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HIGHER GROUND

Lessons From Hurricane Melissa
for Resilience, Relief, and Recovery



Higher Ground

Lessons From Hurricane Melissa for Resilience, Relief, and Recovery

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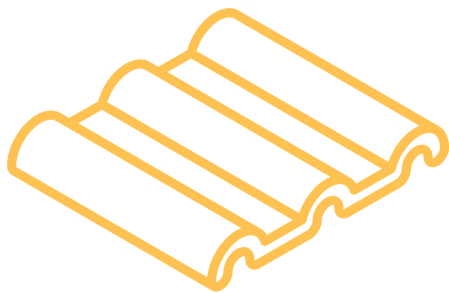
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Acronyms

CAPRI	Caribbean Policy Research Institute
CARE	COVID-19 Allocation of Resources for Employees
CCRIF	Caribbean Catastrophe Risk Insurance Facility
EbA	Ecosystem-based Adaptation
ECLAC	Economic Commission for Latin America and the Caribbean
EM-DAT	Emergency Events Database
GDP	Gross Domestic Product
GOJ	Government of Jamaica
IDB	Inter-American Development Bank
IFRC	International Federation of Red Cross and Red Crescent Societies
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
JDF	Jamaica Defence Force
JHDINA	Jamaica Household Damage, Impact, and Needs Assessment
JPS	Jamaica Public Service Company
MHPSS	Mental Health and Psychosocial Support
MOFPS	Ministry of Finance and the Public Service
NARRA	National Reconstruction and Resilient Authority
NbS	Nature-based Solutions
NCD	Non-communicable Disease
NDF	National Disaster Fund
NEPA	National Environment and Planning Agency
NRCA	Natural Resources Conservation Authority
NSWMA	National Solid Waste Management Authority
NWA	National Works Agency
NWC	National Water Commission
ODPEM	Office of Disaster Preparedness and Emergency Management
OUR	Office of Utilities Regulation
PAHO	Pan American Health Organization
PIOJ	Planning Institute of Jamaica
ROOFS	Restoration of Owner or Occupant Family Shelter
STATIN	Statistical Institute of Jamaica
UN	United Nations



Executive Summary



The roofs, poles, and water systems being replaced after Melissa will be rebuilt to the old standards unless those standards are revised first.

Hurricane Melissa made landfall on Jamaica's southwestern coast on 28 October 2025 as a Category 5 storm, the first Category 4 or 5 hurricane on record to strike the island directly. Its total effects were estimated at J\$1.95 trillion, or US\$12.2 billion, making it the most destructive hurricane in Jamaica's recorded history. This report examines how the state's risk posture, meaning its judgements about which hazards to plan for and how much to commit to them in advance, shaped Jamaica's ability to withstand the storm, keep essential services running, and recover. It looks at four areas: the natural environment, the built environment, public services and welfare, and disaster financing.

What held best was the country's finances. More than a decade of fiscal discipline allowed Jamaica to absorb the shock without a fiscal or market crisis. The government had paid premiums in calm years for a catastrophe bond and for parametric insurance through CCRIF, and both paid out within weeks of the storm. In all, the disaster risk financing framework supplied about US\$1 billion, more than the government's expected share of the cost of a severe hurricane.

The built environment fared far worse, accounting for 86 percent of Melissa's damage. Almost every building standing when the storm arrived had gone up be-



fore Jamaica had an enforceable national building code. The building code, drainage standards, and grid design standard were all set against a record with no direct landfall of a Category 4 or 5 hurricane, and the grid was built for a Category 3 storm. Most of the damage to homes began at the roof, where sheet-metal roofing held down only by screws gave way and let in the rain. In timber-built Westmoreland, one in three assessed homes was destroyed outright, against one in seven in block-built St. Elizabeth.

Jamaica's natural defences had already been weakened. The laws to protect mangroves and forests largely exist, but permit exemptions and ministerial overrides have allowed them to be cleared. About a third of the island's mangroves have been lost since the 1970s. In a one-in-200-year hurricane, Jamaica's mangroves protect an estimated 177,000 people and US\$2.4 billion in buildings and infrastructure, yet that protection is not counted in planning decisions or in reconstruction.

Jamaica's catastrophe bond and insurance paid out within weeks. Five months after landfall, only **1.8%** of **J\$1.4billion** in cash donations had been spent.

Public services had no plan for losing several systems at once. Electricity took seven months to restore, and water, health care, and schooling could recover only as fast as the grid. Five hospitals were left wholly or largely out of service, leaving some 31,000 patients without specialist care. A year after landfall, some 80 public schools were still teaching in tents or on rotation. Relief moved quickly where the military and international agencies had the capacity, but 29 communities were cut off for weeks, and the tools for deciding who should receive help were built during the response. Money was also slow to move once it arrived. Five months after landfall, ODPEM had spent 1.8 percent of the J\$1.4 billion in cash donations it received. The reserves meant for smaller, more frequent disasters were drawn down, with the National

Disaster Fund 93 percent below its 2025 level, and there is no rule for rebuilding them. For now, Jamaica is better protected against another catastrophe than against the ordinary storm or flood that is more likely to come next.

Many of these gaps reflect the limits of a small public service, in which preparing for a storm the island had never experienced competed with more immediate work for the time of the same officials. Across all four areas, the state planned ahead where someone outside it required it to. Investors and insurers will not take on Jamaica's risk without pricing it against models of future storms, so the financing framework was built to that standard. Building codes, grid standards, and land-use decisions face no such requirement, and were set against the

storms already in the national record. The same holds for households. Most of those affected by Melissa owned their homes, but almost none were insured. Without a lender or insurer involved, nobody checks a house against a standard, and the state ends up paying through relief.

Reconstruction is the point at which this can change. The roofs, poles, and water systems now being replaced will be rebuilt to the old standards unless those standards are revised before the rebuilding is finished. Jamaica has already shown, in its disaster financing, that it can plan for future storms. The task now is to do the same for its homes, its public services, and its natural defences.





Recommendations

**1**

Protect and restore mangrove forests, and count natural defences in reconstruction plans.

**2**

Protect remaining unprotected primary forests, except in limited cases enumerated in law.

**3**

Revise design standards against a forward assessment of the hazard, beginning with how roofs are fastened.

**4**

Upgrade the electricity grid to withstand a Category 5 hurricane, beginning with the transmission network.

**5**

Draft a wind standard for the frames that hold solar panels and require it in every contract for new utility-scale solar generation.

**6**

Relocate water treatment plants, water mains, and pumping equipment to locations less exposed to flooding, or raise equipment above flood level.

**7**

Keep new construction, public and private, out of the most exposed locations, and raise or relocate houses that flood.

**8**

Plan the order and standard of reconstruction before the next storm.

**9**

Build a national record of buildings and infrastructure, and make the issue and renewal of utility licences conditional on contributing to it.

**10**

Require a costed and funded service continuity plan from every licensed utility provider as well as from every hospital and school.

**11**

Construct dedicated, multi-hazard shelters at strategic locations.

**12**

Establish a permanent digital relief management and claims platform, backed by a standing register of households.

**13**

Open the dedicated National Disaster Fund account that the Disaster Risk Management Act has required since 2015, and appoint the Fund Committee and Chairman.

**14**

In the annual budget, make a minimum, mandatory contribution to the National Disaster Fund, and set a rule for replenishing the framework's lower tiers after a storm.

**15**

Establish real-time digital accounting, reporting, and audit protocols so that disaster funds are deployed quickly and transparently.

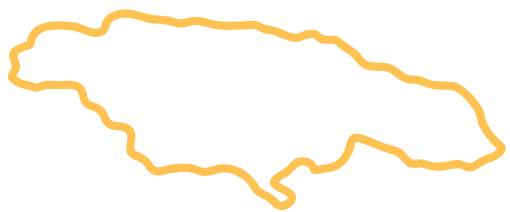
**16**

Expand parametric insurance and catastrophe-bond capacity.



1

Introduction



Jamaica's protective standards were set against the storms in its record, and no hurricane in that record had made landfall at Category 4 or 5.

Hurricane Melissa came ashore on Jamaica's southwestern coast on 28 October 2025, a Category 5 storm with sustained winds of 184 miles per hour, and by cost it became the most destructive hurricane in Jamaica's recorded history. Total effects were estimated at J\$1.95 trillion, or US\$12.2 billion, more than four times the cost of Hurricane Gilbert.¹ Housing alone accounted for J\$687 billion of physical damage, more than half the total.² At one point, more than 532,000 customers, roughly 77 percent of the Jamaica Public Service customer base, were without power. The water system went down with the grid: 395 of the National Water Commission's 570 production and pumping facilities were out of service. Of that number, two-thirds were offline because they had lost electricity rather than because the storm had damaged them.³

Public services fared badly in general. Five hospitals sustained major damage, and the closure of the worst affected was projected to leave some 31,000 patients unable to access clinical specialty and radiology services after the hurricane and into the following year. Two-thirds of schools were hit, with 721 of 1,010 public schools damaged, disrupting learning for roughly 407,000 students.⁴ Around 90 percent of official shelters were also schools, and close to 78 percent of them were damaged. In effect, the buildings designated to receive people displaced from their

homes by the storm were among the least storm-resistant in the public estate.⁵

The basis on which Jamaica set its protective standards was the condition that most shaped how badly Jamaica fared. The building code, the drainage standards, and the design standard for the electricity grid had all been set with reference to storms in the national record, but no hurricane had made landfall in Jamaica at Category 4 or 5, notwithstanding the Intergovernmental Panel on Climate Change (IPCC)'s pre-existing projections that tropical cyclones affecting small islands would grow more intense.⁶ Because Jamaica's infrastructure systems depend on one another, a standard set too low in one of them did not stay contained. Research on national infrastructure has shown that electricity, water, telecommunications, and transport are closely enough linked that a disruption in one has ripple effects through the others and into the wider economy.⁷ Recent assessments have identified this pattern in Jamaica directly, whereby cascading failures triggered by weaknesses in the electricity network have in turn disrupted the water supply, health services, telecommunications, and education across the island.⁸ The Public Services and Welfare section sets these findings out in full.

Harm persisted after services were restored, most of all in the economy. An economy projected to grow by 2.2 percent in fiscal year 2025/26 instead was expected

to contract by 1.4 percent, a swing of 3.6 percentage points attributable to a single storm, with the overall fiscal deficit projected at 3.5 percent of gross domestic product (GDP) against what had been a balanced budget.⁹ A shock of that size reaches directly into the recurrent budgets that fund hospitals, schools, and utilities in the years that follow, so a hurricane that lasted mere hours goes on constraining public provision for years thereafter.

These costs have fallen unevenly across parishes and households. Damage to the health sector was concentrated in the poorer western and southern parishes, with St. Elizabeth alone accounting for 30 percent of health sector damage.¹⁰ Eighty percent of damaged households were owner-occupied, but only 1 percent of them had insurance, so the overwhelming majority had no financial buffer, and were dependent on the state for disaster relief.¹¹

The weaknesses in standards and in relief delivery can be considered "failures of anticipation". In the first case the state did not plan for the strength of storm Jamaica could face. In the second it had not built arrangements for getting relief funds to where they were needed quickly or accountably when a disaster happened. Both failures originate in the state's "risk posture", meaning the judgements it makes about which hazards to plan for and how much it is prepared to commit, in advance of a disaster, to protecting against them

Jamaica's economy, projected to grow **2.2%** in 2025/26, was instead expected to shrink **1.4%**, a swing of **3.6%** points from one storm.

and organising a response. Jamaica's posture has been set by the storms of its past, resulting in underinvestment in protection and in the means of delivering relief and recovery, and in a disaster architecture where agencies and information systems work in silos and financial flows are hard to track.

That posture has also been shaped by the limits of a small public service. Continuity plans, beneficiary registers, enforceable building standards, and a working disaster fund all have to be built and kept up by the same officials who carry more immediate responsibilities, such as, say, the restructuring of public sector compensation. With no Category 4 or 5 landfall in the record, the case for giving their time to a never-before-seen storm of Melissa's strength may not have been strong enough, and the work that would have made the response easier would have competed with work whose returns were more certain. Many of these constraints are systemic, amongst them thin staffing, procedures that route emergency money through the ordinary budget, and statutory duties assigned to agencies without the people to carry them out. Closing the gaps this report documents will require a commitment to procuring the capacity, staff, and money for preparedness in advance, in the same way that premiums are set aside each year for the catastrophe bond, having calculated the cost benefit to doing so.

This report examines how Jamaica's risk posture shapes the state's capacity to provide the public goods on which disaster risk management depends in four domains, and that posture is not the same in each. The natural environment falls short on the first failure of anticipation, since the state has allowed its defences to be degraded through permitted development and weak enforcement. So does the built environment, most of which went up before any code could be enforced, while the standards that did apply were sized to storms weaker than Melissa. Public services and welfare fall short on both, because they depended on an under-built grid and because relief was slow to reach the households that needed it. Disaster financing is the one area where the state planned ahead. Under the catastrophe

bond the government pays premiums in calm years, and the bond pays out automatically once a storm crosses a pre-determined intensity threshold, as happened after Melissa. The rest of the fiscal framework was less well prepared. No comparable advance arrangement existed for handling relief funds, and with no rule to replenish the framework's lower tiers once a storm has drawn them down, those tiers are now depleted.

