bah/index.php?option=com_content&view=article&id= 190:pahowho-assists-the-bahamas-to-cope-with-health-impact-of-hurricane-joaquin&Itemid=224
45. International Federation of Red Cross and Red Crescent Societies. (2015). "Bahamas Red Cross Responds to Hurricane Joaquin" Available at: http://www.ifrc.org/en/news-and-media/news-stories/americas/bahamas/bahamas-red-cross-responds-to-hurricane-joaquin-69521/

The solid waste disposal site is in an elevated location and suffered waste dispersion due to the wind. This location is only used for waste disposal, not as a sanitary land fill.

WSC reported that full water services were restored to Long Island within three days. Minor damage was reported in pipelines. PAHO reported, "...flooded areas contaminated with faecal matter from septic tanks. Water contact is a risk. Well water not suitable for drinking, use bottled water. Potable water supplies are adequate at present. Routine household sewage management systems are still functional in intact houses once water is available. People located on elevated areas may use well water for flushing and washing."[46] Waste collection services were interrupted due to damage to the roads.

Rum Cay depends on ground water from well fields. No service of WSC was assured before the hurricane; however, WSC has since decided to install a desalination plant.

In San Salvador the WSC reported service restoration within five days after the hurricane. There was no damage reported to their supply, storage or distribution components.

2. Losses

Losses in this sector are related to the interruption in the provision of water for human consumption, sewerage and waste collection. As it has been mentioned, losses are directly related with the extent of damage suffered by physical assets. Water infrastructure withstood minor damage and most facilities could have continued servicing costumers. However, electricity was interrupted for several days and weeks throughout the affected islands, thus interrupting the service provided through desalination plants and pumps. Where in place, waste collection services were also interrupted due to the extensive damage to roads in most islands.

It is estimated that 62 per cent of the population in the affected islands was directly affected by the disaster. Considering a standard water consumption of 50 imperial gallons per person per day, losses are estimated at $78,525.

Losses in this sector were caused primarily by the interruption in the provision of electricity. This highlights the importance of relying on alternative sources of energy to provide stable service to the affected islands in an effort to reduce the identified development gaps between New Providence and the Family Islands.

At the same time, it underpins the importance of decentralised systems that can support scattered settlements with small populations, especially considering the high per capita costs of infrastructure development in the Family Islands. In this sense, events such as hurricane Joaquin worsen the conditions of existing infrastructure, which already experiences losses of 56 per cent, contributing to the already high development and maintenance costs.

46. Pan American Health Organization. (2015). "PAHO/WHO Assists The Bahamas To Cope With Health Impact of Hurricane Joaquin" Available at: http://www.paho.org/bah/index.php?option=com_content &view=article&id=190:pahowho-assists-the-bahamas-to-cope-with-health-impact-of-hurricane-joaquin&Itemid=224

3. Additional costs

Additional costs in this sector are divided into two main activities. First, in terms of response to the emergency, NEMA, WSC and other agencies distributed water in the affected islands. Drinking water was not assured by the desalination plants, therefore, plastic bottles and tankers were primarily used in the relief efforts. In areas of Acklins and Crooked Island where service has not been restored, water supply is currently assured by water tankers.

Second, it refers to additional expenses to restore normal service of the utility. These costs were elevated since power was interrupted for days to weeks in the islands, so generators and fuel had to be shipped.

Table 48- Additional costs in the water sector

Item	Cost
Supply of water	401,740
Diesel and related supplies	24,497
Emergency standby generators	120,000
Supply, installation and commissioning of 2 donated desalination plants	500,000
Total	**$1,046,237**

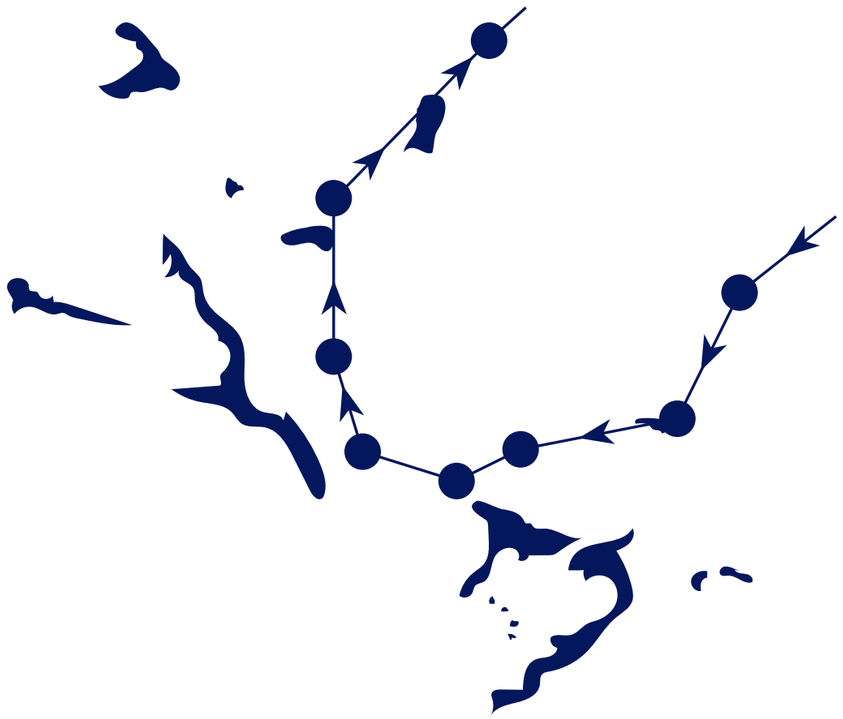
Source: Estimations by disaster assessment team based on the information provided by WSC

Total additional expenses are estimated at $1,046,237 corresponding 47.8 per cent to the installation and variable costs of two desalination plants, see Table 48. WSC installed a temporary reverse osmosis plant in Acklins (Lovely Bay), and stand-by generators and small reverse osmosis plants in Snug Corner, Masons Bay, and Salina Point.

A reverse osmosis plant was procured for Crooked Island, therefore, immediate efforts include preliminary civil works for the installation of the plant, improvement works in Cripple Hill, and a tanker delivery truck. A stand-by desalination plant generator was installed in Long Island (Simms). In San Salvador, a temporary power generator was installed at Cockburn Town, while a permanent one is built.

Although desalination plants had water stored to last for several days, it could not be used due to widespread power outages. In this regard, it is important to consider sustainable water storage solutions suited for small communities, which are also scattered and could be isolated as a result of a disaster, such as Lovely Bay.

PRODUCTIVE SECTORS



Tourism

Introduction

Tourism services and industries include lodging, transportation, recreation, entertainment, and retail trade. According to the Tourism Satellite Account (TSA),[47] the core tourism industry represented 21 per cent of The Bahamas' Gross Domestic Product in 2003,[48] and is the most important economic activity on the affected islands. However, the assessed islands represent only a small share of the tourism as a whole in The Bahamas, as hotel rooms represent 2 per cent of the national total.[49]

The only affected islands with a port of entry, Long Island and San Salvador, account for 1 per cent of foreign inflow to the country.[50] Tourism generates direct economic value in various sectors, especially hotels, restaurants, and transportation (Box 2).[51] Additionally, tourism generates direct economic output in other less obvious sectors such as real estate, government, and manufacturing.[52] North America provides the majority of tourism to The Bahamas (in 2013), with approximately 87 per cent of all tourists coming from the United States and Canada.[53]

With the exception of Club Med in San Salvador, the hotels on the islands are small. They are part of the private sector, and most of them offer recreational activities like fishing and diving, as well as the inclusion of meals.[54] Fishing for recreational purposes in The Bahamas is associated to flats fishing, and the country is known as a world-class destination for bonefish. Being a local disaster within a few Family Islands, and considering that other Bahamian islands outside of the disaster area have attractive offers this fishing season, the five affected islands could suffer mounting effects by tourism relocating to other territories of The Bahamas.

In the affected islands there is a diversity of fishing experiences available that range from high-end exclusive all-inclusive fishing lodges in remote locations, to wading flats in front of a hotel or a bed and breakfast. The affected islands provided approximated 7.1 per cent of the total fishing guided days in The Bahamas.[55]

47. This narrow definition of tourism includes only the value added of sectors with direct visitor contact. On this basis, tourism can be accurately compared to other sectors. No other sector comes close to the value of tourism in The Bahamas.
48. The Bahamas Tourism Satellite Account. (2006). Global Insight. Preliminary Results. Lexington, Massachusetts, United States
49. Estimations in the disaster assessment included rooms in guest houses, and may not be exact. The data for the inventory of rooms is from the Research & Statistics Dept. Ministry of Tourism.
50. Data from the Research & Statistics Dept. Ministry of Tourism.
51. Hotels and restaurants generate 41.8 per cent of value added.
52. In the affected islands, a business closely linked with hotels is the air transportation of guests. The disaster assessment team interviewed two of the companies that provide this service to the islands affected. Both expect an ebb in their income in 2016 because of a possible reduction of tourists.
53. Data from the Research & Statistics Department. Ministry of Tourism.
54. Tourist activity is seasonal. The peak season for all affected islands is November to May, with the exception of small hotels in San Salvador, whose high season runs from April to September, due to its association with scuba diving season.
55. This figure is for 2008. Estimations based on data from Fedler, T. (2010). The Economic Impact of Flats Fishing in The Bahamas. Study prepared by The Bahamian Flats Fishing Alliance.

To estimate the effects of the disaster on the tourism sector small hotels are separated from Club Med. Most of these small hotels did not have proper financial protection against hurricanes, having insufficient or no insurance (Box 1), which may lead to longer times before reconstruction and means further losses (Box 3). Hotels that were not destroyed still suffered severe indirect effects. The devastation to airports, docks and roads, and interruption of critical services such as water and sanitation, could potentially affect the number of expected visitors. Proper reconstruction and preparation will make for safe and resilient communities to attract and sustain tourism, lessening the vulnerability of small islands and adding value to the operation of The Bahamas.

Box 1- Insurance situation of The Bahamas

According to the Bahamas Insurance Association (BIA) the level of insurance penetration decreases as one moves south along the chain of islands in The Bahamas.

According to the Insurance Commission of The Bahamas (ICB), total sums insured in the islands impacted by the storm is approximately $80 million. Looking further into this figure in terms of concentration of sums insured, it should be noted that Long Island accounts for roughly 48 per cent, Cat Island 20 per cent, San Salvador 10 per cent and the other islands account for the remaining 22 per cent.

In preliminary assessments by the BIA, with available data up to 1 December, which is enhanced by information from the ICB suggests that gross losses to the insurance industry caused by hurricane Joaquin is approximately $14 million, that is 14.3 per cent of estimated damage It should be noted that this is only an estimate and could be adjusted in future based on additional data received.

This has repercussions from a micro and macro perspective as it not only affects the ability of individuals and companies to recover (and rebuild) in the aftermath of this disaster, it could place upward pressure on government expenditure as individuals look to the state for assistance in the reconstruction of their homes.

Due to the unique nature of the Bahamian insurance industry, the total gross losses will not be borne by local insurers solely because the majority will be absorbed by global reinsurers. Property and casualty insurers in The Bahamas have to purchase large amounts of reinsurance annually to cover the risks that they write (or take on) due to their capital structure. Hence, global reinsurance rates is an important determinant of local general insurance premiums.

1. Damage

The damage to the infrastructure of hotels, furniture, including boats and equipment were approximately $ 2.5 million (Table 49). Of these about 60.3 per cent took place on Long Island. Damage was generalised, ranging from external roofs, ceilings, floors, furniture, and air conditioner units, to assets like boats, fishing gear, and scuba diving equipment.

Table 49- Damage to small hotels by island

Island	Damage
Acklins	381,000
Crooked Island	400,000
Long Island	1,560,000
San Salvador	325,000
Total	**$2,486,000**

Source: Estimations by disaster assessment team

There are six small hotels on **Acklins**. All hotels suffered damage, and two of them had considerable damage. They are considered bonefishing lodges. Normally the guests at those hotels pay a "package price" to a fishing lodge, which includes guided fishing, lodging, and meals. As of the beginning of December, these hotels had not yet restarted operations.

Crooked Island has two small hotels and seven guest houses. Both were severely affected by the event. They specialise in providing guests with fishing excursions, so boats are within their assets. According to the owners of these establishments the expected opening date is the first of January 2016. The damage to these properties accounted for 81.3 per cent of the total damage to small hotels. The rest of the damage is associated to seven guest houses on the island.

Long Island had the biggest number of small hotels. Before the disaster there were a total of 15 hotels. The total number of rooms was 199. The hotel Cape Santa Maria is the largest on the island (63 rooms), followed by the Stella Maris (21 rooms). Both hotels are in the northern part of the island, which was the least hit by hurricane Joaquin. As Box 2 explains, when the tourism sector suffers, many other businesses will indirectly suffer.

All hotels on the island suffered some damage. Four hotels were severely damaged. These hotels had a total of 40 rooms. They suffered damage to roofs, windows, furniture, and air conditioning units. As of 1 December hotels with minor damage had restarted operations. In the case of the most damaged hotels the date to start operations is still undetermined.

In **San Salvador** one small lodge was inspected. All 32 rooms showed damage, mostly to roofs and water penetration. The hotel will not accept bookings before March 2016. The hotel had insufficient insurance due to needing a re-evaluation.

As it was mentioned, San Salvador is the only island that has a large hotel: Club Med Columbus Island. This hotel has 216 rooms. At the moment when this hotel was hit by hurricane Joaquin, it was closed as normally is during this time of the year. Club Med is the largest private sector asset to be directly impacted by hurricane Joaquin. Additionally, it is the largest employer in San Salvador. It belongs to an international company and it was insured. There was no significant structural damage to the resort but there was damage to the exterior roofs, including lost shingles and waterproof membrane. In addition, there was minor water intrusion in some areas. The landscaping, including hundreds of palm trees, was seriously damaged. The hotel announced it will start operations on 20 December, although they were supposed to be open by 18 October. The estimated damage is approximately $8,000,000. The estimated foregone income of this hotel is approximately $3,500,000. For this estimation the assumption is made that occupancy rate of the hotel would start to increase from the beginning of November.

Box 2- Other affected businesses

On Long Island many different businesses were affected. The Chamber of Commerce of Long Island compiled a list of the affected business. It includes a gas station, ice supplier, wholesale seafood buyer, clothing stores, grocery stores, miscellaneous stores, craft stores, car rental companies, and bars.

The damage includes destruction of infrastructure, furniture and equipment, vehicles and inventories of goods for sale. As in the case of hotels, most of these businesses had no insurance or were insured for less than the value of their assets. The estimated damage is $1.3 million.

For a community to return to normal routine after a disaster, infrastructure should be rebuilt and the main economic activities should be restored. In the case of the affected islands, most of the entrepreneurs were owners of small/medium productive or commercial units. It is crucial to assess. A specific assessment of the situation suggests. Due to the recurrence of these events in The Bahamas, debt of these businesses should be monitored.

Common modalities for recovery of this sector include:

a) Cash grants to micro-enterprises for recapitalization, and concessional financing for SMEs through Development Bank
b) Provision of temporary tax relief for medium enterprises

2. Losses

In this case losses are the hotel services that go suspended from the time the disaster occurs until full recovery and reconstruction is achieved. They are foregone income for these firms. To estimate losses several assumptions were made related to high and low season dates, the rates in those seasons, the hotel occupancy rate and the expected date of commencement of operations of the damaged hotels.[56] An additional assumption, about number of fishing services that would be hired, had to be made to reflect the typical activity of these lodges. For the small hotels in Acklins, Crooked Island, and Long Island, the high season is from November to March, while San Salvador's high season is from March to August.

Small hotels losses were approximately $1,430,000. Consistent with the damage estimation, Long Island was the territory with most foregone income, 57.6 per cent of the total, seen in Table 50Table 50- Estimated losses to small hotels by island. San Salvador losses are the smallest because the hurricane hit the island five months before its high season starts. Even for hotels that had small damage October and the beginning of November were lost because of damage to the infrastructure of the islands.[57]

Table 50- Estimated losses to small hotels by island[58]

Island	Losses
Acklins	280,450
Crooked Island	262,500
Long Island	823,961
San Salvador	62,514
Total	**$1,429,425**

Source: Estimations by disaster assessment team

Table 51- Estimated summary of damage and losses to all hotels[59]

Island	Small hotels	Per cent	Hotels	Per cent	Total
Damage	2,566,000	24	8,000,000	76	10,566,000
Losses	1,429,425	29	3,533,826	71	4,963,251
Total	**$3,995,425**		**$11,533,826**		**$15,529,251**

Source: Estimations by disaster assessment team

56. These assumptions were made on the basis of the information gathered in several interviews with hotel owners on each island.
57. The restitution of power, water, and the restoration of roads have the same importance to this sector as the rebuilding of its infrastructure and reposition of other assets. The disaster assessment team heard this opinion several times during contact with the owners of these lodges. It is important to note that losses (forgone income) could be extended to 2016 because it is reasonable to expect that given the damage, this coming high season will not be as well as previous seasons.
58. Estimated loss for each small hotel is the gross value of production (GVP) that was not provided. So, it is not only that each firm is not getting the amount of money that they usually got in the past, but also that a portion of the GVP corresponds to a lost labour earnings.
59. It should be noted the estimations presented in this section are the floor estimates for the losses on the tourism sector related to this disaster. It is likely to cost the affected islands more in foregone income for a variety of reasons, several million dollars in lost economic activity on top of the damage caused, and employees losing a potential two months of tips.

Fisheries

Introduction

Fisheries contribute approximately 2.2 per cent to the GDP of The Bahamas, the most important products are spiny lobster, grouper and conch.[60] The Government of the Bahamas has attempted to reserve commercial fishing within the exclusive economic zone for exploitation by Bahamian nationals. In terms of increasing sustainability of the fish stocks, the government has regulated the use of low impact fishing gear, forbidden the use of poisons or dynamite, and closed seasons for species such as grouper and lobster. In 2013, the total value of fish exports was $91,239,108.

In the islands under review, the fishing community combines fishing with other productive activities to complement their earnings, especially during low catch periods. Their fisheries livelihood strategy consists of using different methods such as fish pots and lining to maximise their probability of making a catch. Multiple livelihood sources protect the fishermen from the loss of livelihood in the aftermath of a disaster, but this situation also highlights the vulnerability of the sector and contributes to the development challenges faced by the Family Islands.

1. Damage

According to the Food and Agriculture Organisation (FAO), in The Bahamas "subsistence and commercial fishing activities make a major contribution towards preventing rural to urban drift. (...) In some instances communities undergoing hardships due to the lessening of employment alternatives heavily depend on fishing for subsistence and income."[61] The 1995 fisheries census revealed that there were approximately 9,300 full-time fishers and over 4,000 small boats and vessels. This information, combined with the small populations in the affected islands, makes the estimated numbers of fishermen and fishing catch in those islands small in national terms but important to the islands and the livelihoods of the fishermen.

This section provides a qualitative description of the effects of hurricane Joaquin in two groups of fishermen in Acklins and Long Island. The estimations and information provided are based on interviews with fishermen from both islands. The estimated cost of damage in Acklins and Long Island is $560,000, which affected approximately 150 fishermen.

60. Organisation of American States. (2015). "The Bahamas National Report: Integrating Management of Watersheds and Coastal Areas in Small Island Developing States (SIDS) of the Caribbean" Available at: http://www.oas.org/reia/IWCAM/pdf/bahamas/Bahamas%20Report.PDF
61. Food and Agriculture Organization of the United Nations (FAO). (2015). Country profile: The Bahamas. Accessed 5 December. Available at: http://www.fao.org/fishery/facp/BHS/en#CountrySector-Statistics

Table 52- Estimated damage to fisheries, Acklins and Long Island

Description	Damage
Destroyed boats	100,000
Partially damaged boats	120,000
Damage to gear and equipment	40,000
Damage to engines	300,000
Total	**$560,000**

Source: Estimations by disaster assessment team

In Acklins, the main occupation among males is fishing. There are approximately 50 fishermen, many of whom also work in construction. Based on interviews with fishermen, the average monthly income is approximately $1,500. There are approximately 100 fishermen in Long Island. The majority of operators in the sector are small artisanal fishermen. The island is washed by the North Equatorial Current, which brings with it a wide variety of fish species.

Fishermen lost pots and lines, which are the most commonly used gear, as well as boats and engines. In Acklins, the refrigeration facility was also damaged.

The assets of the fishermen interviewed were not insured, so damage is borne by each individual. There are no cooperatives or other pooling arrangement that protects their assets and operation against natural events like hurricane Joaquin.

2. Losses

Considering the reported number of affected fishermen, and the average monthly income the estimated losses are $225,000. Considering that their assets were generally not insured these unmitigated risks result in a lack of sustained accumulation of income from this type of fishing because of a lack of support to protect the fishermen from events that tend to occur every 4 to 5 years in The Bahamas.

Summary

The estimated total damage to the affected islands is $104,788,224. Insurance only covers approximately 13.4 per cent. In order to successfully assess the total damage of the affected islands, the team had to look at the damage to each of the three main sectors, and their individual subsectors. Damage to the infrastructure sectors made up 53 per cent of all damage caused by Joaquin. Roads were the most affected subsector of infrastructure, due to a combination of factors including vulnerable locations and poor pre-existing conditions. The telecommunications subsector was also severely damaged, with 20 per cent, and $20,675,279.

The social sectors comprised 36 per cent of the damage to the affected islands with $37,969,751 in estimated damage, and the housing subsector alone accounted for $32,877,400, at 31 per cent of the total damage incurred. Finally, the productive sector accounted for 11 per cent, $11,226,000. Tourism was the predominant subsector that sustained damage.

By island, Long Island suffered the greatest percentage of the damage with $35,693,528, which was 34 per cent of the total $104,788,224. This can be accounted for by Long Island having the largest population of the affected islands, which means more assets exposed to the effects of the disaster. Acklins followed with 25 per cent of the damage, at $26,476,794. San Salvador and Crooked Island sustained 19 per cent and 18 per cent, respectively, totalling over $38,000,000. Rum Cay was the smallest island in size and population that sustained damage from Joaquin, and had the least damage, their $4,410,435 amounted to 4 per cent. Note that most of the damage, 62 per cent, was sustained by the private sector.