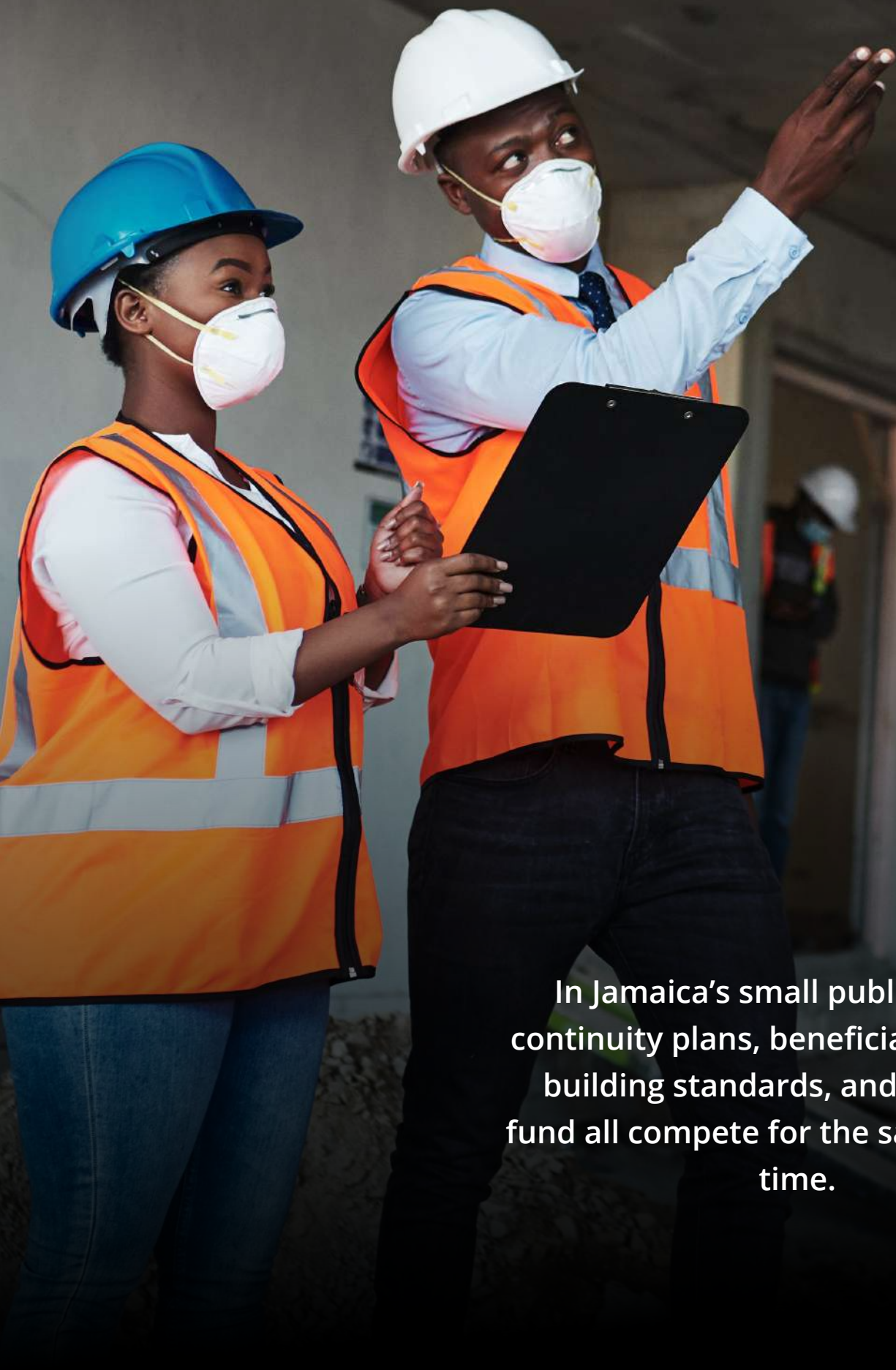
The report begins with the natural environment, which grounds the analysis both literally and logically, and with the extent to which natural defences have been compromised. The built environment is the next layer, and its strength or weakness can either mitigate or intensify a disaster's impacts. The report then considers the disruption of services and the delivery of relief, and finally the fiscal capacity that determines how well a government can cope. The conclusion sets out a policy framework to put Jamaica on higher ground before the next storm arrives.

Methodological Note

This report is based on documentary evidence published up to September 2026; no primary data were collected for it. Its main source on the scale and distribution of Melissa's effects is the joint damage and loss assessment published by the Planning Institute of Jamaica (PIOJ) with the Economic Commission for Latin America and the Caribbean (ECLAC) and the Inter-American Development Bank (IDB), referred to in this report as the PIOJ assessment. That assessment is read alongside the Auditor General's compliance audit of donated relief funds, the National Disaster Fund, and the roof restoration component of the ROOFS programme. Situation reports and operational updates from the Pan American Health Organization (PAHO), the International Federation of Red Cross and Red Crescent Societies (IFRC), and the United Nations, a rapid gender analysis, and ministry statements and parliamentary testimony reported by the Jamaica Information Service and the press are used to trace how health, education, utility, and relief services performed in the months after landfall.

The legal and policy framework is reviewed through the Disaster Risk Management Act, the Natural Resources Conservation Authority Act, the Office of Utilities Regulation Act, the Building Act, the National Hazard Risk Reduction Policy, and the 2026/27 Estimates of Expenditure. The environmental analysis draws on published flood modelling and mangrove valuation studies for Jamaica, and Melissa is compared with Hurricanes Gilbert, Gustav, and Beryl. The built environment analysis draws on the assessment's sector data, compiled into a dataset, the National Hurricane Center's report on the storm, the legislative history of the building code, and engineering studies of how roofs and solar installations fail in high winds.

The fiscal section calculates an annual average loss from 63 years of inflation-adjusted hurricane damage in the EM-DAT database and applies a government share of that loss derived from PIOJ assessments of Hurricanes Gustav, Beryl, and Melissa. It then compares the result with the instruments available under the National Natural Disaster Risk Framework before and after the storm. The evidence from all four domains is assessed according to whether the state set its protections and its delivery arrangements against a forward assessment of the hazard or against the storms already in its record. The analysis is limited to what has been published. No estimate yet exists of the learning lost across the pandemic, Beryl, and Melissa, and no data on the mental health workforce were available. The loss estimate also rests on the observed record rather than on a probabilistic catastrophe model.



In Jamaica's small public service, continuity plans, beneficiary registers, building standards, and a disaster fund all compete for the same officials' time.



2

The Natural Environment



More than **12%** of Jamaica's primary forest were lost between **1998** and **2013**. Total forest cover grew, but the new forest protects less.

Jamaica's forests, mangroves, and coral reefs are part of its defence against hurricanes. They absorb wind and wave energy, store floodwater, and hold soil in place, so their condition affects how much damage a storm does to people and property. This section argues that Jamaica's risk posture has undervalued these defences. The laws needed to protect them largely exist, but permit exemptions, ministerial overrides, and weak enforcement have allowed mangroves and primary forest to be lost, and the protection they provide has yet to be counted in national planning or in reconstruction after Melissa. Climate change, which originates outside Jamaica, will erode some of that protection whatever the state does, which makes it more important to keep what remains. The section concentrates on hurricanes and the flooding that accompanies them. It sets out what these ecosystems are worth in avoided damage, how far they have been degraded, why the legal framework has not prevented that, and what that means for reconstruction after Melissa.

What Natural Defences Are Worth

Hurricanes, depressions, and tropical waves account for between 46 and 67 percent of the floods that do serious damage in Jamaica, and hurricanes alone for 34 percent of severe flood events, with heavy



rain the next most common cause.¹² Tropical cyclone records for Jamaica from 1678 to 2010 put the cost of an average severe flood at US\$83 million (J\$13 billion).¹³

Mangroves reduce much of that damage. Coastal flooding from storms costs Jamaica an estimated US\$136 million a year, and without mangroves it would cost a further US\$33 million. The damage they avoid is greater in extreme events. In a one-in-100-year hurricane, mangroves protect 22,000 people and US\$386 million of built capi-

tal, and in a one-in-200-year hurricane they protect 177,000 people and US\$2.4 billion.¹⁴ The value protected is highest in Kingston (Hunt's Bay) and Old Harbour Bay, where commerce, industry, and population are concentrated. It is lower elsewhere, and some areas, such as Montego Bay, no longer benefit at all because their mangroves have already been removed.¹⁵

When development moves into high-risk coastal zones, exposure grows twice over. Buildings and infrastructure are placed

In a one-in-200-year hurricane, Jamaica's mangroves protect **177,000** people and **US\$2.4 billion** of property.

where storms do the most damage, and the mangroves cleared to make room for them can no longer protect what is built. Storm damage, illegal logging, and contamination by waste weaken mangroves in the same way, leaving the homes, businesses, and infrastructure behind them more exposed.

How Much Has Been Lost

Estimates put forest cover at up to 55 percent of Jamaica's land area, and the total has grown over the past two decades because trees have regrown on abandoned farmland faster than forest has been cleared elsewhere.¹⁶ Clearing has been heaviest in the northern parishes, mainly for infrastructure, housing, and bauxite mining, and mined-out land is not reforested.¹⁷ The rise in total cover hides a decline in quality. More than 12 percent of Jamaica's primary forest was lost between 1998 and 2013, and the young secondary forest that grows in its place has less structure and biomass, so it does less to break wind, hold soil, and regulate stormwater.¹⁸

Mangroves have fared worse. Data limitations make estimates of the change imprecise, but several sources show a decline, concentrated in St. Elizabeth, Trelawny, St. Catherine, and Clarendon, from about 150 square kilometres in the 1970s to about 100 square kilometres today.¹⁹ Much of what remains is threatened by human disturbance, including the dumping of waste.

Poor waste management makes the effects of a hurricane worse. Rubbish dumped on land is washed into drains, gullies, and waterways when it rains, where it blocks the flow of water off paved surfaces and along the channels and causes flooding.

Effluent and solid waste also change nutrient and salt levels in mangroves and stop water moving freely through them, which degrades them. The Forestry Department found these problems most often in St. Catherine, Kingston and St. Andrew, and St. James.²⁰ Apart from St. James, these were not among the parishes Melissa hit hardest, but they hold much of the island's population and coastal development, and the next storm may take a different track.

Climate change adds pressure that Jamaica cannot control. Global warming of more than 1°C above pre-industrial levels has already made extreme weather more frequent and intense, disrupted coastal, freshwater, and terrestrial ecosystems, raised the risk of wildfire, and killed coral through bleaching, and the pace of change is approaching the limits within which natural systems can adapt.²¹ Hotter, longer droughts matter particularly for Jamaica, because soil baked dry sheds heavy rain instead of absorbing it.²² Flood risk is projected to rise substantially above current levels as storms grow more powerful.²³ As the sea rises, sea-level extremes that now occur once a century could occur every year on most coastlines, and even small changes in water depth or salinity can threaten low-lying coastal ecosystems such as mangroves.²⁴

Law, Policy, Enforcement

Some of this loss happened within the law, through exemptions and overrides the law itself provides. Jamaica's laws and regulations already prescribe where and how construction, agriculture, and settlement may take place. The NRCA Act protects several ecologically sensitive areas from development, zoning laws and building codes restrict building on unsta-

ble land and in areas prone to landslides and flooding, and further rules govern the collection, processing, transport, and disposal of solid, liquid, and chemical waste. These protections are often circumvented through exemptions obtained by permit application.

The permit route explains part of the continued loss of mangroves, primary forest, and other sensitive ecosystems. Projects in sensitive areas can go ahead with the approval of the Natural Resources Conservation Authority even when they disturb mangroves, seagrass, or other habitats, usually on condition that remedial measures are taken.²⁵ The law also gives the minister power to overturn the regulator's decisions, and that power has been used. In *Bengal Development Ltd v Lee (Wendy) et al*, a recent case, the Court of Appeal limited the executive's ability to overrule decisions against potentially damaging developments, particularly where those developments would infringe the citizen's right to a safe and healthy environment. The government has said it will appeal.²⁶ People also continue to occupy land known to flood, with explicit or tacit government approval.²⁷

Hazard policy recognises the link between the environment and disaster risk. The draft National Hazard Risk Reduction Policy (2005) treats environmental management as a tool for reducing hazard risk and calls for an inclusive, equitable framework operating at every level.²⁸ It identifies inappropriate land use as a source of vulnerability and proposes relocation as a strategy for reconstruction after a disaster.²⁹ Community-based disaster management has been part of disaster planning for around two decades.³⁰

Some recent decisions suggest that policy-



Jamaica has most of the laws it needs to protect its natural defences. The weakness lies in how those laws are applied.

makers either do not fully understand the effects of climate change or are not giving them enough weight. The government has championed the redevelopment of downtown Kingston and the construction of major highways close to the coast.³¹ Projects like these are sometimes unavoidable for economic or technical reasons, but they add to the investment sunk in places that are already under threat.

Officials have begun to give the environment more weight in planning since Melissa. Several have said that relocation will be central to some reconstruction plans, because the facilities destroyed stood in floodplains or other sensitive areas.³² Relocation applies only to facilities already destroyed, and new construction in sensitive coastal zones and flood-prone areas continues.

Estimates of the economic value of natural ecosystems now exist, which adds an economic argument to the normative case



The government owns **47%** of Jamaica's mangrove and swamp forests. Protecting them needs a ministerial declaration, not a new law.



for protecting them, but that value has yet to be built into national planning.³³ Changes to the building code that would encourage denser housing and commercial development, by making more use of brownfield sites and less of underused space such as parking lots, have not been implemented.³⁴ Housing and urban development instead expand mainly by absorbing green space within and around cities, which reduces natural area and spreads the urban footprint.

Some improvements need no change in the law. Twenty percent of Jamaica's land area is protected, which is above

the world average but below comparable small island territories such as Trinidad and Tobago (31 percent) and Hong Kong (41 percent).³⁵ Protected status under the NRCA Act of 1991 limits large-scale construction, deforestation, and the release of harmful waste, and under section 33 the minister can declare an area protected and require the Authority to prepare and carry out a plan for it. The government owns about 47 percent of Jamaica's forested wetlands (swamps and mangrove forests), private owners hold 41 percent, and ownership of the remaining 12 percent is unclear.³⁶ Only 5,828 hectares of forested wetlands are protected under

Jamaican law, and the National Mangrove and Swamp Forests Management Plan aims to protect 7,600 hectares of mangrove forest.³⁷ Most forested wetland is therefore already in state hands and within the minister's power to protect.

Jamaica therefore already has the legal means to keep development out of its most dangerous and sensitive zones. The permit exemptions, the ministerial override in the Bengal case, and the continued occupation of flood-prone land point to gaps in how those zones are identified and classified, in the commitment to manage them, or both.



Ecosystem Restoration in Reconstruction Planning

Melissa's damage to the environment is estimated at J\$209 billion, of which J\$185 billion was lost ecosystem services and J\$23.8 billion destroyed natural assets. That is about one sixth of planned expenditure for the 2025/26 fiscal year and 11 percent of the total cost of the hurricane.³⁸ Forests, mangroves, and reefs that recover well will cut wind and wave energy and absorb rainfall better in the next storm, and they work alongside structural measures such as levees, break-

waters, and seawalls, and non-structural ones such as early warning systems. Ecosystem-based Adaptation (EbA) and Nature-based Solutions (NbS) have been shown to reduce climate risks, including flooding and urban heat.³⁹

How much protection mangroves and reefs give against storm surge and wind depends on the topography of the land, the bathymetry (the depth and shape of the seabed), the health, density, and type of mangrove, and the character of incoming waves.⁴⁰ Ecosystem-based measures also have limits. Their effectiveness

declines once warming exceeds 2°C and falls sharply beyond 3°C, and natural adaptation is already meeting hard limits at present levels of warming. Under the most optimistic projection of half a metre of sea-level rise by 2100, they delay impacts by only about 15 years, after which sea defences or relocation will be needed.⁴¹ They are a sound adaptation measure but cannot be relied upon indefinitely.