The total estimated losses due to the suspension and disruption of services are $9,652,816, and will continue to rise until a complete recovery is accomplished. Losses were mostly suffered by the productive sector, and just the tourism subsector's loss is 51 per cent of the total at $4,929,425. The disruption of services like roads and water influence the losses in tourism, which is heavily relied on for employment on the affected islands. Tourism will continue in The Bahamas so a full and fast recovery would help prevent any further economic disparities caused by foregone income between the islands. The next largest loss by sector was to the social subsector of housing, which accounted for $2,677,500. That makes up 28 per cent of the losses. The infrastructure sector was an estimated combined loss of $1,3390,511, or 14 per cent.

The island that suffered the most losses was San Salvador, whose Club Med helped account for $4,588,272 total, which was 48 per cent of the $9,574,291 combined for the islands, and will continue to accrue until a recovery is complete. Following San Salvador was Long Island, with 37 per cent and $3,496,282 in losses. Acklins, Crooked Island, and Rum Cay together were responsible for approximately $1,500,000.

The estimated total of $5,196,300 in additional costs were spread more evenly among the affected islands. The infrastructure sector incurred approximately $2,831,000. The social sector was responsible for $2,365,383. Clean-up crews were needed on every island, and infrastructure damage created a need for generators to power critical buildings such as health centres and water desalination plants. The hiring of temporary relief employees throughout the affected islands also contributed to the additional costs.

Table 53- Aggregate damage by sector

Sector	Damage	Per cent
SOCIAL	**37,969,751**	**36%**
Health	1,602,525	2%
Education1	1,161,853	1%
Housing	32,877,400	31%
Public buildings	2,327,973	2%
INFRASTRUCTURE	**55,592,473**	**53%**
Roads	24,546,054	23%
Airports	1,771,964	2%
Docks	5,768,576	6%
Power	1,980,600	2%
Telecommunications	20,675,279	20%
Water and sewerage	850000	1%
PRODUCTIVE	**11,226,000**	**11%**
Tourism	10,666,000	10%
Fisheries	560,000	1%
TOTAL	**$104,788,224**	**100%**

Source: Estimations by disaster assessment team

Table 54- Aggregate damage by island

Island	Damage	Per cent
Acklins	26,476,794	25%
Crooked Island	18,558,557	18%
Long Island	35,693,528	34%
Rum Cay	4,410,435	4%
San Salvador	19,648,910	19%
TOTAL	**$104,788,224**	**100%**

Source: Estimations by disaster assessment team, 2015

Table 55- Aggregate losses by sector

Sector	Damage	Per cent
SOCIAL	**3,107,880**	**32%**
Health	20,260	0%
Education	410,120	4%
Housing	2,677,500	28%
INFRASTRUCTURE	**1,390,511**	**14%**
Power	653,167	7%
Telecommunications	658,818	7%
Water and sewerage	78,525	1%
PRODUCTIVE	**5,154,425**	**53%**
Tourism	4,929,425	51%
Fisheries	225,000	2%
TOTAL	**$9,652,816**	**100%**

Source: Estimations by disaster assessment team

Table 56- Aggregate losses by island

Island	Losses	Per cent
Acklins	746,785	8%
Crooked Island	644,172	7%
Long Island	3,542,833	37%
Rum Cay	113,288	1%
San Salvador	4,605,738	48%
TOTAL	**$9,652,816**	**100%**

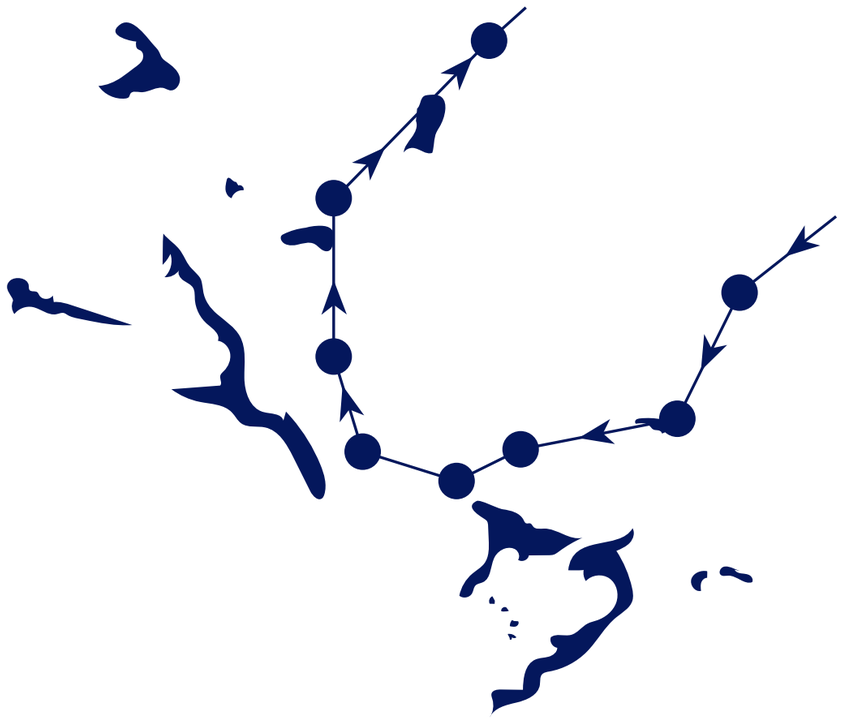
Source: Estimations by disaster assessment team, 2015

Table 57- Aggregate additional costs by sector

Sector	Damage	Per cent
SOCIAL	**2,365,383**	**46%**
Health	424,468	8%
Education	56,215	1%
Housing	1,884,700	36%
INFRASTRUCTURE	**2,830,917**	**54%**
Power	114,725	2%
Telecommunications	1,669,955	32%
Water and sewerage	1,046,237	20%
TOTAL	**$5,196,300**	**100%**

Source: Estimations by disaster assessment team

Macroeconomic Assessment of the Impact of Hurricane Joaquin on the Family Islands in The Bahamas



Introduction

The Bahamian economy grew by 2.1 per cent from 2000 to 2007 - the period before the global crisis. Since the crisis of 2008, average growth has slowed to a mere 0.1 per cent. The slowdown in growth since the crisis has resulted in a 0.4 per cent decline in tourism, a 0.8 per cent reduction in financial, real estate and business services and a 2.1 per cent contraction in agriculture, all partly reflecting reduced demand abroad, and reduced business and consumer confidence at home.

In the last few years, the tourism sector has been recovering in line with the recovery in the United States, the major market for visitors. Real output in hotel and restaurants the proxy for the sector has grown by grown by 1.7 per cent in the last three years, underpinned both by the rebound in United States demand and higher spending on marketing programs such as the companion fly free program.[62]

The offshore financial services sector has been an important contributor to high quality jobs for Bahamians. A number of citizens have obtained specialised skills and training that have equipped them to hold managerial and skilled technical jobs in the sector. Nevertheless, in recent years, the sector has been affected by increased regulation and compliance costs with the implementation of number of regulations by the Organisation for Economic Co-operation and Development (OECD) aimed ostensibly at tightening tax loopholes for their citizens. Important among these have been the Foreign Account Tax Compliance Act (FATCA) and a number of tax information agreements (TIAs). This has increased the cost of operations for institutions. In addition, there has been wide-ranging consolidation in the sector since the global crisis, with a number of institutions streamlining their operations, including the closure of Bahamian branches in an effort to remain competitive and profitable.

The fiscal challenge and efforts at reform

Prior to the global crisis, The Bahamas had one of the most enviable fiscal situations in the Caribbean. However, since the crisis, the fall-out in growth and government's efforts at stimulation has led to a sharp hike in deficits and public debt. The average primary deficit expanded more than five-fold from -0.3 per cent of GDP from 2000-2007 to -1.7 per cent of GDP from 2008-2015. Similarly, the overall deficit more than doubled from 1.8 per cent of GDP to 4.2 per cent of GDP during the same periods.

Increasing deficits led to an escalation in government debt, which doubled from to 32 per cent of GDP in 2007 to 65 per cent of GDP in 2014. Therefore, debt is now a real constraint to sustained growth and countercyclical fiscal policy since it limits the space for stimulus during downturns or in the event of disasters such as the hurricane Joaquin.

62. The companion fly-free program provides a free airfare for a companion to visitors travelling from the continental United States and Canada who stay more than four nights in The Bahamas.

An important consideration is the need to account for the full scope of contingent liabilities of parastatals to gauge the full extent of the debt.

Similar to other Caribbean countries, the profile of government expenditure continues to display high outlays on consumption, including spending on wages and salaries and goods and services. However, spending on public investment is also important and has been ratcheted up in recent years to create a modern infrastructure, including roads and the airport. This provides some space for the government as the focus can now shift to maintenance rather than major infrastructure development.

Another important reflection of recent economic challenges has been the spike in the rate of unemployment, which almost doubled from 7.9 per cent in 2007 to 15.7 per cent in 2014, before falling to 12 per cent in 2015. High youth unemployment has been of particular concern with many young graduates entering the labour market later than usual or being forced to accept lower paying jobs.

The situation in the Family Islands

The Family islands that were affected by hurricane Joaquin and that are analysed in this report are Acklins, Crooked Island, Long Island, Rum Cay and San Salvador. The total population on these islands was over 5,000 at the time of the disaster, representing less than 1.5 per cent of the population of The Bahamas as a whole. Furthermore, they accounted for a relatively small portion of the total GDP of the country. Nevertheless, the hurricane had a major impact on the local economy, society, and environment in the islands that far surpasses their relative weight in these categories in The Bahamas.

Overview of economic performance in 2015

The economy of The Bahamas continued to recover in 2015. Growth is expected to increase to 1.5 per cent, up from 1.0 per cent in 2014. Growth was initially expected to be higher, at 2.3 per cent, but has been dampened by repeated delays in the opening of the mega Baha Mar resort, which was expected to boost tourist arrivals. Nevertheless, growth was bolstered by decent growth in high-spending stopover visitor arrivals and medium and small scale foreign investment projects in tourism and buoyant activity in the offshore financial services sector. The introduction of the value added tax (VAT) in 2015 spearheaded dynamic growth in government revenues, which offset a more muted increase in expenditure. Monetary developments were marked by a build-up in bank liquidity amidst higher foreign exchange inflows from the real sector and a decline in credit to the private sector. The balance of payments current account deficit contracted in the wake of reduced spending on imports. The economy is projected to grow by 2.4 per cent in 2016, buoyed by continued growth in tourist arrivals, hotel construction and buoyant activity in offshore financial services.

The main thrust of policy in 2015 continued to centre on fiscal consolidation to bring down public debt to sustainable levels, as a catalyst to a return to trend growth. The key pillar of this effort was the introduction of the VAT at a rate of 7.5 per cent in January 2015. This supported customs modernisation, real property tax reform, and the establishment of a Central Revenue Authority. All of these measures are aimed at strengthening the efficiency and effectiveness of government revenue collection and administration.