Restoration is also harder where the cause of the original damage persists. Natural processes, including the effects of climate change, accounted for 20 percent of

the mangroves lost in North and Central America after 2000, more than clearance for aquaculture (19 percent) or wood extraction (16 percent).⁴² Replanting is unlikely to succeed where natural processes caused the loss, since those processes will still be at work. Even so, mangroves are among the most restorable coastal ecosystems.⁴³ Coral reefs in Jamaica and elsewhere have been partly restored despite bleaching and a shortage of mature animals.⁴⁴ The main threats to coral are overfishing, climate change, coastal development (which changes the composition of nearby seawater), disease, and hurricanes, and public policy can reduce several of them.⁴⁵

Restoring mangroves costs less than building engineered defences. Mangrove restoration costs between US\$1.4 million and US\$4.5 million per square kilometre depending on location and conditions, and around US\$3.2 million in Jamaica. Coral reef restoration is far more expensive, at about US\$64 million per square kilometre.⁴⁶ Shore protection structures

in the region typically cost between US\$6 million and US\$20 million per linear kilometre, and several kilometres would be needed to match the protection a restored mangrove gives.

Natural regrowth is cheaper still. Mangroves tend to regenerate on their own once the barriers to regeneration are removed, while replanting programmes often fail, because the species chosen are unsuited to the site or because organisers have not won enough support from the community.⁴⁷ Worldwide, natural gains in mangrove area exceeded natural losses by 58 percent between 2000 and 2020, even counting losses to natural disasters.⁴⁸ Recovery will take years or decades whichever route is chosen, but in cost the order runs from natural regrowth, to restoration, to engineered replacement.

Conclusion

Jamaica has most of the laws it needs to protect its natural defences; the weakness lies in how those laws are applied. Permit

exemptions and ministerial overrides have allowed mangroves and primary forest to be cleared, construction has continued on sensitive and flood-prone land, and the protective value of these ecosystems is not counted in planning decisions. Climate change will erode some of that protection whatever Jamaica does, which makes what remains more valuable. Protecting it, removing the barriers to natural regeneration, and declaring state-owned wetlands protected can all be done under existing law, and are likely to cost less than the engineered defences that would otherwise be needed. In the terms this report uses, the natural environment falls short on the first failure of anticipation, since the protection these ecosystems give has been left out of decisions about where and how to build, and the recommendations that follow set out how it can be brought in.





3 The Built Environment



Almost every building Melissa hit predated an enforceable national building code. For more than a century, the only code Jamaica could enforce dated from **1908**

The damage Hurricane Melissa did to Jamaica was concentrated in what the country had built.

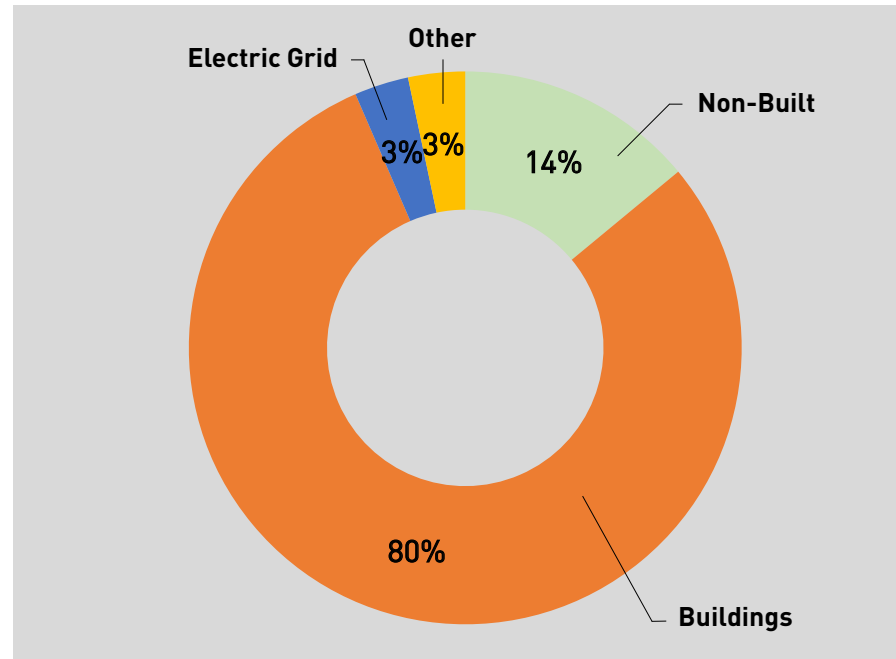
The built environment accounted for 86 percent of the damage and buildings alone for 79 percent (Figure 1). The remaining 14 percent fell on crops and livestock, fishing gear, and business inventories and equipment, according to the PIOJ assessment.⁴⁹ Winds reaching 184 miles per hour crossed the island from the south-west, over buildings and networks erected more than a century ago.⁵⁰ Much of what Melissa damaged had never been required to meet any standard, and where a standard did apply it had been set against a hazard record the storm exceeded. Nor was there any register of buildings and networks that would show which of them met a standard.

This section argues that the test of Jamaica's rebuilding is whether what replaces the damage is built to a standard set against the hazard the country now faces, more than how quickly the repairs are done, and that Jamaica needs a record showing which buildings meet that standard. It looks first at the standards Jamaica built to, then at buildings, the electricity grid, and the remaining infrastructure, and finally at the records the rebuilding will need.

Buildings account for the majority of the damage caused by Melissa.



Cost of Damage to the Built Environment from Hurricane Melissa



Source: Planning Institute of Jamaica (PIOJ)

The Design Basis

Jamaica's geography puts most of its people in the path of a hurricane's worst effects. The island lies on the route storms take

west from the Atlantic, about 82 percent of Jamaicans live within five kilometres of the coast, and the mountains pull extra rain onto steep slopes that give way as landslides.⁵¹ As the climate warms, a larger

Jamaica's electricity grid was built to a Category 3 standard, JPS told Parliament in January 2025. Melissa, a Category 5 storm, arrived nine months later.

share of hurricanes is projected to reach Category 4 or 5.⁵²

Jamaica's storm record before Melissa contained no direct landfall of a Category 4 or 5 hurricane. Gilbert, in 1988, was the island's most destructive storm until Melissa, costing US\$700 million in 1988 dollars and 45 lives.⁵³ Ivan in 2004 and Dean in 2007 reached Category 4, but both passed to the south without making landfall.⁵⁴ The wind speeds in the building code, the size of drains and culverts, and the grid's design standard were all set against that record, so a building could meet every requirement that applied to it and still fail in a storm like Melissa.

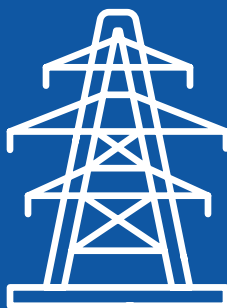
For more than a century, the only building code Jamaica could legally enforce dated back to 1908. A revised code issued in 1983 and the Caribbean Uniform Building Code were never given legislative backing, and a national review based on the Caribbean code was abandoned in 2000, about 70 percent complete, for want of funding.⁵⁵

In 2003 the Jamaica Institution of Engineers took over development of a national code. It adopted the International Building Code as its base and wrote an Application Document to adapt it to Jamaican conditions, and the project commissioned Jamaica's first national hazard maps for seismic activity, wind speed, rainfall, flood plains, and land slippage. That code still had no legal force. The Building Act, passed in 2018 and in force from January 2019, repealed the Kingston and St. Andrew Building Act and created the basis for enforcement, and the Small Building and Residential Code, which covers the ordinary houses that make up most of Jamaica's buildings, followed in 2023, two years before Melissa. Almost every building standing when Melissa arrived was therefore built before an enforceable national code existed.⁵⁶

The electricity grid was designed for a weaker storm too. In January 2025 the chief executive officer of the Jamaica Public Service Company (JPS) told Parliament that the grid was built to a Category 3 standard and that the company had begun designing for Category 5.⁵⁷ The Of-

fice of Utilities Regulation, the statutory body responsible for the standards JPS operates to, did not require the change.⁵⁸ Melissa arrived nine months later.

Melissa exposed two separate problems in Jamaica's built environment, both which call for different remedies. The first, building without an enforceable code, concerns existing houses and can be dealt with in a few years. The second, standards set for weaker storms, including the Category 3 standard for the grid, cannot be fixed by stricter enforcement, and any revision will take effect only over decades, as buildings and poles are replaced.



With the west-east transmission lines down, the western parishes, where damage was worst, were cut off from two-thirds of Jamaica's generating capacity.



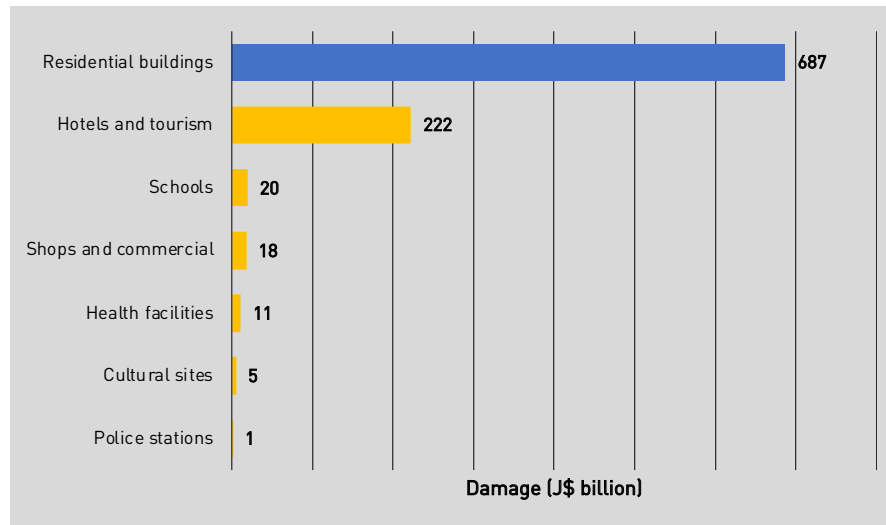
Buildings

Building damage is concentrated in two kinds of building: housing, at J\$687 billion, and hotels, at J\$223 billion, which

between them account for 94 percent of it (Figure 2). Schools, shops, health facilities, cultural sites, and police stations make up the remaining J\$54 billion.⁵⁹

Housing and hotels account for the majority (94 percent) of building damage.

2 Building Damage



Source: Planning Institute of Jamaica (PIOJ)

Most of Melissa's damage to buildings began with the screws that hold roof sheets down, one of the least costly failures to prevent.

Most of the damage to Jamaica's buildings started at the roof. A sheet of zinc lifted in the wind, the rest of the roof followed, and rain ruined what was inside. Because the failure began with the screws that hold the roof sheets down, it is also one of the least costly failures to prevent. The houses most exposed to it are concentrated in the western parishes, and so was the damage.

Residential Buildings

Housing alone accounted for more than half of all the damage Melissa did. Of the 85,127 homes assessed, 76,981 were damaged, 31,557 of them badly and 14,130 destroyed outright, affecting more than a quarter of a million people.⁶⁰

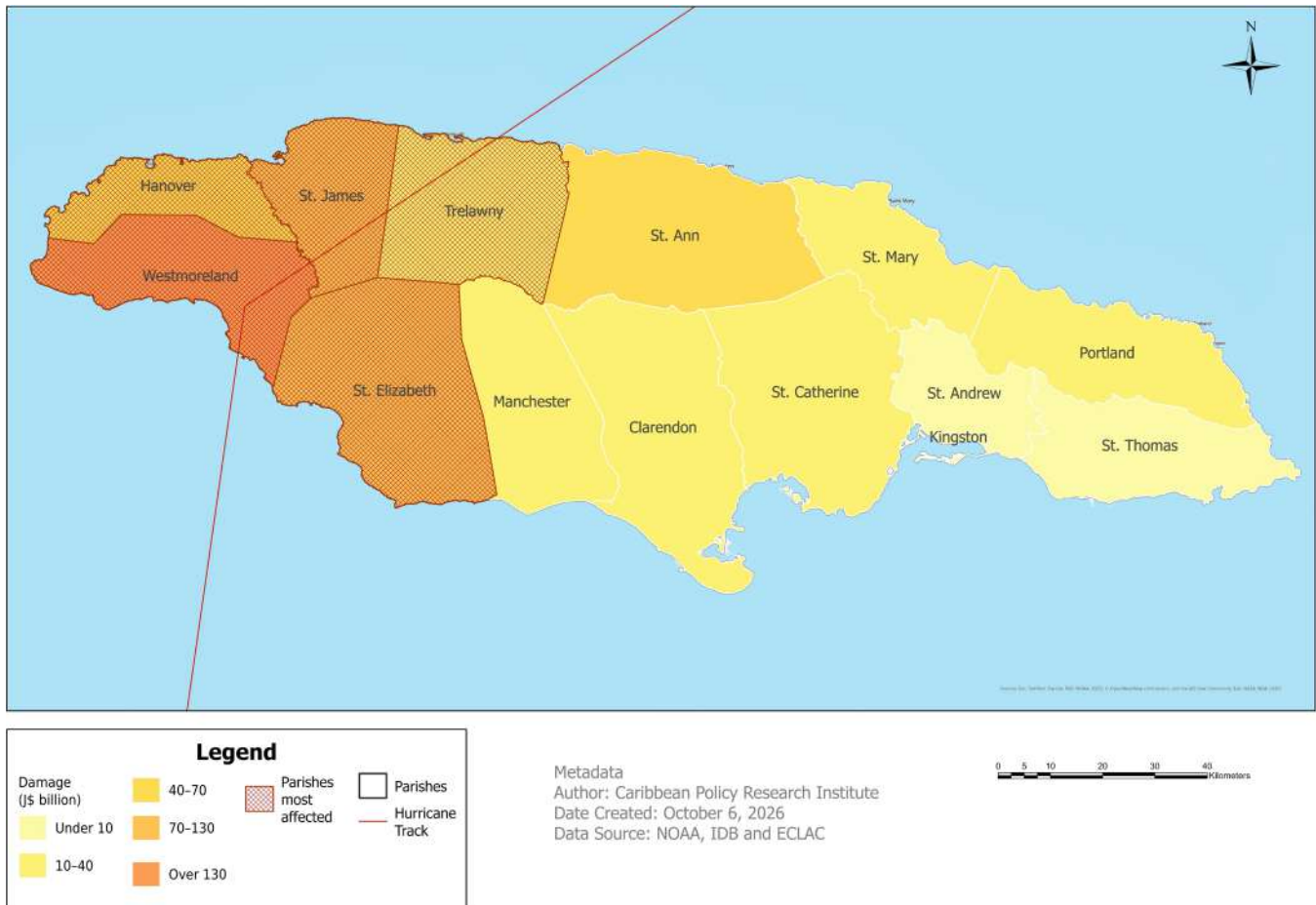
The clearest evidence that construction materials largely decided whether a damaged home was destroyed comes from Westmoreland and St. Elizabeth, the two parishes that took the worst of the storm,

which together account for 43 percent of the value of housing damage and more than half of the homes badly damaged or destroyed (Figure 3). The two parishes are built differently. In Westmoreland, 57 percent of homes have timber walls and metal roofs; in St. Elizabeth, 82 percent have concrete block walls and metal roofs.⁶¹ Of the homes assessed after the storm, one in three in Westmoreland was destroyed outright, against about one in seven in St. Elizabeth.⁶² This matches the assessment's estimates of how each type of house performs in high winds, which find that in Category 4 and 5 winds timber houses with metal roofs are destroyed, block houses with metal roofs suffer moderate to severe damage, and houses with concrete roofs suffer little.⁶³

Housing damage was heaviest in the western parishes, led by Westmoreland and St. Elizabeth, and St. James.



Residential Building Damage



Across timber and block houses alike, the weak point was the roof. More than nine in ten homes in the affected parishes had sheet-metal roofs; only 7.5 percent had concrete roofs.⁶⁴ Where houses had block or brick walls, the assessment found that the walls suffered minor damage and the damage was mainly to the roofs.⁶⁵

A sheet-metal roof is held down only by the screws that fix each sheet to the roof frame. Wind pulls upward hardest at the edges and corners of a roof, and that pull falls on the screws.⁶⁶ Once one sheet goes, wind enters the house and pushes the rest of the roof up from below, and the remaining sheets peel away one after another.⁶⁷



Investigators found the same sequence on the ground. In the parishes crossed by the eyewall, the ring of strongest winds around the storm's centre, the National Hurricane Center reports that wind destroyed virtually all wooden structures

and stripped the roofs from most buildings, and that in coastal towns such as New Hope, Crawford, and Black River nearly all homes lost their roofs and could not be lived in.⁶⁸ The assessment ranks poor roof fastening, along with rusted

zinc, first among the five main features of Melissa's damage.⁶⁹

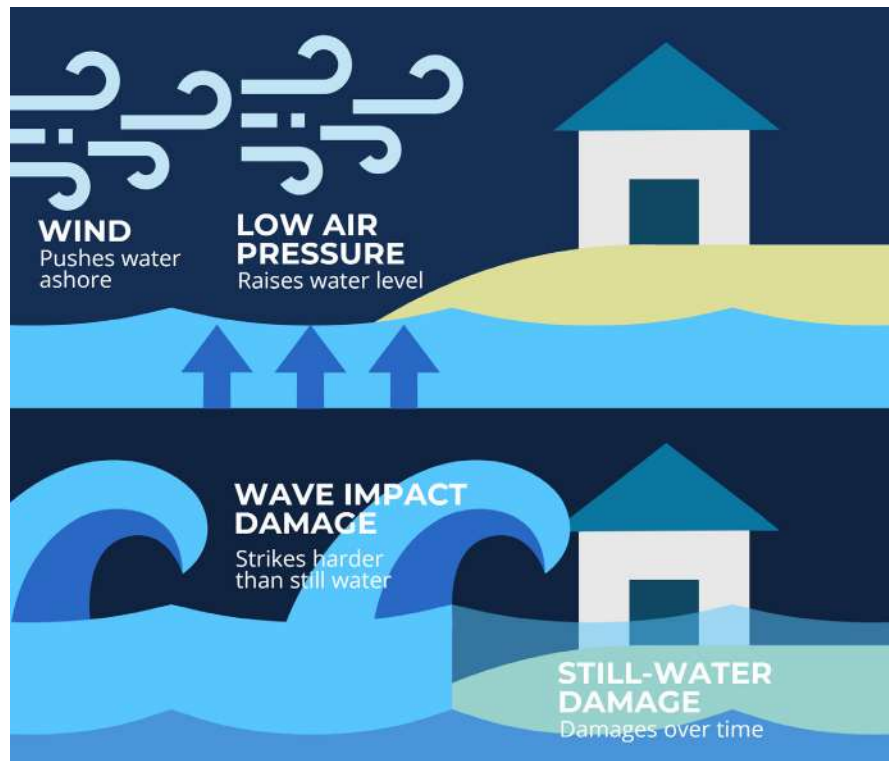
Once the roof was gone, the rain ruined what was inside. Between 25 and 29 October, 41 of Jamaica's 57 weather stations recorded more rain than they normally receive in the whole of October.⁷⁰ That rain fell into houses that had lost their roofs, soaking ceilings, wiring, furniture, and appliances in homes whose walls were still standing. The assessment counts J\$90.1 billion of the housing damage as damage to household goods, the contents the roofs had been protecting.⁷¹ A house that loses its roof but stays dry can usually be repaired, whereas one left open to days of rain often cannot be lived in afterwards.

In river valleys and on the coast, water also came in at ground level, and no roof could have kept it out. Inland, rivers burst their banks in the Black River valley in St. Elizabeth and the Cabarita River basin in Westmoreland, and stormwater overtopped drains and culverts built for far smaller flows.⁷² On the coast, storm surge pushed the sea ashore at towns such as Black River and Savanna-la-Mar.⁷³ Moving seawater, with waves breaking on top of it, can push in walls and lift light houses off their footings.⁷⁴

Non-Residential Buildings

Non-residential buildings carried J\$277 billion of damage and failed through the same sequence as houses, beginning at the roof. Hotels and other tourism properties account for J\$223 billion of that total, with the remainder spread across schools, shops, health facilities, cultural sites, and police stations.⁷⁵ Across these buildings, the assessment identifies roof damage, and the water that entered once roofs failed, as the main source of loss rather than structural collapse. Roofing was the most widespread repair need in the education sector, affecting at least 534 public schools, and in hotels and shops the heaviest damage fell on the furniture, equipment, stock, and building services that the roofs had been protecting.⁷⁶

The main policy question for non-residential buildings is the order in which



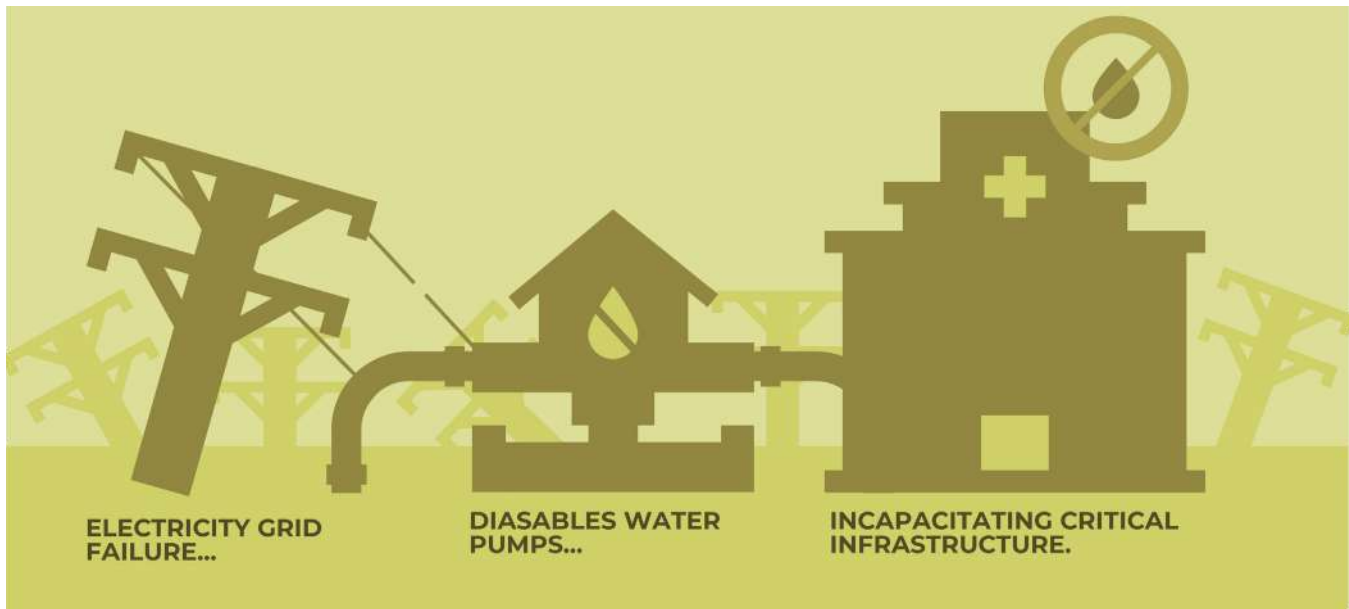
they are repaired. Losses from homes standing unusable came to about 1 percent of housing damage, but tourism losses reached J\$265 billion, 84 percent of the sector's damage, and are expected to persist into 2027 on the south coast.⁷⁷ Education losses reached J\$10 billion, half the sector's damage.⁷⁸ Ordering repairs by the cost that accrues while a building stays shut, instead of by the size of the repair bill, would do more for the economy for the same spend.

The Electric Grid

Melissa did little damage to Jamaica's power stations, and most of the grid's damage fell on the poles, lines, and towers. The standard the network is rebuilt to will decide whether the next storm does the same damage. The grid's repair bill understates what its failure cost Jamaica, because much of the cost arose from how long the power stayed off. The assessment puts the sector's damage at J\$38.6 billion and its losses at J\$9.7 billion, but the losses count only the electricity JPS could not sell. The outage added up to some 14.7 million customer-days, the equivalent of almost four weeks for each of the more

than 532,000 customers cut off at the peak.⁷⁹ In Savanna-la-Mar, where structural damage was limited, many shops and restaurants stayed closed for weeks because the power did not return.⁸⁰ (The Public Services and Welfare section examines these knock-on costs.)





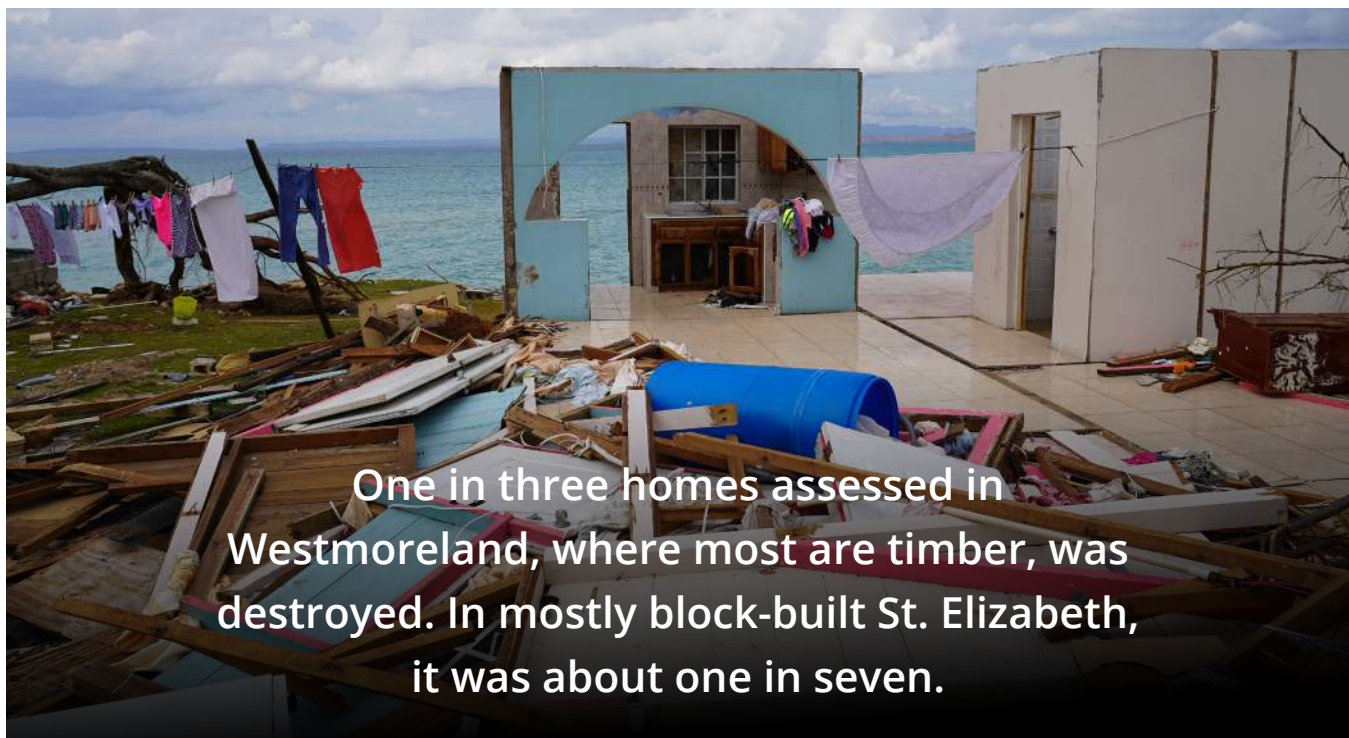
Generation

Generation came through Melissa largely intact, except at the country's largest solar plant. The 52-megawatt Eight Rivers Solar Park at Paradise Park in Westmoreland, 5 percent of the island's installed capacity, was shut down completely.⁸¹ The assessment puts the damage at J\$3.7 billion, but that figure is an estimate rather

than the result of an inspection. It was calculated by assuming what share of each part of the plant was destroyed and applying that share to what the part cost to build.⁸² Neither the assessment nor the plant's owner, InterEnergy, has reported what actually broke, whether panels were torn from their mountings, the mountings themselves gave way, or something else failed. InterEnergy has said it will re-

build the park to withstand more severe storms. The company may well know why the plant failed, but until it says so publicly there is no way to check that the rebuild fixes the weakness that brought it down.⁸³

Jamaica is about to add more than 300 megawatts of new renewable generation, much of it solar, towards a target of half its electricity from renewables by 2030,



One in three homes assessed in Westmoreland, where most are timber, was destroyed. In mostly block-built St. Elizabeth, it was about one in seven.

close to a third of a system that now totals about 1,000 megawatts.⁸⁴ Many large solar farms mount their panels on rows that tilt to follow the sun, and strong wind can set a whole row twisting until it breaks.⁸⁵ The contracts for that capacity are being awarded now, and they will set the wind standard those plants are built to.