Fiscal expansion moderated in 2015, as the fiscal deficit for the first eleven months of FY2014/15 (July to June) fell to 2.2 per cent of GDP from 4.9 per cent of GDP. Fiscal performance was influenced by an 18.3 per cent growth in tax revenue, driven by intake from the newly introduced VAT. VAT proceeds met expectations and amounted to approximately $182 million. Expenditure grew by a mere 0.3 per cent, as a 6.5 per cent increase in current spending was offset by 32.2 per cent decline in capital expenditure. The sharp fall in capital expenditure reflected a return to normal spending following the hike in 2014, linked to the acquisition of new Defence Force ships and also the unwinding of outlays on public infrastructure. Meanwhile, higher current spending was driven by strong growth in subsidies and transfers, reflecting increased pension payments and outlays for the administration of the VAT. The fiscal deficit is projected to further decline to 1.5 per cent of GDP in 2016 as the VAT and containment of expenditure bolster the consolidation effort.

With no real pressure being placed on the exchange rate, the Central Bank maintained its neutral monetary stance from the previous year by holding its discount rate at 4.5 per cent. During the first nine months of 2015 was marked by strong growth in bank liquidity, fuelled by a pickup in real sector activity, especially tourism inflows and increased government borrowing. Growth in domestic credit slowed to $123.6 million in the first nine months of 2015 from $158.4 million in similar period of 2014. A pick up in credit to the public sector ($6.4 million) was offset by the decline in credit to the private sector. Developments were influenced by a decline in credit to the private sector amidst continued high unemployment and sluggish consumer demand. Credit quality in the banking system improved in the first nine months of 2015, owing to increased loan write-offs and the pickup in economic activity that led to lower private sector loan arrears. As a result, non-performing loans contracted by 8.6 per cent to $893.7 million.

The external position of the economy was projected to improve in 2015. The current account deficit narrowed from 15.9 per cent of GDP to 11.6 per cent of GDP year-on-year to June. The result stemmed mainly from a sharp decline in payments for construction services with the winding down of major FDI-financed investment projects alongside a 4.8 per cent fall in the merchandise deficit, partly linked to lower international fuel prices. The services surplus expanded by 25.4 per cent, with travel receipts up by 5.4 per cent, underpinned by higher visitor arrivals, while payments for construction services was down by 51 per cent. Higher outflows of investment income led to a 22.1 per cent increase in the in-

come account deficit. In a major turnaround, the surplus on the capital and financial account contracted by 79.6 per cent, mainly driven by a 75 per cent reduction in FDI inflows to US$53.2 million, occasioned by lower inflows for the Baha Mar Resort and a fall in equity inflows, following exceptional inflows for the purchase of a high-end resort in 2014. For the first half of 2015, international reserves declined by 6.2 per cent to $953.1 million, covering 18.4 weeks of non-oil merchandise imports, compared with 20.4 weeks in the similar period of 2014.

Economic growth picked up to 1.5 per cent in 2015 from 1.0 per cent in 2014. This was a downward revision from the initial projection of 2.3 per cent, but growth was dampened by the extended delay in the opening of the mega Baha Mar resort, the dampening effect of the VAT on consumer demand and continued high unemployment among other factors. Growth in 2015 was driven by an increase in high-spending stopover visitor arrivals and buoyant activity in the construction and offshore financial services sectors. Stopover arrivals were boosted by significant marketing, particularly in Grand Bahama, where arrivals rose sharply. For the period January to August 2015 air arrivals increased by 4.0 per cent to 984, 309 visitors, but were partly offset by a 3.6 per cent decline in sea arrivals. Overall arrivals in 2015 would be affected by a lower number of visitors to the outer islands, including Long Island and San Salvador that were affected by Hurricane Joaquin. Construction tapered off compared with sharp growth in 2014, but remained buoyant, as activity was bolstered by a mix of smaller and larger FDI-financed projects in the hotel and tourism sector. This helped to partly offset the winding down of activity on large projects, including the Baha Mar.

Inflation moderated from 2.0 per cent in 2014 to 1.6 per cent in 2015, reflecting the impact of lower international fuel prices. Year-on-year to June, the cost of transportation decreased from 3.8 per cent to -1.9 per cent, also, the Bahamas Electricity Corporation's fuel charge fell by 24.2 per cent. Lower fuel and other costs were only partly offset by higher food and health costs. Unemployment declined from 15.7 per cent in 2014 to 12.0 per cent in 2015. This reflected the exceptional hiring of workers by the Baha Mar resort in anticipation of its opening and the temporary hiring of workers for carnival and other cultural events. A number of the Baha Mar employees have subsequently lost their jobs with the postponement of its opening.

Table 58- Bahamas main economic indicators

Indicator	Year		
	2013	2014	2015[a]
	Annual percentage Growth rates		
GDP	1.6	1.0	1.5
Variation in consumer prices	1.0	2.0	1.6
Money (M1)	7.9	3.1	18.4[b]
	Annual Average percentages		
Unemployment	15.4	15.7	12.0
Central Government Overall Balance/GDP[c]	-6.5	-4.9	-2.2
Nominal Deposit rate	1.7	1.4	1.3d
Nominal Lending rate	11.1	11.8	11.98[d]
PRODUCTIVE	**Millions of Dollars**		
Exports of Goods and Services	3626.2	3575.4	1,814.2
Imports of Goods and Services	4794.2	5028.9	2,051.7
Current Account Balance	-1168	-1453.5	-510.2
Capital and Financial Account	1425.4	1936.8	675.7
Overall balance	**-68.5**	**46**	**165.5[e]**

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of official figures.
a. Data for 2015 is from January to June
b. Twelve-month variation to September
c. Fiscal year, July to June
d. Deposit rate, weighted average
e. Preliminary data

GDP Impact

Although Joaquin caused significant disruption to economic activity in the affected islands, in terms of the overall impact on The Bahamas, the hurricane was mainly a livelihoods event. The total damage amounted to $104,788,224, equivalent to 1.2 per cent of the GDP of The Bahamas. In the case of the losses those figures are $9,652,816, and 0.11 per cent. From these estimates, the impact on foregone wages is approximate 430 thousand, and the impact on foregone profits is 9.2 million. It is important to highlight two issues:

a) Those figures under estimate the effect on the local economy because the informal sector is not included
b) They are very important in terms of the local economy

The impact on GDP is 0.11 per cent. Before the disaster the expected GDP growth rate was 1.5 per cent. After the disaster is 1.39 per cent. Nevertheless, for the affected islands, if the total impact was weighted by their GDP, it would have represented a significant share of their GDP. This highlights the fact that substantial differential impacts can result from a disaster in a multi-island state, which might not be felt much at the national level.

Fiscal Impact of Hurricane Joaquin

This was not estimated because we did not receive the data from the MoF

2015 was an important turning point for fiscal consolidation in The Bahamas with the introduction of the VAT as a key pillar for revenue expansion, alongside restraints on expenditure and improved revenue administration. However, higher spending following the hurricane is expected to lead to some fiscal slippage in 2015. The fiscal deficit for 2015/16 is expected to increase from a projected ---% of GDP to -----% of GDP.

The Impact of Hurricane Joaquin on the Balance of Payments of the Bahamas

This section will be finished with fiscal information

The Bahamas is a highly open, import-dependent economy. Therefore, the relief, rehabilitation and reconstruction effort is expected to lead to a substantial increase in imports of a range of materials and supplies including building materials, equipment and food products. This alongside buoyant growth in exports of goods and services is expected to result in a widening of the current account deficit of the balance payments in 2015.

PART 2:
A Post-Disaster Reconstruction and Development Plan

Introduction

Disasters such as hurricane Joaquin are socio-environmental by nature and their materialisation is the result of the social construction of risk. Therefore, their reduction must be integrated into broader decision making processes including planning for post-disaster reconstruction, public policy formulation, and long-term strategising for sustainable development.[63]

Planning for sustainable development and disaster risk reduction are closely related concepts; development cannot be sustainable if it remains at high risk of disaster. But a process of disaster risk reduction is not feasible unless it is accompanied by a considerable reduction of social vulnerabilities and a strategy to make the territory affected by the disaster economically viable. Disasters set back accomplishments in social and economic gains at the same that time that they highlight existing vulnerabilities and disparities, and put strain on national budgets. This is of particular concern for The Bahamas, where government debt doubled from 32 per cent of GDP in 2007 to 65 per cent of GDP in 2014.

In a study on disaster risk and poverty in the context of climate change, it was found that disasters have major social impacts that are manifested in different dimensions of human development and poverty. The empirical evidence seems to indicate that disasters negatively affect anti-poverty efforts.[64] This cycle is not sustainable in social or in economic terms, hence the relevance of making efforts towards disaster risk reduction.

Disaster risk reduction is "the concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events."[65]

This definition considers four fundamental elements; first, disaster risk reduction is an ongoing and dynamic process that requires permanent attention. Second, disaster risk management refers both to reducing the existing risks, and preventing new risks from arising through the identification of risks and vulnerabilities. Third, disaster risk management should be an integrated effort that incorporates stakeholders from different sectors and disciplines in order to mainstream its principles. Finally, it is a comprehensive process, not a set of isolated measures. As such, disaster risk reduction is best achieved as part of a systematic program.

63. Inter-American Development Bank (IDB) (2011). "Indicators for Disaster Risk and Risk Management." Program for Latin-America and the Caribbean. The Bahamas. Environment, Rural Development and Disaster Risk Management Division. Technical note: IDB-TN-790.
64. UNISDR. (2009). "Global Assessment Report on Disaster Risk Reduction: Risk and poverty in a changing climate. Invest today for a safer tomorrow." United Nations, New York.
65. UNISDR. (2009). "UNISDR Terminology on Disaster Risk Reduction." United Nations, Geneva, Switzerland.

For these reasons, disaster risk reduction is a complex process. Note that after a disaster, a society demands quick answers. Emergency response should be timely, fast and efficient. Meanwhile, reconstruction must follow general guidelines for a local development vision. Reconstruction is usually expensive; therefore, it should be subject to an assessment of social cost-benefit. If a decision is made to undertake a reconstruction process, it must contain: a) a master plan defining criteria for location and resilient reconstruction of the affected structures b) criteria of economic and social viability of the territory affected by the event.

Resilient reconstruction is a combination of structural and non-structural measures and processes. Risk reduction management should be intertwined with policies to address the already identified social and economic vulnerabilities in the Family Islands.

The hurricane demonstrated that most houses that followed the building code or were located in safe areas were not considerably affected. However, focusing on introduction and enforcement of regulations and technical standards is not enough to accomplish a resilient reconstruction. Furthermore, if this is the sole criterion, the social and economic vulnerability of a country would be equal to the one it had before the disaster occurred.

The communities in the affected islands under analysis face a series of vulnerabilities. Settlements are dispersed and contain small populations, which increases the costs associated with the provision of public utilities and the development of infrastructure, which extends for long distances to supply small communities. Dispersion of population also contributes to inequitable access to quality health, education and other social services. These disparities are both within the islands and between the Family Islands and the more populous islands of New Providence and Grand Bahama. The provision of the services, however costly, is taken over by the government, affecting the country's economic situation. These costs are exacerbated in times of disaster. Territorial planning is a fundamental tool to address such issues of physical vulnerability, and must be accompanied by social policies to reduce the gap in terms of quality of services and utilities. Concentration of populations would increase efficiency in public spending and resilience of settlements.

Additionally, the islands face economic vulnerabilities. Next to the local government, tourism and fishing are the most important employers in the islands under analysis. Hurricane Joaquin caused widespread damage that directly and indirectly affected the operations of hotels and fishermen, halting most productive activities. Both sectors are closely affected by the quality and state of docks, roads, airports and public utilities. Still, these activities are limited and the actual scale of the operations is not likely to support important development advances.

Therefore, strengthening structural measures is required; however, it must follow an all- encompassing strategy to promote sustainability and feasibility of the islands. The recurrence of events like hurricane Joaquin, the social and economic setbacks that they cause and the investments that must come after call for an update in the reconstruction paradigm followed, towards a more resilient, cost- effective and comprehensive strategy.

The Bahamas has made important efforts in mitigating risks and improving resilience, through instruments such as hard engineering and a building code. Even though it is advisable to update the code to incorporate lessons learned and technical improvements, the 2003 version is nonetheless a modern building code. Nevertheless, the effects of hurricane Joaquin brought to light many areas that still require improvement, not only in terms of physical risk, but social and economic. Therefore, it is recommended to deepen these efforts through the formulation of a development strategy for the Family Islands within the National Development Plan that is in the process of elaboration. Including a special strategy for the Family Islands will allow for the incorporation of specific policies and programs that address the islands' particular issues. In this regard, education and public awareness must be a crosscutting component of any disaster risk management plan, especially in terms of safe settlements, which relates to territorial planning, building practices, insurance and other private issues that could impact public finances.

Some disaster risk reduction policy measures could have specific benefits in terms of risk reduction, while also having crosscutting impact in other sectors. A modern energy policy that incorporates widespread use of renewable energy and invests in energy efficiency would reduce risk in isolated communities, while reducing the country's expenditure on fossil fuels and production of greenhouse gas emissions. At the same time, a more stable grid would increase the resilience in areas such as health, water, and production. Territorial planning is another important area that requires attention as one of the first steps towards resilience.

In general, through lessons learned from this and past disasters, it is possible to incorporate specific social and economic measures into the National Development Plan to boost the development and economy of the islands through mainstreamed disaster risk reduction. This will be an important effort in economic terms, but through the Plan it will be possible to organise the country's fiscal accounts and prioritise investment areas in order to use public funds efficiently.

The reconstruction process of the affected islands in a resilient manner could be used as a pilot project towards improving resilience throughout the country.

Recommendations for a resilient reconstruction

In an attempt to propose comprehensive structural and non-structural recommendations, this section will expand on specific strategies to improve resilience in each sector and island under analysis. Additionally, it incorporates policy recommendations that could have more generalised effects in The Bahamas. To this end, findings and recommendations are analysed in light of the five pillars of action proposed by the Global Facility for Disaster Reduction and Recovery (GFDRR) and adopted by the Sendai Framework for Disaster Risk Reduction 2015-2030 (Box 3).

Recommendations are based on the findings of the field visits and other data gathered from official sources. It must be noted that it is not advisable to adopt these measures separately as resilience requires a combination of actions and each measure in its own would not have the desired effects of an integrated plan. The planning process must go beyond this assessment and incorporate comprehensive measures that work together in an integrated development plan. Some of these core issues and recommendations could be generalised for other Family Islands that face similar conditions.

Box 3- 5 Pillars of action for disaster risk reduction

Pillar 1	Risk identification	Improved identification and understanding of disaster risks through building capacity for assessments and analysis
Pillar 2	Risk reduction	Avoided creation of new risks and reduced risks in society through greater disaster risk consideration in policy and investment
Pillar 3	Preparedness	Improved capacity to manage crises through developing forecasting and disaster management capacities
Pillar 4	Financial protection	Increased financial resilience of governments, private sector and households through financial protection strategies
Pillar 5	Resilient recovery	Quicker, more resilient recovery through support for reconstruction planning

Source: Global Facility for Disaster Risk Reduction (GFDRR), "Strategy 2013-2015. Managing Disaster Risks for a Resilient Future."

These pillars are closely interrelated, and should be accompanied by an enabling institutional, political, normative and financial environment that allows the allocation of resources, roles and responsibilities.

Pillar 1. Risk identification

This pillar suggests that, in order to manage disaster risks, first it is first necessary to understand the hazards, exposure and vulnerabilities faced by a community. As it is well known, the most important natural hazards to the country are tropical storms, lightning, tornadoes and drought. These are the extreme events that would cause the major losses in the future in The Bahamas.

By identifying the risks, it is then possible to foresee the potential effects and impacts of a disaster in a society and its economy. Implementation of data sharing, mapping and modelling are some activities that could better guide this process.

Risk identification focuses in two aspects. First, it considers the assessment of multiple threats, including frequency, intensity and magnitude. Second, it identifies exposed infrastructure, services, communities and other elements, as well as their vulnerabilities.

In The Bahamas 88 per cent of the population lives at an elevation of less than 10 meters above sea level,[66] and most of its critical infrastructure is also located near a coast. This makes it relevant for NEMA to strengthen collaboration with the Bahamas National Geographic Information Systems Centre (BNGIS) and with the Ministry of Environment to utilise maps of vulnerabilities in the affected islands, which can inform the reconstruction process in terms of location of settlements, public infrastructure and public services. This could also allow NEMA to prioritise its response to an emergency and provide relief to vulnerable populations and settlements.

In addition, the Ministry of Works and Urban Development, the Water and Sewerage Corporation, the Bahamas Electricity Company and the Bahamas Telecommunications Company could benefit from partnering with BNGIS to map the location of each sector's infrastructure. This would contribute to planning and monitoring maintenance of the infrastructure, but also to identify vulnerabilities due to location. In addition, when assessing the effects of a disaster, maps of roads and other critical infrastructure allow identifying location of affected assets, priority areas for intervention and need for relocation. In general, there is a need to improve the quality and availability of spatial data to inform national planning and decision making.

Considering that the Government of The Bahamas is working on a National Development Plan, the NRRU, NEMA-BNGIS and CDEMA could technically inform the elaboration process of the disaster risk manage-

66. McGranahan, Gordon; Balk, Deborah; Anderson, Bridget. (2007). "The rising tide: assessing the risks of climate change and human settlements in low elevation coastal zones" Environment & Urbanization, Vol 19(1): 17–37. International Institute for Environment and Development

ment strategy. This will allow the government to mainstream disaster risk reduction and climate change adaptation through a multi-sectoral approach, and move away from isolated risk reduction and climate change adaptation measures.

NEMA and The Bahamas Meteorology Department could benefit from partnering with the National Oceanic and Atmospheric Administration (NOAA) in the United States, specifically with the National Hurricane Centre, or with other research institutes to map the most relevant natural hazards to which inhabited islands are exposed to. This will allow the country to have a comprehensive assessment of their hazards, as well as the frequency and intensity.

Another instrument to identify risks is through the assessment of disasters. Disasters expose strengths and areas that need improvement. This gives an opportunity to plan better for potential hazardous events and make the necessary changes to prevent similar disasters from happening in the future. Instruments such as the Disaster Assessment Methodology, which was followed to elaborate this report, are intended to provide a comprehensive assessment of the social and economic effects and impact of a disaster in a community. Partnering with organisations like ECLAC in the evaluation of disasters would allow understanding the hazards better.

The assessment of disasters such as hurricane Joaquin could be substantially improved by having detailed and updated economic statistics and national accounts. This requires the allocation of more financial resources to the Department of Statistics. Challenges encountered during the assessment process allow suggesting improvements in five areas:

1. Draw up an annual Supply-and-Use Table, as the latest available is from 2007.

2. Breakdown variables such as gross value added by industry, total production (output) by industry and employment by activity and by island or district.

3. As a country that depends primarily on tourism, it is essential to have an updated Tourism Satellite Account (TSA), the latest available is from 2003. This is especially important as this sector is usually affected by a disaster. An inter-institutional platform could be created to develop a new TSA with involvement of the Ministry of Tourism, the Department of Statistics, the Central Bank (mainly for the detailed measurement category “travel”), the tourism business sector and the academia.

4. Develop a system of quarterly national accounts that enable intra-annual monitoring allowing the analysis of cyclical trends and determining the possible inflection points of economic activity. This tool not only has an analytical and policy use, but also strengthens the predictions / macroeconomic and sectoral projections.

5. Strengthen national accounts through the consolidation of basic statistical infrastructure whose central core is the Directory of Companies and Establishments (DCE) to the universe of resident economic units in the Bahamas. The DCE should be periodically updated. In addition, it should incorporate economic variables such as the amount of sales, the amount of assets and number of employees. Besides serving as a sampling frame, it would make possible some estimates by DCE segments (large, medium and small companies) and the GDP by island.

More in-depth economic data such as GDP per island or district could inform development and investments programs; while in times of disaster, it can help to have a better understanding of the impact of the event on the island’s economy, and subsequently to its population.

The availability of economic data must be accompanied by appropriate metadata as the only way to ensure transparency and better use of information by decision makers in the public and private sectors, planners, analysts and civil society.

Besides producing information, it is vital that institutions share their knowledge with other institutions. This pillar is fundamental for risk reduction and preparedness, as it can inform policies and decision makers with specific information on social, economic, environmental and physical vulnerabilities of populations and infrastructure. Information should also be readily available for the population in terms of raising awareness in regards to hazards, risk areas, and communicating other measures to manage the risk of disaster.

Pillar 2. Risk reduction

When risk exposure and its potential harmful effects are identified and understood, it is then possible to take actions to reduce such risk. In this pillar, instruments such as policies and investment programs are critical to reducing existing risks and preventing new ones from arising, in this regard, it is necessary to also consider the effects associated with climate change. Depending on the type of risk, it could be reduced, or at least reduce the exposure of a community or asset to a particular threat. Therefore, structural and non-structural prevention and mitigation measures are core components of this pillar.

This subsection includes policy and specific recommendations for three critical sectors, housing and public buildings, public utilities and transportation infrastructure. These sectors withstood the highest most amounts of damage and losses from Hurricane Joaquin, and this had negative effects in the quality of life and economic activities of the population. Recommendations are a combination of policies and particular technical solutions. These measures should be accompanied with a comprehensive development plan, as their not isolated implementation would not greatly improve resilience in the islands.

Housing and public buildings

The damaged houses had structural vulnerability (old buildings) or were in vulnerable areas near the coast. The most widespread measure to reduce risk in the islands is to enforce the use of the building code in the recovery and reconstruction process, as well as in any new development. The inspections carried out during the visits to the islands revealed that most dwelling that complied with the standards of the code withstood the effects of the hurricane or only suffered minor damage. Therefore, it is evident that during the reconstruction process of new homes, the code should be enforced as a measure to grant access to government assistance.

Even though The Bahamas has a modern building code, it was most recently updated in 2003 and international practice suggests updating it every five years. Therefore, it must be updated in light of lessons learned during this and past disasters. Particular measures should be considered for shelters, schools, and clinics; their location must be adequate and the building characteristics must meet multi- hazard criteria.