Transmission

The break in the lines linking west to east split the island into two power systems. When the PIOJ assessment was compiled, the network was still operating as two isolated systems, and JPS had made restoring transmission its first priority, ahead of distribution and customer connections.⁸⁶ About two-thirds of Jamaica's generating capacity is in four parishes in the southeast: Kingston, St. Andrew, St. Catherine, and Clarendon. With the west-east lines down, the western parishes, where the damage was worst, could not draw on those power stations until the lines were repaired.⁸⁷ Transmission lines are only a small part of the grid, but a break in them can cut off half the island, where a broken distribution line leaves one street in the dark.⁸⁸

Melissa's winds brought down steel transmission towers along with wooden and concrete poles.⁸⁹ Testimony to Parliament's Public Administration and Appropriations Committee indicated that the damaged towers were around 50 years old, against a nominal 70-year design life.⁹⁰ Standing towers of the same age will need replacing within two decades.

Distribution

Transmission and distribution account for J\$34.9 billion of the sector's J\$38.6 billion in damage, most of it to poles and lines, and the damage was heaviest where the storm came ashore. Across the island, the assessment estimates that 11 percent of poles and 7 percent of transformers need replacing, some 35,600 poles and 2,900 transformers. In St. Elizabeth and Westmoreland, those shares rise to 65 percent of poles and 50 percent of transformers.⁹¹ In those two parishes, the local network in effect had to be rebuilt rather than repaired.

Most poles failed at the base, where they were set into the ground, and the assessment found that many of the poles that fell were themselves structurally sound. Concrete and composite poles performed better than wooden poles, and the assessment recommends minimum foundation depths.⁹² The length of the outage also depended on how the network is laid out. Nearly 93 percent of JPS's distribution feeders were affected, and the network had few alternative routes around damaged lines and little capacity to isolate them.⁹³ The repairs exceeded what JPS's own crews could absorb, even with more than 400 international line workers.⁹⁴ A revised pole standard would limit how much of the network fails in the next storm, but only investment in alternative routes and repair capacity will shorten the outage. One year on, poles and lines are still being replaced. Unless a revised wind standard is published before that work is finished, they will be rebuilt to the Category 3 standard that failed during Melissa.

Roads, Water, and Debris

Most of the damage to Jamaica's roads and water systems was caused by rain and flooding. How badly each road, pipe, or treatment plant was damaged depended mainly on where it was built and how well it had been maintained, so reducing future damage is a matter for planning and maintenance more than for design standards. Melissa damaged roads in every parish, and most were already in poor condition: before the storm only 15 percent of main roads and 5 percent of municipal roads were rated "good."⁹⁵ Because the rain fell across the whole island, road damage was spread more evenly than housing damage. Clarendon had more road damage than any other parish but only 3 percent of housing damage, so a recovery programme focused on the parishes with the worst housing damage would miss about two-thirds of the damage to roads.⁹⁶ Some roads that still look usable have lost the base beneath a thin surface and will break up years early. Repairing the storm damage alone would return most of the network to poor condition.⁹⁷



Road damage was spread across the island and was heaviest in Clarendon.



Road damage



Most of the damage to the water system happened at plants and pipes built beside or across rivers. Water and sanitation facilities suffered J\$2.2 billion in damage, 77 percent of it in St. James and Trelawny.⁹⁸ A quarter of that total was at a single site, the Dornoch Water Treatment Plant in Trelawny, which sits on the bank of the Rio Bueno. Floodwater washed away the riverbank beneath the plant, putting its foundations at risk, and destroyed the only bridge leading to it. The assessment's cost estimate assumes the plant will be moved to a safer site rather than rebuilt in the same place.⁹⁹ Pipelines failed in the same way: almost 80 percent of the cost of

pipeline damage came from three places where water mains cross rivers or gullies. At pumping stations, the main damage was to motors, electrical equipment, and backup generators that were flooded.¹⁰⁰ Repairing these assets where they stand would leave them exposed to the next flood.

Clearing debris, one of the largest costs of the recovery, can be planned in full ahead of a storm. The United Nations Development Programme estimated that Melissa left more than 4.8 million tons of debris, about four times the waste Jamaica produces in a normal year. The

debris blocked roads and drains and delayed the restoration of water, electricity, and other services.¹⁰¹ Almost all of the J\$8 billion the transport sector spent on emergency work went on clearing roads, and the J\$73.0 billion in public spending recorded under housing covers debris removal, running shelters, and assessing damage, and does not include the repair of homes.¹⁰²



Rebuilding Without a Record

Jamaica does not keep an up-to-date record of what its houses are built from, where its networks run, or what condition they are in. The PIOJ assessment of Melissa had to fill those gaps with satellite images, old census data, and estimates. Without better records, the rebuilding programme cannot be aimed at the buildings and networks most at risk, or checked once the work is done.

The figure this section relies on most, the share of homes with sheet-metal roofs, comes from a census taken in 2001. Neither the 2011 nor the 2022 census asked what homes are roofed with.¹⁰³ The figure is therefore a quarter of a century old, and it does not show which houses have been built or re-roofed since. Where records did exist, the organisations holding them did not hand them over. JPS was asked in November 2025 for a detailed account of damage to its network and had not supplied one when the assessment was published, so no exact count of damaged poles had been released. Digicel and Flow were asked again for damage data in December 2025, and they also did not respond. Damage reports from the Port Authority, the Maritime Authority, and the Airports Authority were still outstanding.¹⁰⁴ Without that information, the assessment could not say in detail which parts of the country's power and telecommunications networks failed, or why.

The assessors themselves concluded that Jamaica needs an up-to-date record of its buildings and networks. Their first recommendation for reconstruction is an investigation of why buildings and networks failed, covering roof fastening, the electricity network, and the exposure of schools, health facilities, roads, and drainage. They also call for a national register of disaster-exposed infrastructure, databases that map where assets are, and a national risk information system that shows how well buildings, and their roofs in particular, would stand up to a storm.¹⁰⁵ The assessment used satellite damage maps to count damaged houses after the storm.

Conclusion

Stricter enforcement of Jamaica's building rules would have prevented only part of Melissa's damage, given that the standards themselves were set against a storm record with no Category 4 or 5 landfall. Across the built environment, the damage started at a small number of weak points: roof fixings that gave way, poles poorly anchored in the ground, and roads and water systems built on coasts, slopes, and riverbanks. Fixing them costs far less than the repairs Melissa made necessary.

Unless revised wind standards are in place before poles and roofs are replaced, Jamaica will rebuild to the same standards Melissa has just defeated, including the Category 3 standard that JPS told Parliament was inadequate nine months before landfall. And without a record of what the country has built, no one will be able to say which buildings and networks meet the new standard once the work is done. In the terms this report uses, the built environment fell short on the first failure of anticipation, and the recommendations that follow are aimed at keeping the rebuilding from repeating it.



Clarendon had more road damage from Melissa than any other parish, but only **3%** of housing damage. Road repairs need their own plan.





4 Public Services and Welfare



Electricity took seven months to be fully restored across Jamaica, and the outage held back the water, health, and education services that depend on it.

Beyond physical damage, Melissa disrupted health care, education, water, electricity, and social protection. More than half the national population felt the disruption in some form, and housing damage displaced people at a scale that overwhelmed the systems meant to provide relief. Some 77,000 homes were damaged or destroyed, affecting more than a quarter of a million people, while shelter occupancy peaked at 7,208 individuals across 513 active shelters in the days after impact.¹⁰⁶ Melissa showed that Jamaica had no plan or operating model for a prolonged loss of infrastructure across several sectors at once.

Continuity of care for chronic disease patients, of schooling, and of welfare support was interrupted by the near-simultaneous collapse of several interdependent systems, as failures in the electricity network cascaded into water supply, health services, telecommunications, and education across the island. This section argues that Jamaica's recovery from Melissa should be judged by how long services took to return, whose needs were deprioritised in the meantime, and whether the systems that failed are being redesigned for long-term resilience. It covers health care, education, and the utilities those services depend on, then the delivery of relief and the administrative arrangements behind it.



Healthcare

Healthcare cannot be deferred. A school can reopen late and a water main can be repaired in sequence, but a missed dialysis appointment or an obstructed birth has no later substitute, so a gap in continuity costs most in the health system.

Melissa damaged 143 public health facilities; the five hospitals left wholly or largely out of service were concentrated in the western and southern parishes. Across the sector the damage covered 18 hospitals, 120 health centres, and five parish health department offices. The five hospitals that lost most of their function (Cornwall Regional in St. James, Sav-la-Mar Regional in Westmoreland, Falmouth Hospital in Trelawny, Noel Holmes Hospital in Hanover, and Black River Hospital in St. Elizabeth)

had not been built or retrofitted to withstand wind and storm surge of the kind previous hurricanes had already demonstrated.¹⁰⁷

The closure of the five most affected hospitals, Black River among them, was projected to have left at least 31,000 patients without clinical specialty and radiology services months after the hurricane, and St. Elizabeth alone accounted for 30 percent of total health sector damage.¹⁰⁸ With its own hospitals out of service, Jamaica depended on surge capacity. Foreign field hospitals were deployed at Black River and Falmouth with the support of the Government of Spain. That response was effective, but it was improvised in answer to a scale of damage the health authorities had not planned for, and it substituted for the pre-positioned domestic surge capacity

The closure of five hospitals was projected to leave at least **31,000** patients without specialist and radiology services months after Melissa.

that best practice treats as the means of maintaining both emergency and primary care during a disaster.¹⁰⁹

While that surge capacity was being assembled, routine care stopped. All health centres were closed until further notice and hospitals operated in emergency mode, providing only critical and life-saving care, which narrowed access to routine services.¹¹⁰ The sector's total effects were estimated at J\$18.7 billion: J\$13.1 billion in damage to buildings and equipment, J\$3.1 billion in the value of services the sector was unable to deliver while facilities were closed, and J\$2.5 billion in additional costs incurred to mount the response, of which 87 percent went to environmental health alone.¹¹¹

The longest-running loss was in chronic disease care, which depends on continuity rather than on surge capacity. Non-communicable disease (NCD) management, already a burden on Jamaica's primary care system, became harder to sustain after Melissa.¹¹² With all health centres closed in the immediate aftermath, the Pan American Health Organization (PAHO) recorded NCD treatment for hypertension and diabetes being interrupted by power outages and supply-chain disruption.¹¹³ In the hardest-hit western parishes, where 60 primary health care centres still had major structural damage three months on, people managing chronic conditions went without reliable checkups or prescriptions for extended periods.¹¹⁴

A mental health response appeared to have been organised more quickly. According to government and PAHO accounts, a National Mental Health and Psychosocial Support (MHPSS) Working Group convened within days of landfall and coordinated 14 organisations, rapid needs assessments were completed across all four Regional Health Authorities within three weeks, and some 3,000 health workers were sensitised in basic psychosocial support.¹¹⁵ However, none of the published sources reports whether people in need actually received care, whether referrals were completed, or whether anyone was followed up. The reach that was reported is small against the need: 20 vol-

unteers saw about 950 people in shelters in the first fortnight, after a storm that disrupted services for more than half the population, and there is no assessment of what those volunteers did.

The response also rested on a specialist base that Melissa reduced. Four of six mental health service sites in St. Elizabeth and two of six in Trelawny stopped functioning, in the parishes where demand rose most, and the gap was filled with volunteers, task-shifting to non-specialist staff, technical assistance from PAHO, and unpaid work by professional associations.¹¹⁶ Psychosocial needs after a disaster emerge over months and years, long after emergency structures stand down, and mental disorders, self-harm, and violence already accounted for about 10 percent of healthy life lost in Jamaica before the storm.¹¹⁷ A response measured in sessions delivered and workers sensitised cannot show whether that need was met. Field hospitals and volunteers trained in psychological first aid filled part of the gap, but they were mobilised by others after the event and could not replace the routine care in which the longest losses fell.

Roughly 90%
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families.

Education

Education has recovered the slowest of the public services, partly because Jamaica's schools are also its shelters, and a school cannot reopen while it is still housing families whose homes the storm damaged or destroyed.

School closures cost the sector J\$30 billion. At least two-thirds of the island's educational institutions were affected in some way, and learning disruption touched roughly 407,000 students in primary, secondary, and tertiary education, along with an additional 24,000 children in early-childhood institutions.¹¹⁸ Within that national picture, 721 of Jamaica's 1,010 public schools were damaged and 290 were deemed "severely impacted".¹¹⁹ Two-thirds of the J\$30 billion is damage to buildings, due to roof failure; the remainder is the value of the teaching that could not be delivered while classes were suspended, counted as a loss of service rather than of assets. More than 90 percent of Jamaica's school enrolment sits in public institutions, so both that cost and the recovery that follows it fall on the state rather than on independent schools.

Roughly 90 percent of the ODPEM-designated shelters were schools, and close to 78 percent of those shelters were themselves damaged, which suggests that shelter policy did not require buildings to be assessed and built to withstand a stated category of hazard.¹²⁰ Weeks after the storm, 59 schools were still in use as shelters, so the pace of housing recovery decided when classes could resume. The government set a reopening target of 6 January 2026, but education stakeholders said they had not been adequately consulted before the deadline was set, which suggests the date was not based on verified assessments of whether schools were ready.¹²¹

Nearly a year after Melissa, part of the system was still running on temporary arrangements. When the 2026/27 academic year opened in September 2026, the Ministry of Education reported 92 percent of schools at full capacity.¹²² The remaining 8 percent, some 80 public schools, were still using temporary learning spaces and

rotation schedules: classes under tents and, in at least one documented case, a bamboo structure, with principals in the western parishes reporting incomplete repairs and undelivered furniture in the first week of the term.¹²³ In those schools, rotation between limited in-person classes and learning from home, introduced as a stopgap, had become the normal way of operating, which risks adding to learning loss.¹²⁴

Melissa also struck a system that had not finished recovering from the previous storm. Hurricane Beryl damaged 364 schools in July 2024; by January 2025 repairs had been completed at 87 of those, with work still under way at the remainder, and Melissa made landfall nine months after that.¹²⁵ In September 2026 the Jamaica Teachers' Association placed the sequence of pandemic closures, Hurricane Beryl, and Hurricane Melissa at the centre of its call for a national foundational learning emergency plan, arguing that "the recovery effort to date had gone into recovering buildings rather than recovering learning."¹²⁶

Dependence on the Grid

The Built Environment section examines why the grid failed. Most if not all public services relied on electricity and could not operate without it. More than three-quarters of JPS customers lost power at the peak, and supply reached 99.81 percent of customers only some seven months after the hurricane, well into the planning for the next hurricane season.¹²⁷ Four days after landfall, 395 of the National Water Commission's (NWC) 570 production and pumping facilities were not operating, two-thirds of them because they had lost electricity rather than because they had been damaged, and some 190,095 NWC customers lost water service.¹²⁸ Hospitals and schools that needed water were held back in turn.