In this line, it is necessary to note that some structures that had been identified as shelters were destroyed or severely damaged by the hurricane, such as on Crooked Island. NEMA and the local governments have the responsibility of inspecting any building designated to protect the population from hazards, as this serious issue could have resulted in fatalities.

Considering the cost of building and maintaining public facilities in the affected islands, it is not feasible to build shelters whose use could be very limited and in infrequent situations. Therefore, it is recommended to build community centres in sites where significant populations are concentrated in each island. These centres would serve multiple purposes in the communities, but should be designed to function as shelters that can withstand severe natural hazards. As shelters, these multi-purpose centres should also have a protected facility to store basic supplies that are usually needed during and after an emergency.

Based on the type of damage identified by the assessment team on dwellings and buildings, some specific recommendations for all dwellings and structures can be made. Buildings should not be constructed with wooden external walls, and all exterior elements like water tanks, pumps, generators, gas bottles, and air conditioning units should be sufficiently affixed and protected. Loss of shingles and windows were a widespread effect of high winds, showing inadequate fixture. Loss of roof, when observed, was frequently due to a lack of anchorage between the roof, tie-beams and columns. In general, roof loss is a main cause of structural damage, so special attention must be paid to the reinforcement details of anchorage and connecting elements.

Structural measures are important but must go hand in hand with adequate planning and land use, in which the Ministry of Environment and Housing plays a crucial role. Considering the low-lying nature of the affected islands, the presence of marshes and the effects that climate change is already having on the islands, land use studies are fundamental in identifying the most apt and sustainable areas to locate private and public infrastructure. It is recommended to study the quality of the soil and its suitability for different types of development, such as urbanization, agriculture, and conservation, among others.

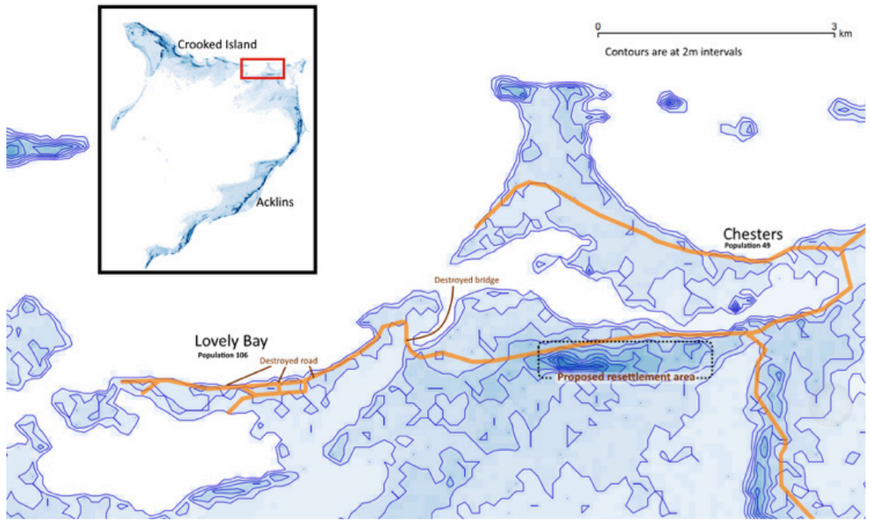
Another role played by the Ministry of Environment and Housing in coordination with other public service providers, is the identification of safe locations that could be fit for settlement in each island. Settlements and populations are dispersed and small in the affected islands, which affects the availability and quality of public services and utilities. It also elevates the per-capita cost in the provision of such services, and these expenses are exacerbated in times of disaster. Therefore, locating private and public infrastructure in risk prone areas is unsustainable in financial terms and also in regards to human development.

Considering that events of this magnitude tend to occur every 4 to 5 years, it is crucial to do the cost- benefit analysis of concentrating populations in each island, as well as assess the sustainability of rebuilding settlements in risk areas. Settlements such as Masons Bay and Mangrove Bush are very close to the coast and suffered severe damage. The community of Lovely Bay is located between two bodies of water and had insufficient protection from both.

Map 4 shows a possible option for the relocation of Lovely Bay. This would depend on suitability and compliance with environmental and land studies, and should be done in close consultation with the communities. Regardless of the location selected, concentrating communities in safe locations must be a priority.

If relocation processes are undertaken, they should be carried out in a coordinated and inter institutional manner. Settlements should be located in areas that provide basic public services and infrastructure, as well as opportunities to develop productive activities.

Map 4- Alternative for relocation of Lovely Bay, Acklins



Source: Disaster assessment team based on elevation data from the United States National Aeronautics and Space Administration (NASA)

Where relocation is not possible in the short term, floodplain regulations requiring higher structure elevations in areas close to the seashore should be enforced. Houses should be raised from the floor level in order to protect them from flooding. In addition, it would be necessary to formulate climate change adaptation strategies for such settlements in order to minimise the effects of sea level rise and storm surge. The use of soft and hard adaptation technologies could reduce the risk associated with coastal erosion and flooding.

Safe location is also relevant in terms of institutional presence and provision of services. During and after an emergency, it is critical to have a strong network of institutions that inform and guide the population from response to recovery. However, most public buildings that suffered damage were located in risk areas, and in many cases, operations and services had to be interrupted. Therefore, construction guidelines and adequate location are especially important in the case of public buildings and services.

In Crooked Island, most public offices were damaged and closed after the disaster. At the time of the visit (20 November), most of those offices remained closed, giving the population a sense of institutional vacuum and lack of guidance in the recovery process.

There are some critical cases that require special attention, such as the Administrator's offices in Acklins and Crooked Island. It is crucial that these offices continue operating during and after the disaster as headquarter to direct local operations. However, the office in Acklins is located on the coastline and was only protected by a seawall that was destroyed by the hurricane. It would be advisable to consider relocation of this building, and to develop land use studies before choosing the location. The Acklins office suffered severe damage as a result of its vulnerable location.

Besides institutional buildings, other public assets such as clinics and schools were damaged. Health services have dual importance; they provide a basic service to the population, but also should be able to continue operating during and after a disaster. Consequently, sound structures and continuity are two key concepts in this sector.

There were fourteen health facilities on the affected islands, all of which suffered some degree of damage, one was destroyed and three sustained severe damage. The clinic in Acklins was located too close to the coastline, and the clinics in Long Island and Crooked Island suffered widespread damage; therefore, it is advisable to relocate those structures that were located in risk areas. It is also recommended to reinforce and protect windows and doors, and to provide periodical maintenance to these structures.

In the case of schools, most were closed for one to three weeks, interrupting the normal education cycle that students are expected to have. An important outcome of this is the deepening of inequality between islands, as students are not receiving a complete cycle or are doing so in suboptimal or stressful conditions

The quality of the educational infrastructure is also very important. Students are one of the most important assets of a society. Therefore, education facilities should be able to withstand the effects of a hurricane and other events, and protect students. Some facilities show insufficient fixture of non-structural elements such as shingles (this is the case of the school in United Estates, San Salvador). Damage was also observed in auxiliary structures such as the walkway at the entrance of Colonel Hill High School that collapsed during the hurricane. Special attention must then be paid to the maintenance and adequate design of the schools, and their structures must fulfil all code requirements.

In The Bahamas it is well known that schools are not used as shelters, which benefits the continuity of education. However, it is fundamental to ensure the quality of construction and maintenance of these facilities.

During the inspection of the assessment team, it was observed that some buildings showed signs of damage prior to the hurricane due to corrosion of the steel reinforcement of the structural elements. This has produced cracking in some beams and columns making those buildings more vulnerable to wind. The effects of the corrosion should be assessed to verify if the resistant capacity of the structures has been affected. In the future it is crucial to periodically the structural conditions of the buildings.

In general, relocation measures should be enforced for public buildings. Additionally, for those buildings that were safely located and still withstood damage, or for those buildings that cannot be relocated in the short term, reinforcement and retrofitting are necessary. If buildings cannot be relocated, it is necessary to analyse the terrain and determine the suitability of soft or hard defences to also minimise the effects of climate change associated with flooding and sea surge.

The Ministry of Works and Urban Development, in coordination with the Ministries of Health and Education, Science and Technology, must strictly supervise the compliance of the regulations established in the building code when developing new infrastructure.

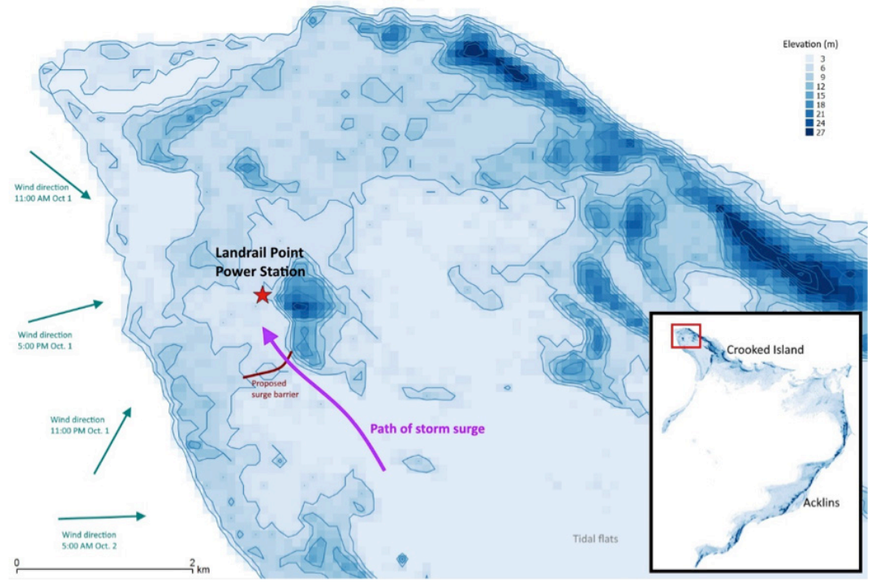
Public utilities

Public utilities were also affected by the disaster. There was widespread damage to telecommunications, as well as power outages that resulted in the interruption of water services.

Power

The Landrail Point Power station experienced storm surge in excess of two meters. In light of the damage to generators and fuel tanks that was caused by the storm surge, it may be advisable to relocate the power station to a higher part of the island. Currently, the power station is situated in a shallow valley adjacent to an area of tidal flats, and near the base of a hill. This local geography had the effect of channelling and magnifying the storm surge. As the water, driven by wind blowing from the west, piled up against the side of the hill it reached exceptional heights, even for this storm. Thus, despite an inland location, the power station was in a particularly vulnerable spot in terms of exposure to storm surge. Accordingly, the Bahamas Electric Company should consider relocating this station to another part of the island – perhaps as near as 500 meters to the north-east, on the other side of the hill, and at a higher elevation.

Figure 4- Landrail Point Power Station



Should a decision be taken not to move the power station, due to cost considerations, or a preference to avoid the risk of polluting another site on the island, steps could be taken to reduce the risk to the power station and, more broadly, to the power infrastructure on the island. Barriers might be considered – for example the power station could be afforded some protection by surrounding it with an earthen berm, or a protection barrier could be constructed across the area where the shallow valley opens up into the tidal flats. Material for either of these works could be found in the ample quantities of rubble that have accumulated on the island as a result of storm damage.