Telecommunications also failed, which hampered relief coordination. National connectivity fell to 30 percent immediately after the storm, and Digicel reported only 60 percent of its mobile network restored two weeks after landfall.¹²⁹ Twenty



percent of broadcasting licensees were left non-operational, cutting off a channel the public relies on for emergency information. The sector's economic effects were estimated at J\$20 billion, split almost evenly between infrastructure damage and the losses that followed from weeks of degraded service.¹³⁰

A water plant or hospital can be stopped by a grid outage, so contingency plans drawn up by each utility on its own miss the main risk.

Relief Delivery and Welfare Support

Relief was distributed quickly and on a large scale, mostly through the military and international humanitarian agencies, which brought logistics capacity and staff. The Jamaica Defence Force (JDF) alone conducted more than 200 flight operations, reached over 300 communities, and distributed 130,715 food packages in coordination with the Ministry of Labour and Social Security, while ODPEM distributed a further 98,367 packages and World Central Kitchen served more than 2.5 million meals. During the response the government also moved ODPEM to the Office of the Prime Minister to speed up coordination and decision-making.

Some communities were missed entirely. In total, 29 communities, among them the Accompong Maroon village, where more than 80 percent of homes were destroyed, remained cut off from formal shelters and outside assistance for weeks, reachable only through improvised JDF outposts, because no relief logistics protocols had been planned in advance.¹³¹ The instruments that decided who received what were built during the response itself. The Jamaica Household Damage, Impact, and Needs Assessment (JHDINA), managed by the Ministry of Labour and Social Security, had completed over 37,600 household assessments by 8 December 2025, about six weeks after Melissa made landfall. The number grew by tens of thousands in the months that followed, and the JHDINA became the main evidence base for humanitarian targeting well into the recovery. Housing recovery followed the same pattern through



the Restoration of Owner or Occupant Family Shelter (ROOFS) programme, which received an allocation of J\$10 billion and issued grants tiered by damage severity, from J\$75,000 for minor damage up to J\$500,000 for extreme cases to residential household structures.¹³² Five months after the hurricane, the government had distributed more than half of that allocation, using a text alert and QR code system intended to provide faster, more trackable relief.¹³³

The JHDINA recorded which households included elderly people, persons with disabilities, and pregnant or breastfeeding women, but that information was not used to decide who received relief first. The UN Resident Coordinator also reported that many persons with disabilities were not told where shelters were and that shelters were often inaccessible. A rapid gender analysis three months after the storm found that distribution at churches and schools disadvantaged

those who could not travel, queue, or carry supplies, that identification requirements excluded people whose documents had been lost or who had never held them, and that crowded shelters without segregated sleeping areas or lockable sanitation raised the risk of gender-based violence. Many LGBTQIA+ people did not seek formal assistance at all, and a referral pathway through TransWave Jamaica was set up only later in the response.¹³⁴

Relief planned during an emergency tends to reach the most accessible households first. Jamaica moved supplies quickly because the institutions that moved them already had the capacity, but the tools for deciding who should receive them were being built at the same time, and later corrections did not fully make up for the early mistakes. Arrangements for people who could not reach a distribution point, or could not prove their identity after losing their documents, had not been settled before Melissa.

Four days after Melissa, **395** of **570** water production and pumping facilities were down. Two-thirds had lost electricity; the storm had not damaged them.

Where Planning Broke Down

Across health, education, and welfare, there was a disaster response, but no systems had been built to sustain core services while it was under way. The Auditor General's audit of relief funds found that of the J\$1.4 billion in cash donations ODPEM received for Melissa relief, only J\$26.2 million, or 1.8 percent, had been spent four months after the hurricane. As of 2 April 2026, the start of the new financial year and five months after landfall, 88 percent was still uncommitted. Nor was this a one-off lapse: the same audit found J\$138.8 million and US\$101,974 still unspent from Hurricane Beryl donations when Melissa struck, so ODPEM carried an unresolved utilisation problem across two consecutive disaster cycles.¹³⁵

ODPEM told the Auditor General that the Ministry of Finance and the Public Service had not authorised it to spend the funds. Under the Financial Instructions to the Financial Administration and Audit Act, an agency that receives cash donations must advise the ministry and ask for the money to be brought into the Estimates of Expenditure before it can be spent. ODPEM never did this for the Hurricane Beryl donations, which is why they were still unspent when Melissa struck. For Melissa, it wrote to the ministry on 4 February 2026, 14 weeks after landfall, asking to regularise the donations and to use about J\$500 million of them for shelter repairs. By 23 February it had received no reply, and by 2 April the amount spent had not changed. The published audit noted no response from the ministry. Most of the donated money therefore sat idle for two reasons that compound each other: ODPEM took

more than three months to ask for authority to spend it, and the ministry did not answer. Behind both lies a rule that routes emergency donations through the ordinary budget process, and the audit mentions no faster route for money given in a disaster.¹³⁶

The procurement record for ROOFS shows the same weak financial control. Of four roofing material contracts worth J\$167 million, three were awarded to suppliers who did not hold valid procurement registration or a current tax compliance certificate at the time of award, a gap ODPEM justified under an emergency procurement guidance note. Of J\$123 million in building supplies delivered to JDF distribution points, only J\$89 million, or 72 percent, was formally acknowledged as received, leaving J\$34 million in materials unverified and unaccounted for by either receiving party.¹³⁷

No agency in the chain of command treated verification of completed repairs as its responsibility. ODPEM reported that 421 roofs had been repaired under the government-directed component of ROOFS, yet when the Auditor General requested the documentation behind that number, none of it existed in a verifiable form: no beneficiary selection criteria linking repairs to assessed damage, no independent verification or approval process, and no completion reports for work carried out using J\$167 million in public and donated materials.¹³⁸ Asked directly about its role in verifying that repairs were properly targeted, the Ministry of Labour and Social Security responded in writing that "its role, responsibility, and expertise does not include the verification of construction works."¹³⁹

The National Disaster Fund tells a parallel story that predates Melissa. Established by statute in 2015 as Jamaica's dedicated vehicle for disaster management financing, it has never had its own designated bank account as the law requires, running instead through ODPEM's general capital account. ODPEM wrote to the Accountant General twice in 2019 about separate accounts, received no reply, and never followed up. For the past five years the Fund's balance has been folded into ODPEM's general financial statements and reported as a non-current liability rather than audited as the standalone statutory fund it is, and no annual report on its administration has been produced, because the Fund Committee and Chairman that the Disaster Risk Management Act requires before such a report can be prepared are not in place.¹⁴⁰ None of this is storm damage. Each lapse was a governance choice. Opening the Fund's account, appointing its committee, and settling how donations are brought into the budget all take staff time in agencies that have little of it to spare, and before Melissa the chance that any of it would be needed for a storm of this size seemed remote.

The government's defence of the unspent balance does not address the delivery failure. The Prime Minister argued publicly that funds are fungible and better directed toward a visible, lasting housing rollout than dispersed piecemeal, which may hold as an argument for long-term capital allocation.¹⁴¹ It does not explain why an emergency relief mechanism meant for immediate household needs sat administratively idle for months while the same agency managed J\$167 million in roofing contracts without basic delivery verification.

Financing was not the constraint. The catastrophe bond and CCRIF cover paid out J\$23 billion and J\$15 billion within weeks, and some CCRIF money reached households through the national social protection system, the one standing channel that existed. The constraint lay in turning money into verified, adequately sized assistance. The JHDINA, built after landfall, became the eligibility gateway for later programmes, including the World Food Programme-supported cash transfer launched two months after Melissa for about 50,000 people in the five worst-affected parishes. The government's own post-distribution monitoring of the multi-purpose cash programme found that only 22 percent of recipient households could meet most or all of their basic needs, against a target of 90 percent, because the transfer of J\$35,000 was below the minimum expenditure basket.¹⁴²

Jamaica arranged its disaster financing in advance and its disaster delivery after the fact. The machinery for turning money into assistance (beneficiary records, vulnerability registers, assessment capacity, a procedure for bringing donated funds into the budget, and a statutory fund with its own account) either did not exist or had never been made to work.

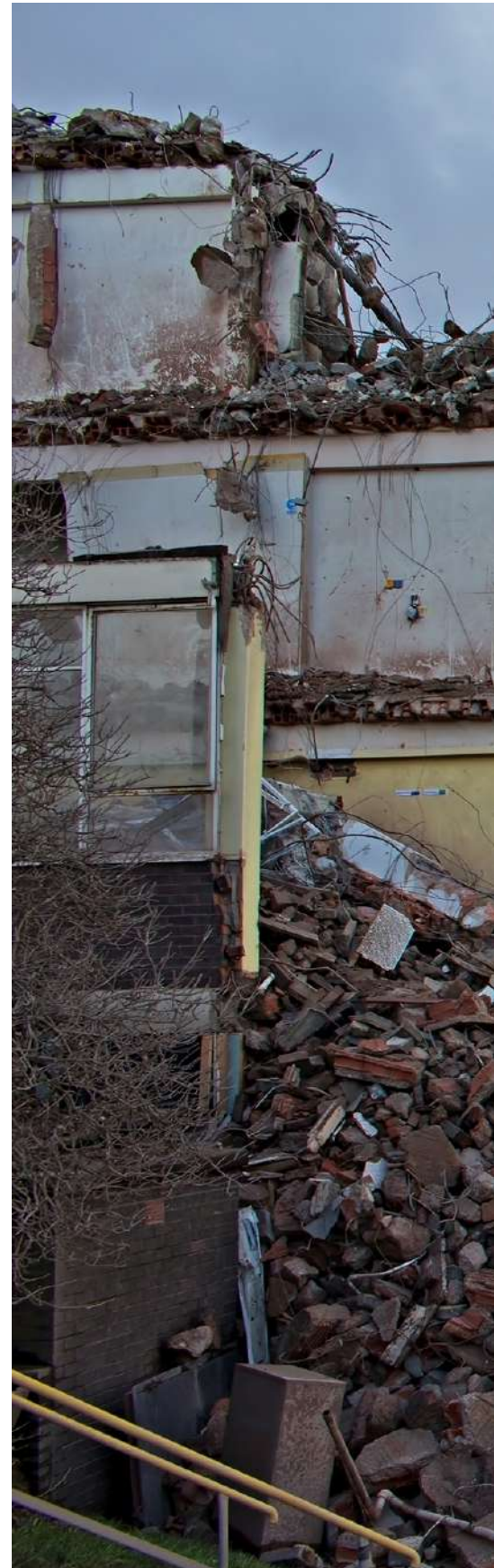
Conclusion

Electricity took seven months to restore across Jamaica, and the water, health, and education services that depended on it recovered no faster than the grid. A year after landfall, some 80 public schools were still teaching in tents and on rota-

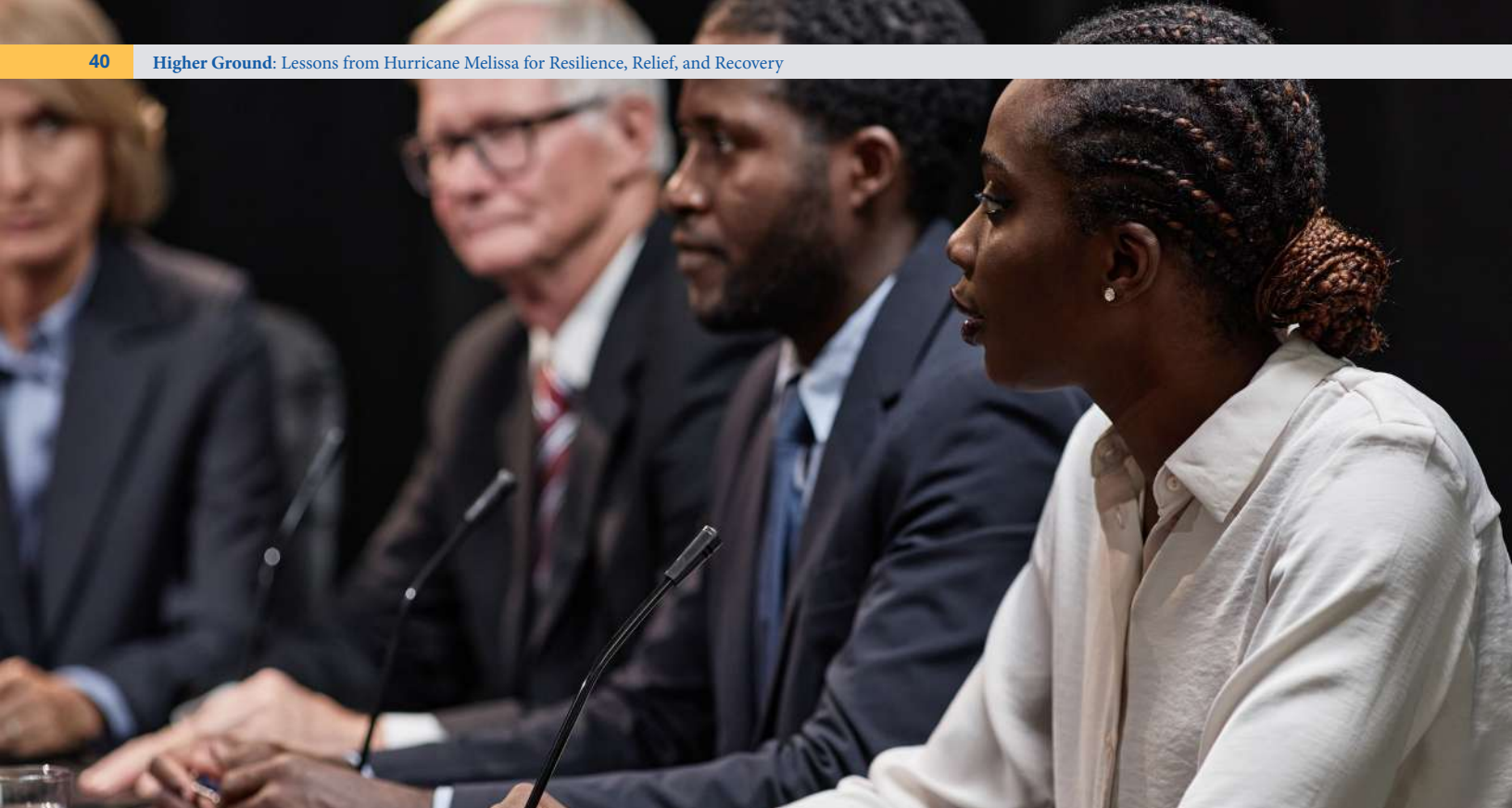
tion, and patients managing chronic conditions in the western parishes had gone months without reliable care. The needs deprioritised were those of vulnerable populations hardest to reach: remote communities, persons with disabilities, and people who could not get to a distribution point or prove who they were. What held the system up was improvisation, partnership, and goodwill, none of which was planned for a storm of Melissa's strength or can be relied on in the next one. Planning of that kind competes for the time of the same small group of officials described in the introduction, and judged against the storms in the national record, the risk of a hurricane like Melissa likely did not seem great enough to justify drawing them away from other work. Much of what went undone before the storm went undone for that reason.