In general, for a deeper level of resilience in the affected islands, there is a need to diversify power generation, so that the failure of a single power station – and the destruction of the power lines that bring energy to the far corners of the island – would not result in a total loss of electricity to the community. Instead of replacing the ruined diesel generators with new diesel generators of the same size, it would be appropriate to install a lower capacity diesel system, with the aim of using that to supplement a combination of solar and wind-powered generation systems located at geographically dispersed points on the island. For example, one or more wind turbines might be located in the Major's Cay area, some 20 kilometres away, and photovoltaic solar panels could be located on hurricane-rated rooftops throughout the island. The geographic dispersal of power-generation assets would substantially reduce the risk of total loss of power generation capability in future disasters. Additionally, by placing consumers closer to sources of power generation, it would make communities less reliant on far-flung power lines that remain highly vulnerable to wind damage.

Telecommunications

In Landrail Point on Crooked Island, a Bahamas Telecommunications Company (BTC) cellular tower was snapped off from its base by the force of wind, and collapsed across the compound of a medical clinic. Another tower – of the same "monopole" design – collapsed in Major's Cay, also snapping off at the base. One monopole tower on Long Island also collapsed, though its point of failure was halfway up the tower. Cellular towers are typically designed to have a lifespan of 30 years or more, but these towers were less than 10 years old. Given that all three collapsed towers were of the same design, while other "lattice" type towers in the area survived, it is worth considering that this particular tower design may be at high risk in hurricane wind situations.

Based on the direction of the tower's fall in Landrail Point, in combination with information about wind direction at different times during the storm, it can be surmised that the tower fell at about 11:00 p.m. on 1 October, after having been exposed to hurricane-force winds for approximately 12 hours, and to tropical storm-force winds for almost 12 hours before that. It is likely that the repeated swaying of these towers in the wind eventually led to metal fatigue, which caused the metal to tear and the tower to collapse. Notably, this was not the first time these towers had been through a hurricane, as they had all survived Hurricane Irene in 2011. As a result of this previous storm, some level of metal fatigue may have already been incurred, potentially leading to corrosion that may have contributed to the tower's collapse.

Given that those monopole towers left standing in the affected area have now been subject to the accumulated metal fatigue of two hurricanes, they should all be considered to be at an elevated risk of failure in the next storm. They should each be examined at the base and at the midsection for signs of metal fatigue, such as microscopic cracks or indications of corrosion. It may be necessary to remove and replace these towers with models designed to perform better in high wind. If the towers are not replaced, they should at least be reinforced, such as through the use of guy-wires. These precautions should also be taken with all other cellular towers of this design in the country – especially those that have stood through previous hurricanes.

There is also a concern over the location of these towers, as illustrated by the collapse of the tower in Landrail Point, which came within two meters of landing on a medical clinic. These towers should be farther removed from built-up areas; ideally, each tower would be surrounded by an exclusionary "drop zone," equal to the height of the tower plus 10%, inside of which would be no buildings or public thoroughfares. These islands appear to have enough empty land that appropriate locations could be found; this is a matter for consideration by each island's local planning body.

Water and sanitation

In terms of access to safe water and sanitation, most of the population relies in desalination plans, and wells to a lesser extent. The provision system is designed to supply a dispersed and small population. However, it carries very high per capita costs and it is an energy intensive process, which is counterproductive in a country that already depends heavily on imported fossil fuels. It also reproduces disparities in the quality of the service provided to the Family Islands in comparison with New Providence.

The majority of the population in the affected islands uses septic tanks for wastewater disposal. However, many tanks are neither properly maintained nor periodically emptied and cleaned. Full or damaged tanks allow leachate to flow to groundwater and pollute the already scarce water resources.

Freshwater in the islands is superficial (depth to water table of up to 1.5 meters in most areas),[67] this has two main consequences. First, the leachate can reach the source more easily and faster, compromising the quality of water consumed by humans. It could also have devastating environmental effects on the rich marshes of the islands. In addition, during the disaster, this generated a health hazard as in cases where septic tanks overflowed or were damaged due to the storm surge. It is necessary to create local capacity to provide maintenance to tanks, but also to treat and dispose the wastewater collected.

Second, this shallowness makes freshwater vulnerable to storm surge and sea level rise, and eases the digging of wells through different methods. Considering that digging of private wells is not regulated in The Bahamas, this could lead to over-extraction, damage to sources due to poor digging and construction techniques, such as saline intrusion, as well as consumption of low quality or contaminated water. Groundwater is already very fragile in the southern islands, and lack of regulation and monitoring could exacerbate the problem of access.

Regulating private wells would provide several benefits. First, by having an inventory of the existing wells it is possible to determine their quality and potential vulnerabilities. Second, it allows establishing infrastructure and environmental requirements to improve the sustainability of the resource.

It is also advisable to analyse the quality and condition of freshwater in the affected islands to identify contaminated sources and guide basin interventions to recover or rehabilitate the resource. Information about wells, combined with environmental studies to determine the recharge rate of groundwater would allow the establishment of sustainable extraction rates. Considering that these islands are considerably drier than islands in the north, the recovery or rehabilitation of water sources and the regulation of private uses could improve water quality, and increase resilience in times of disaster as water would be readily available and treated safely.

67. US Army Corps of Engineers. (2004). Water Resources Assessment of The Bahamas.

It is recommended to create decentralised supply systems by providing isolated communities with water storage solutions. It should be encouraged that each house have a rain water catching and storage system, as it is already considered in the building code.[68] It is advisable to analyse if this should be a mandatory request in dispersed communities, such as those affected by hurricane Joaquin. This measure would increase resilience in the communities, and would alleviate provision costs.

Even if desalination is energy intensive and could have detrimental impacts on the environment, it is possible that it must be used in the short and medium terms; therefore, it would be necessary to expand the use of renewable energy and improve energy efficiency to reduce the economic costs and the environmental impact associated with this practice. In this regard, a modern energy policy could increase resilience in both the power and the water sectors and improve the quality and stability of the utilities provided.

Sustainable solutions especially suited for small communities should also be planned to solve the problem of wasted waters. Development of a low-cost infrastructure, small diameter sewers, cost effective wastewater treatment and management, and waste disposal alternatives should be considered.

The design and implementation of an adequate system of solid waste disposal, such as sanitary landfills, must be designed and implemented in all islands. These procedures are required in order to preserve the environment and the quality of life, and to avoid the type of damage that was noted as a result of hurricane-scattered refuse at the dump on Crooked Island.

Transportation

In terms of public infrastructure, most main roads on the islands are located in flood-prone areas or on the coast. In addition to their exposure to natural threats due to their location, most of the analysed infrastructure shows damage previous to the hurricane, as a result of normal use, insufficient maintenance and lack of repair of damages caused by previous natural events (such as hurricane Irene) and annual rains.

In relation with the actual condition of the docks, the majority of the Family Islands are challenged with relative inconsistency of transport services, inadequate port infrastructure, relatively high freight transportation costs and insufficient port security.

Minimum infrastructure should be considered to ensure safe and suitable accommodation for supplies, repair, loading and unloading cargo in order to facilitate the activities and functions of the existing ports. Cold storage could specially be considered for fishing ports.

Access is also a key issue. The maintenance of the connection to roadways is important to improve transportation of products to the interior

68. Section 3617.12: Rainwater Disposal. (a) Minimum requirements: (2) "Rain water may be either collected on roofs and conveyed to storage tanks or connected to drains.

of the island. In addition to protecting dock infrastructure against natural hazards, it is necessary to ensure protection against wind and waves, which could affect the performance of the dock adjacent areas.

Reconstruction of the damaged infrastructure on the affected islands should be conceived in two levels or stages. The first phase corresponds to the attention of the affected population, aiming to the recovery of the functionality of the existing infrastructure and the normalisation of productive activities. In this situation, it is advisable to repair the damage caused by the disaster and ensure minimum maintenance plans and prevention measures to preserve the investments and the security of the population.

The second level of the reconstruction is more related to an upgrade of the infrastructure within the framework of a strategic infrastructure development plan, as part of the National Development Plan. Improvement or major investments in infrastructure projects shall be considered according to the specific demands and resources allocated in the plan.

An infrastructure development plan should consider a careful design of new ports within an integrated vision of the transport system of the Family Islands. In the more important ports, detailed planning may be required to optimise logistics between docks, warehouses, storage, container handling, and terminal facilities. Small and simple docks may be sufficient for artisanal fishing or touristic activities at a minor scale. In main locations, port facilities may include: cranes, loading platforms, storage facilities, terminals, and security, commercial, legal and administrative infrastructure, among others. Also boat shelters and repair facilities should be constructed in chosen places.

The same considerations apply in the case of airports. The existing infrastructure is currently adequate and functional for the volume of population and economic activities of the islands. However, improvements and new infrastructure developments regarding terminals and related services of existing airports can be considered as part of a comprehensive development plan for the islands.

Vulnerability to natural hazards such as floods, hurricanes, sea level rise related to climate change, and the need to increase resilience all impose an effort for the preparation of a global strategy for the development of cost effective public infrastructure. This strategy must consider relocation of certain roads, if relocation is not possible in the short or medium term, those roads should be retrofitted, elevated, and protected by sea walls and other types of hard protections. However, it must be recognised that recovering some of these roads is not sustainable and future events would have similar effects. This process must be accompanied with an improvement in the availability of quality spatial data, in order to identify suitable locations for roads and other infrastructure. Additionally, such infrastructure must incorporate climate change adaptation technologies to improve resilience.

It is therefore advisable that the Government of The Bahamas considers the incorporation of disaster risk reduction in future investments. This will guarantee that any new infrastructure project incorporates a multi-hazard approach to withstand future events. At the same time, it will protect the government's investments, which are already costly in the affected islands.

Pillar 3. Preparedness

Even if risks can be identified and addressed, it is not possible to completely eliminate them. Therefore, preparedness refers to the knowledge and capacities developed by governments, businesses and communities to anticipate, respond to, and recover from the effects of a natural hazard or disaster. This pillar should contribute to an organised transition from response to recovery.

Most Latin American and Caribbean countries have focused their efforts in this pillar through warning systems, contingency plans, and emergency response. At the same time, this has resulted in reduced attention to other areas of disaster risk management, highlighting the need of strengthening other pillars.

The degree and quality of preparedness will be closely linked to a sound analysis of risks and to existing warning systems. When the disaster assessment team visited the southern Bahamas, a common sentiment heard from affected persons was "there was no warning." Hurricane Joaquin, which took a path farther south than early predictions had expected, caught the population unprepared. A tropical storm warning for Crooked Island and Acklins was not issued until 5:00 p.m. on the evening before the storm, and, in general, the warning did not reach people soon enough to provide sufficient time to prepare buildings or relocate to shelters.

There is a need to review the lessons of this experience, to consider how warnings can be more effectively propagated in future events. There is an important role for telecommunications companies to play here; by implementing a technology called "cell broadcasting," a warning text message could be quickly distributed to users of mobile phones within a specified geographic area. The implementation of this technology would require investment on the part of mobile phone operators, and the development of a protocol for its use, in coordination with officials at NEMA. A requirement to implement cell broadcasting, or equivalent technology, should be considered for inclusion as part of the issuance and renewal of licensing agreements for mobile service providers in The Bahamas.