Each of the failures documented above lacked an agency that was required to act on it: continuity planning that no ministry was required to fund, a network design standard that no regulator was required to revisit, and a statutory fund that no committee was ever appointed to oversee. In the terms this report uses, public services fell short on both failures of anticipation. They depended on a grid built for weaker storms, and the machinery for turning money into assistance was largely assembled after landfall, so while financing arrived within weeks, nearly nine in every ten donated dollars sat uncommitted. The recommendations that follow assign each of these responsibilities to a named agency and, for continuity planning, to a line in the recurrent budget.

Jamaica's household damage assessment recorded which households included elderly people, persons with disabilities, or pregnant or breastfeeding women. They were not given priority for relief.







5

Fiscal Management



Disaster financing is where Jamaica planned ahead best. Its weaknesses lie not in the size of the framework but in how its money is used.

Jamaica has prepared for the fiscal cost of disasters more thoroughly than for most other parts of disaster risk management. Its disaster risk financing framework layers contingency funds, insurance, and contingent credit so that money is available for storms of different sizes. This section asks whether that framework is large enough for the hurricanes Jamaica can expect, how well its money has been used, and what state Melissa has left it in. It argues that the framework is well designed and adequately sized, and that its weaknesses lie in how its funds are used, through slow disbursement and a reliance on one-off programmes over standing systems for relief. Melissa has also drawn down the lower tiers of the framework, so that until they are rebuilt Jamaica is better protected against another catastrophe than against an ordinary storm.

How the Framework Works

Jamaica's National Natural Disaster Risk Framework uses different instruments for disasters of different frequency and severity. For frequent, less severe events such as tropical storms and heavy rainfall, it relies on contingency funds such as the National Disaster Fund (NDF), administered by ODPEM, which receives grants, donations, and allocations from the Government of Jamaica (GOJ). For rare, se-

vere events such as major hurricanes, the government holds parametric insurance, which pays out when specified conditions are met, a catastrophe bond, and pre-approved lines of credit from multilateral lenders such as the IMF.

This layered design is sound. Destruction on the scale of Melissa or Gilbert is rare, and the government could not hold enough cover to meet the full cost of such a storm without giving up the fiscal flexibility it needs for everything else. The framework's task is to meet both frequent small events and rare large ones without destabilising the public finances.

Is the Framework Large Enough?

Melissa was the costliest hurricane in Jamaica's history, so it cannot by itself show what future hurricanes are likely to cost. To estimate the cover Jamaica needs, this section calculates the expected annual cost of hurricanes over the 63 years since independence and the share of that cost that falls on the government. It then compares the results with what the framework supplied after Melissa, which was about US\$1 billion, against a public cost of about US\$2.5 billion out of a total of about US\$12 billion.¹⁴³

Expected annual cost is estimated here as

an annual average loss: total recorded hurricane damage in the EM-DAT database, adjusted for inflation to 2025 US dollars, divided by 63. Parametric insurers such as CCRIF use the same concept but derive it from probabilistic models that simulate thousands of possible storm years.¹⁴⁴ Dividing Jamaica's total recorded hurricane damage by 63 years gives an average annual cost of US\$248 million (Figure 4). The figure should be read with caution, because Melissa alone accounts for nearly two-thirds of all recorded damage, and without Melissa the average annual cost is US\$89 million. Jamaica's losses are concentrated in rare, severe events, a pattern poorly suited to financing built only on saved-up reserves, which is why the framework's insurance, catastrophe bond, and contingent credit matter.

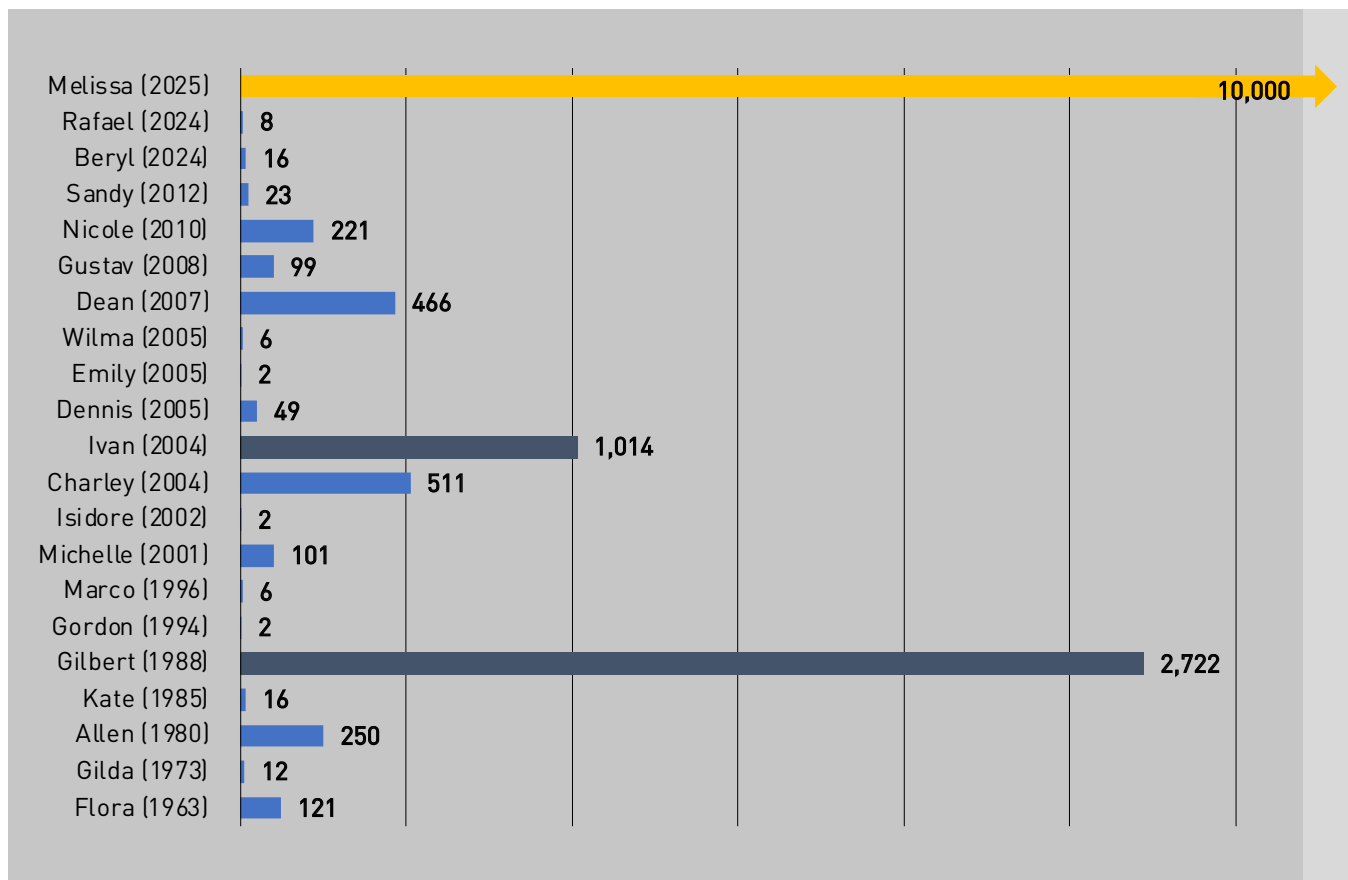
Jamaica built a relief application platform during the COVID-19 pandemic, let it lapse, and had to build a new one after Melissa.

Jamaica's disaster financing framework supplied about **US\$1 billion** after Melissa, above the government's expected **US\$662 million** share of a Category 4 or 5 storm.

Jamaica has been impacted by 23 storms in the 63 years since independence, averaging one every three years and US\$248 million a year.



Cost of Hurricane Damage (US\$m, inflation adjusted)



EM-DAT, The International Disaster Database¹⁴⁵

Much of the damage from a hurricane falls on private homes, businesses, and farms. In the PIOJ assessments of Hurricanes Gustav, Beryl, and Melissa, the government's liability for public infrastructure, emergency relief, and essential utility backstops averaged about 30 percent of the total cost, although for Melissa alone it was closer to a fifth.¹⁴⁶ Applying the 30 percent share to the average annual loss gives an expected annual cost to the government of US\$74 million, the amount it should be prepared to meet in an average year. Because the figure rests on the historical record alone, it will un-

derstate future costs as hurricanes intensify.

In a bad year, the framework's upper tiers of insurance, the catastrophe bond, and contingent credit should be able to supply the government's share of a Category 4 or 5 storm, which comes to about US\$662 million. Of the hurricanes recorded in Latin America and the Caribbean over the past 63 years, 22 percent reached Category 4 and 14 percent Category 5. Weighting the average cost of each category in Jamaica, US\$724 million for Category 4 and US\$5.1 billion for Cate-

gory 5, by those shares gives an expected cost of US\$2.2 billion for a high-intensity storm, of which the government's 30 percent share is US\$662 million. That figure will need to grow as hurricanes intensify. A 2020 study projects the share of tropical cyclones reaching Category 4 or 5 rising by a median of 13 percent under 2°C of global warming,¹⁴⁷ and a shift of that size would raise the government's expected cost of a high-intensity storm, and the cover the framework needs, with it.

Measured against these benchmarks, the framework is adequately sized. It supplied

about US\$1 billion after Melissa, more than the US\$662 million expected for a high-intensity storm and far more than the US\$74 million expected in an average year. Melissa's public cost of about US\$2.5 billion was two and a half times what the framework supplied, and the rest came from the budget and from borrowing. Full cover for a storm of that size would not be affordable, and the framework is not designed to provide it.

How the Money Is Used

Weaknesses appear in how the framework's money is used. The slowest case is donated relief funds, which the Public Services and Welfare section examines in

full. Five months after landfall ODPEM had spent 1.8 percent of the J\$1.4 billion in cash donations it received.

In the months after the storm the government funded a series of one-off initiatives. They included J\$7.2 billion to the Ministry of Economic Growth and Infrastructure Development for roads and 3,300 containerised housing units, J\$4.6 billion to the Ministry of Local Government and Community Development and the National Solid Waste Management Authority (NSWMA) for clean-up, J\$10 billion for the Restoration of Owner or Occupant Family Shelter (ROOFS) programme, and a J\$24.2 billion loan to JPS. The one allocation aimed at reducing the cost of future disasters was J\$10 billion to the National

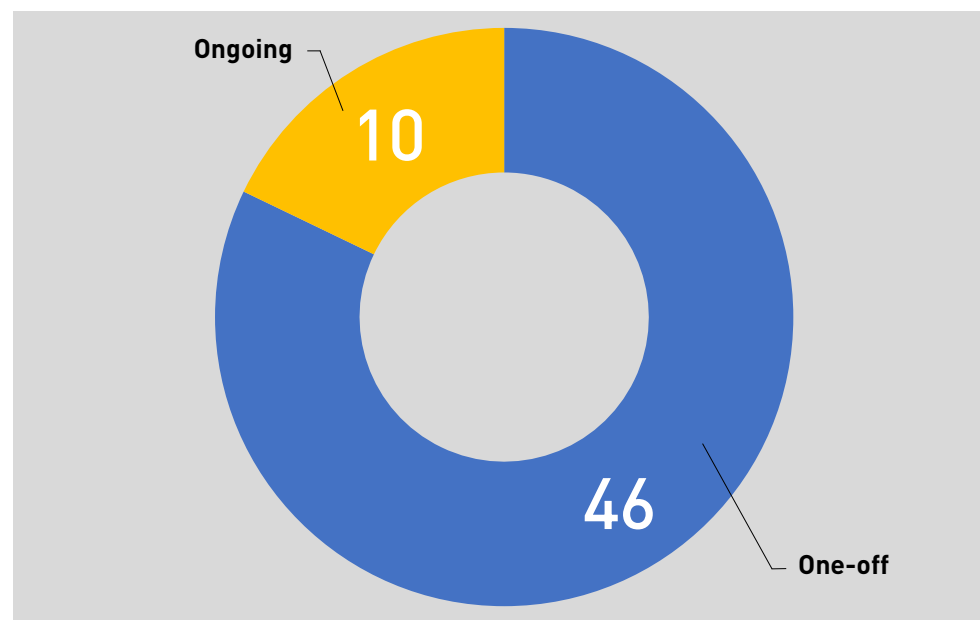
Reconstruction and Resilient Authority (NARRA) for infrastructure rebuilding and climate-resilient housing (Figure 5).¹⁴⁸

Each of these initiatives met an immediate need, but together they leave little in place for the next disaster. Excluding the JPS loan, which is repayable and goes to a private utility, the government committed about twice as much to one-off measures as to NARRA. ODPEM's budget shows the same balance. Of its J\$630 million allocation for 2026/27, only J\$50 million, or 8 percent, is for the annual coordination of relief activities, the one line in its budget directed at future events.¹⁴⁹ Standing systems for relief would shorten recovery from the next disaster and lower its cost.

Most of Jamaica's relief spending goes to one-off initiatives instead of building out a system to manage relief spending.