While mobile phone-based warnings can reach substantial parts of the population, it must also be recognised that significant numbers of people do not make regular use of mobile phones. This includes some of the most vulnerable portions of the population, such as the poor, children, and the elderly. Thus, there is a need for alternate channels of warning, such as a network of warning sirens within earshot of each settlement.

The use of warning sirens would re-enforce the message being broadcast through mobile phones and other channels, increasing the sense of urgency prior to a disaster. These warning sirens could potentially be mounted on existing mobile network towers, which have an appropriate geographic spread to suit the needs of the system.

In terms of response, the multiplicity of agencies involved in the attention of Hurricane Joaquin demonstrated the importance of coordination. It is recommended to establish a network of public and private organisations that meet periodically and define roles and responsibilities in case of a disaster. It is important to promote the participation of the Family Islands, and identify clear communication channels between members, regardless of their location.

In coordination with NEMA and the National Recovery and Reconstruction Unit, this network should establish response protocols for each stakeholder to follow. These protocols should consider accountability in the management of public funds for the attention of the emergency.

Subsequently, it is advisable to conduct simulations to assess individual participation and overall performance, and to consider the incorporation of new stakeholders. Simulations and protocols should inform each other, hence the importance of strong collaboration between agencies.

The health sector should withstand the disaster, and be able to support the population during and after the emergency. In the affected islands, health centres have the capacity to stabilise patients but in general there are no laboratories or operating facilities. In case of emergencies the islands rely heavily on medical air transportation or alternatively on the accessibility of the ports. It is recommended that the Ministry of Health has access to multiple sources of medical transportation in case of severe damage to transportation infrastructure.

Pillar 4. Financial protection

This pillar attempts to create strategies to protect governments, businesses and households from the economic impact of a disaster. Considering that risks cannot be eliminated, it is therefore important that countries protect their fiscal balance from shocks while they are still able to respond to the emergency. Financial protection refers to insurance at the sovereign and household levels, but also in terms of social protection for vulnerable populations.

The level of insurance penetration decreases as one moves south along the chain of islands in The Bahamas. In preliminary assessment of The Bahamas Insurance Association (BIA), with available data up to 1 December 2015, which is enhanced by information from the Insurance Commission of The Bahamas (ICB) suggests that gross losses to the insurance industry caused by hurricane Joaquin is approximately $14 million, that is 13.4 per cent of the total estimated damage (Box 1, p. 96).

The repeated impact of tropical weather systems on The Bahamas clearly indicates that the disasters are a development problem in the country. This suggests that in the same way that the government budgets and programs resources for other key development programs such infrastructure and education; disaster risk reduction and resilience building should be programmed in development planning process. These measures should strike a balance between risk mitigation and risk transfer mechanisms to reduce overall vulnerability and build up resilience to hazards.[69]

Given the importance of finance to recovery and reconstruction following a disaster a careful mix of financial instruments is needed for disaster-proofing The Bahamas. Financial instruments could include catastrophic risk insurance, especially for small and medium sized businesses and operations, micro-finance services and disaster recovery funds for the short to medium-term recovery and rehabilitation. Additionally, a resilience fund is recommended for longer-term reconstruction and economic adjustment, including an economic sustainable plan for those islands where activity is largely dependent on one sector.

With respect to catastrophic risk insurance, The Bahamas is a member of the Caribbean Catastrophic Risk Insurance Facility Segregated Portfolio Company (CCRIF SPC). The CCRIF provides coverage for its members based on a number of parameters, including the intensity of the hazard (wind speed and amount of rainfall) in the case of tropical weather systems. Nevertheless, parametric insurance frameworks like the CCRIF have some constraints in that countries might not get a pay-out or the amount of pay-out expected after a disaster impact. Hurricane Joaquin did not trigger a CCRIF payout to The Bahamas despite hitting some of the affected islands as a category 4 hurricane, resulting in major damage to housing and other infrastructure and livelihood assets. As the CCRIF report noted, the "loss model did not generate government losses due to wind and storm surge damage in the affected countries and therefore no payout is due."[70]

This suggests that The Bahamas might need to consider increasing its coverage under the CCRIF to reduce the trigger point to receive payments, but also to explore other insurance and risk transfer mechanisms.

It is possible to mention four potential options: (i) a government initiated recovery fund to provide liquidity to facilitate recovery after a disaster, (ii) incentivised private insurance, (iii) a micro-credit scheme for micro, small and medium enterprises and poorer households, and (iv) a resilience fund for longer-term structural reconstruction.

The recovery fund could be designed as a reserve fund that would be specifically targeted at providing assistance to affected households and uninsured businesses in the aftermath of a disaster. To reduce the moral hazard of citizens not adopting reasonable risk mitigation measures such as abiding by building codes, citizens could be required to contribute to the fund on a means-tested basis. This would serve both to improve mitigation and to replenish the fund, which is important given the relatively

69. Miller and Keipi note that a balanced approach is key to a successful risk mitigation strategy. See: IADB. (2005). Strategies and Financial Instruments for Disaster Risk Management in Latin America and the Caribbean, Reference No. ENV-145.
70. CCRIF SPC. (2015). Tropical Cyclone Joaquin (AL112015) Wind and Storm Surge Event Briefing, 9 October.

high debt burden in The Bahamas. Importantly, the fund should be administered by an independent oversight body to prevent the resources being used for other purposes.

Payouts from the recovery fund could be used for minor to moderate home repairs, clean-up costs, as working capital to get small businesses up and running, including repairs and stocking of supplies and replace equipment and machinery among other short to medium term projects.

From all indications, the insurance cover ratio in the affected family islands was low. This is partly due to the high cost of insurance coverage, which is a function of weak competition in the sector and the location of The Bahamas in the Atlantic hurricane belt. There is therefore a need to incentivise citizens and businesses that can afford it to insure their properties and assets. As far as possible, citizens should be encouraged to take out full coverage for their properties, but realistically, it is expected that high costs mean that many would continue to underinsure. Further opening up the insurance market to attract more players could also boost competition and drive down the costs of premiums. This would make insurance more affordable to a wider cross section of the population.

The likelihood of events such as hurricane Joaquin and the development of settlements in risk areas underscore the pertinence of household insurance. This is particularly relevant considering that the Government of The Bahamas has undertaken the task of reconstructing private homes, which exerts pressure in the country's budget. Besides public financial measures to minimise the risk faced by these assets, it is imperative to raise awareness among the population and inform them about the risks faced by their communities. The recurrence of these types of events should encourage the widespread use of insurance, especially if the government is subsidising the reconstruction process. Therefore, a key component in a disaster risk management plan should be education and awareness regarding the critical need for private insurance.

Nevertheless, private risk transfer through insurance is not expected to be adequate given the significant losses that could result, especially from a high intensity hurricane. Therefore, a balanced risk portfolio should include a quick disbursement credit facility. A micro-credit facility that balances prudential guidelines to ensure repayment with favourable lending terms could provide ready liquidity for affected households and small businesses to initiate speedy repairs and business restart-up after a disaster. The micro-credit facility would provide small loans at affordable interest rates both for working capital and for medium-term business upgrading.

The final mechanism that could be considered is the development of a resilience fund. This fund will be a structural fund aimed at resilient reconstruction. As such the fund will be focused most heavily on addressing the development constraints that lead to cumulative disaster risk. The resilience fund will finance both pre and post-disaster initiatives that reduce structural vulnerability. Important areas for funding could

include the strengthening of early warning systems, the relocation of the most vulnerable homes and businesses to higher ground, reconstruction to the standards of building codes, the relocation of electricity lines underground and the shifting of workers to more resilient new sectors and activities. The fund would be guided by two broad principles: i) giving highest priority to reconstruction projects and programs that provide the highest return in terms of growth and development and risk mitigation, ii) at the same time giving special attention to the most vulnerable.

International financial institutions such as the Inter-American Development Bank could be enjoined to contribute to the resilience fund as part of their mandate to increase disaster resilience. Also, the fund provides an important mechanism for donor countries to contribute to climate change adaptation and risk mitigation.

Pillar 5. Resilient recovery

If a disaster cannot be prevented, then recovery and reconstruction can be used to improve resilience in the affected areas. Even if disasters have harmful effects on societies and economies, they are also an opportunity to change policies and practices that do not incorporate disaster risk management. It is important to plan a multi-risk reconstruction process that can respond not only to the hazard that caused the disaster, but to any hazard to which the country or community is exposed.

Most institutions and public companies with presence in the islands were affected, and in many cases it would be necessary to relocate strategic infrastructure. For example, the clinic in Acklins was severely damaged by the disaster due to its proximity to the sea, and the Mangrove Bush primary school on Long Island faced a similar situation. The Colonel Hill satellite clinic and the Clarence Town clinic were destroyed. The former is relatively small but it receives on average a higher number of outpatient visits than the Landrail Point Clinic. It is recommended to build a larger facility in higher ground. In the case of the latter, it is recommended to build a larger facility that can provide more services.

BTC, BEC, WSC and other institutions also withstood important damage and losses. Therefore, it is recommended to consider a process of resettlement in which all these institutions collaborate closely in identifying suitable zones in which the provision of services could be more resilient.

After identifying safe areas to locate settlements and public buildings, it would be advisable that main health centres (initially) and schools are certified by UNISDR and WHO's safe schools and safe hospitals initiatives.

Through measures proposed in the previous pillars, it would be possible to reduce the risk of disaster. However, as it has been mentioned, these measures must be accompanied by a development strategy for the affected islands.

Considering that the Government of The Bahamas is in the process of elaborating a National Development Plan, this disaster gives the country a unique opportunity to integrate disaster risk management in strategic long term planning. As it was mentioned, some disaster risk reduction measures could also result in nationwide benefits, such as a modern energy policy and sustainable territorial planning. However, a more comprehensive disaster risk management plan could contribute in the organisation and subsequent prioritisation of activities that would allow the government to allocate resources efficiently and obtain multi sectoral gains.

The elaboration of a National Development Plan calls for the interaction of a multiplicity of actors and sectors. By using this opportunity to incorporate a disaster risk management strategy in the process, it would be possible to design a plan that considers risk management and climate change in a more comprehensive manner and not through isolated programmes from individual institutions.

This multisectoral approach should also integrate the public sector, the academia and the population in general through education and public awareness campaigns. In addition, it is necessary to improve institutional capacity to mainstream disaster risk management and climate change in a crosscutting manner.

Developing a disaster management plan would allow the Government of The Bahamas to strengthen areas such as risk identification, and prevention and mitigation. At the same time, its synergy with the National Development Plan could strengthen financial risk management and preparedness. The plan should also emphasise the importance of education and public awareness. Information compiled in different pillars should be shared with the population to involve them in the process of disaster risk management.

This opportunity to increase resilience in the affected islands should be embraced by the government in order to improve the quality and efficiency of the recovery and reconstruction processes, at the same time that it establishes policy measures to reduce the risk of future disasters and improves resilience throughout the Bahamian islands.

Assessment of the Effects and Impacts Caused by

Hurricane Joaquin

The Bahamas

IDB
Inter-American Development Bank

United Nations
ECLAC