Comparison of One-off Initiatives vs Ongoing Initiatives as a Result of Hurricane Melissa (J\$b)



Source: CAPRI¹⁵⁰

Relief platforms have also been built for the event at hand and then dropped. In 2020 GOJ built the CARE website, through which people affected by the COVID-19 pandemic applied for grants

paid directly into their bank accounts.¹⁵¹ The platform was allowed to lapse, and Jamaica entered the 2025 hurricane season with no standing system for receiving relief applications, even for frequent events such

as drought or heavy rain. After Melissa, a new claims platform had to be built for ROOFS, through which Ministry of Labour and Social Security agents and residents submit claims for damage to homes.

The Framework After Melissa

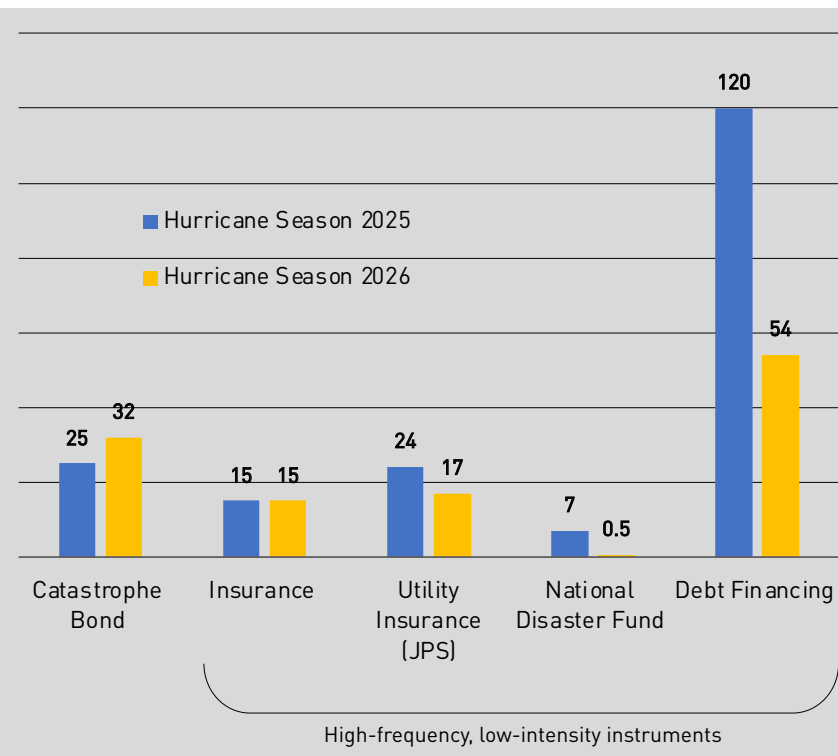
Melissa drew heavily on the framework, as it was designed to, and a year later the instruments meant for frequent, less severe events have not been restored to their pre-storm levels (Figure 6).

A year after Melissa, Jamaica is better protected against another catastrophe than against the ordinary storm far more likely to come first.

The portion of the Disaster Risk Framework designed for high-frequency, low-intensity events has been depleted.



Natural Disaster Risk Framework Financing



Source: CAPRI¹⁵²; Auditor General¹⁵³

The National Disaster Fund, which has no bank account of its own and is held within ODPEM's accounts, stood at under J\$456 million according to the Auditor General, 93 percent below its 2025 level.¹⁵⁴ The contingent loan facilities were drawn on, as intended, and the amount available to borrow for disasters is 55 percent lower than before the storm. JPS's parametric insurance for the 2026 hurricane season, approved by the Office of Utilities Regulation in June 2026, provides com-

bined cover of US\$106.6 million, about J\$17 billion, from CCRIF and Descartes, against about J\$24 billion in 2025, a fall of roughly 30 percent. The regulator gave no reason for the smaller cover, but noted that the Electricity Disaster Fund, which helps pay the premiums, was close to exhausted after Melissa.¹⁵⁵ The catastrophe bond's capacity grew, so for now Jamaica is better protected against another catastrophe than against the ordinary tropical storm or flood that is far more likely

to come first. No rule sets how quickly they must be rebuilt, and a year is a short time in which to rebuild reserves of this kind, but until they are rebuilt, a smaller storm could leave the government paying for relief with money not set aside for disasters.

Jamaica's public financial management gives it a sound base for rebuilding these reserves. Public debt fell from a peak of roughly 140 percent of GDP in 2012 to



62 percent by 2024 under a fiscal responsibility framework with legislated debt targets and an independent fiscal commission that validates any departure from them.¹⁵⁶ Melissa tested that framework directly. The Commission validated the government's assessment and accepted the argument that there was a need for a temporary departure from its fiscal targets, and no major rating agency downgraded Jamaica after the storm. That credibility allowed the country to absorb the shock without a fiscal or market crisis, and it should make Jamaica an attractive counterparty when it seeks more catastrophe bond, insurance, and contingent credit capacity on better terms.

Conclusion

Jamaica's disaster risk financing framework is well designed for the risks it faces. Its layers comfortably exceed expected annual hurricane losses and would cover the government's share of an expected Category 4 or 5 storm. A storm on Melissa's scale lies beyond what any affordable framework would cover in full. The weaknesses lie in how the framework is used: donated funds are spent slowly, one-off initiatives are preferred to standing systems for relief, and reporting between agencies obscures how relief money is spent. Melissa also drew down the lower tiers, which have yet to be rebuilt. In the terms this report uses,

financing is where the state anticipated best, and where it falls short it does so on the second failure, in how relief money is delivered and in the absence of a rule for rebuilding the lower tiers after a storm. Jamaica's record of fiscal discipline, which survived Melissa intact, gives it the credibility to replenish its reserves, tighten accountability, and expand its risk-transfer capacity on good terms. The recommendations set out how.





6 Conclusion



80% of homes Melissa damaged were owner-occupied, and only **1%** were insured, so no lender or insurer checked those houses.

This report set out to examine how Jamaica's risk posture, the judgements the state makes about which hazards to plan for and how much to commit to them in advance, shaped its capacity to provide the public goods on which effective disaster risk management depends. It looked at four areas of public life: the natural environment, the built environment, public services and welfare, and disaster financing. Two failures of anticipation recur across the four domains. First, protective standards were set based on the storms in Jamaica's record, and no Category 4 or 5 hurricane in that record had ever made landfall. Second, the arrangements for turning money and supplies into the assistance that so many people so badly needed were mostly put together after the storm. Both failures, wherever they appear, lie in what the state prepared, or did not prepare, before the hurricane. The remedies and policy implications, however, are different for each domain.

What the Report Found

Jamaica's forests, mangroves, and reefs reduce the damage storms do, and without mangroves coastal flooding from storms would cost Jamaica a further US\$33 million a year. The laws needed to protect these defences largely exist, but permit exemptions, ministerial overrides, and weak enforcement have allowed mangroves and

primary forest to be lost, and their protective value is not yet counted in planning decisions or in reconstruction after Melissa.

The built environment accounted for 86 percent of Melissa's damage. Almost every building standing when the storm arrived went up before Jamaica had an enforceable national building code, and the standards that did apply, including the Category 3 standard for the electricity grid, were set against a storm record Melissa exceeded. Most of the damage to buildings began at the roof, with the screws that hold sheet-metal roofing down. Jamaica keeps no up-to-date record of what its buildings are made of or where its networks run, so the rebuilding cannot easily be aimed at what is most at risk, or checked once it is done.

Public services fell short on both failures

of anticipation. Electricity took seven months to restore, and water, health care, and schooling recovered no faster than the grid. A year after landfall some 80 public schools were still teaching in tents or on rotation. Relief moved quickly where the institutions moving it already had the capacity, but the instruments for deciding who should receive it were built during the response, and households that were hard to reach waited longest. Five months after landfall ODPEM had spent 1.8 percent of the J\$1.4 billion in cash donations it received.

Disaster financing is where the state anticipated best. The financing framework's layers exceed the expected annual cost of hurricanes and would cover the government's share of an expected Category 4 or 5 storm. Its weaknesses lie in how its money is used, and in the lower tiers that Melissa drew down and that have yet to be rebuilt.

When Jamaica transfers risk, an investor or insurer prices it against future storms. Nobody plays that role when building standards are set.

The most a utility can be fined for ignoring the regulator's remedial requirement is **J\$2 million**. Melissa did **J\$39 billion** of damage to the grid.

Many of these gaps reflect the limits of a small public service with systemic constraints on staff and procedure. Every piece of preparatory work competes for the time of the same officials, and with no Category 4 or 5 landfall in the record, the case for giving that time to a storm of Melissa's strength was weak. The question that follows is why, under the same constraints, the state planned ahead in one domain and not in the others.

Unbundling and Instilling Institutional Foresight

In disaster financing the state planned ahead. It paid premiums in years without storms, and the catastrophe bond paid out in full when Melissa met its trigger. In the built environment it did not plan ahead. The building code, the drainage standards, and the design standard for the electricity grid were all based on past storms, and the grid was built for a Category 3 storm.

The difference between the two lies in who holds the government to account. When the state transfers risk through insurance or a catastrophe bond, there is another party to the deal, such as an investor or a regional risk pool like CCRIF. That party will not take on the risk without putting a price on it, and it will not set the price from Jamaica's storm record alone. To get the cover, the state has to accept an accurate assessment of the hazard, because the alternatives are to go without cover or to rely on Jamaica's small domestic financial markets. Nobody plays that role when building standards are set. Codes are revised by committee, based on past practice, on their own timetable, and nobody pays an immediate price when they fall behind the hazard. Jamaica plans ahead for disasters where an outside party will penalise it for not doing so, and does not where there is no such party. Where staff and time are scarce, work that an outside party is waiting for usually gets done first.

The electricity grid shows the same pattern. The Office of Utilities Regulation (OUR) has powers it has not used. Section 4(2) of its Act allows it to direct a licensee to run its services efficiently and in a way that protects users' health and well-being,

and section 9 allows it to require a licensee to put right a failure to meet its licence obligations.¹⁵⁷ The OUR has not used either power to require that the grid be built for the storms Jamaica now faces. The penalties are also small. The most a licensee can be fined for ignoring such a requirement is J\$2 million, while Melissa did J\$38.6 billion of damage to the grid.¹⁵⁸ Building the grid to withstand stronger storms would push up electricity rates, and the benefit shows only as outages that do not happen, so there has been little pressure on either the regulator or JPS to pay for it. The grid has stayed at a Category 3 standard.

After the storm, the regulator approved new parametric insurance for JPS, with cover from CCRIF and a private insurer. Outside pressure therefore produced better insurance for the grid, but it has not produced a stronger grid. An insurer requires an accurate assessment of the risk, but it does not require anyone to reduce it. The renewal of JPS's licence gives the government a way to do that. In July 2025 it gave notice that it will not renew the licence on existing terms.¹⁵⁹ If resilience standards are written into the new licence, the OUR will be able to enforce them under section 9.

Deepening Access Where It Matters

Most Jamaican homes are neither mortgaged nor insured. Eighty percent of the households whose homes Melissa damaged owned them, and about 1 percent had insurance. In most housing markets, a mortgage lender requires the borrower to insure the house and has it inspected before lending. A household without a mortgage, especially one without clear title to its land, goes through neither process, so nobody checks whether the house meets a standard. After each storm the owner repairs the house to whatever standard they can afford, and it is no better able to withstand the next one.

The cost of that risk therefore falls on the state, which pays for relief. Jamaica measures its losses only after a disaster. As the Built Environment section shows, it has no up-to-date record of what its houses are built from, and the roofing figures used to assess Melissa's damage come from the

2001 census. Nor does it estimate, before a storm, the likely loss at any particular site. The state already pays for catastrophe modelling for the catastrophe bond and CCRIF, and that modelling could produce these estimates; models that work site by site already exist elsewhere.¹⁶⁰ Without such estimates, a planning authority knows the total damage for the country but not what building on a particular lot is likely to cost, and the government learns what relief will cost only when the bill arrives. The poorest communities bear most of that cost.

If planning ahead depends on an outside party demanding it, the policy question is whether such parties can be created where they are missing. There are known ways to do this. Insurers can charge lower premiums for buildings that meet the code, development finance can be made conditional on forward-looking design standards, and the law can require standards to be revised against modelled projections instead of past storms. The recommendations that follow set these out in specific form, together with the measures that the findings of each section point to.

Each of these has costs for the poorest households. Insurance requirements price out those least able to pay. Formalising land titles could expose occupants to eviction. Refusing to insure an exposed location means telling people they may not rebuild where they live. Research on Latin America has found that when governments tolerate informal housing and choose not to enforce the rules, this works as a form of welfare for people who have no formal alternative.¹⁶¹ If that applies in Jamaica, then creating these outside pressures would take away a protection people now rely on, and any such reform would need to offer them an alternative.

The parties that push Jamaica to assess its risks accurately are foreign investors and lenders, and they have influence because they can withhold money the state needs. Jamaican citizens have no similar way of pressing the state to plan ahead. Elections are a weak tool for it, because voters see no result when a protection works, and the cost of building that protection comes long before any benefit.

For reforms to last, some group within Jamaica would need to put the same kind of pressure on the state. Foreign investors and lenders are concerned with the government's finances, so their pressure has not reached the standards for hous-

es, drains, or electricity poles. Pressure on those standards will have to come from within the country. So far Jamaica has planned ahead where foreign capital required it, and has not where only Jamaicans would benefit. Until the bodies that

set standards face some cost when those standards fall behind the hazard, the protections that matter most to households will keep lagging, and the next storm will find the country in much the same position as Melissa did in October 2025.



Recommendations

Each recommendation below is tied to the section of the report whose findings support it.

Natural Environment



1

Protect and restore mangrove forests, and count natural defences in reconstruction plans.

- Details: Identify healthy mangrove forests on public land and declare them protected areas under section 33 of the NRCA Act, prohibiting all removal or degradation; identify recovering mangrove areas on public land, assess whether they are suitable for restoration, and where they are, restore them and protect them on the same terms, giving preference to natural regeneration by removing the barriers to it; over time acquire healthy mangrove and other forested wetland on privately owned land, through exchange or purchase, and add it to the protected areas; close the permit exemption route that has allowed mangroves to be cleared. In reconstruction planning, treat forests, mangroves, and reefs as part of the country's protective infrastructure, alongside levees, breakwaters, seawalls, and early warning systems, and count the protection they give when options are compared.
- Lead: NRCA; NARRA for reconstruction plans
- Benefit: Mangroves absorb wave energy and storm surge, protecting built infrastructure along coastal areas.
- Difficulty: The legal power to protect state-owned wetland is already in place under the NRCA Act.
- Cost: Protecting mangroves already in state hands costs little. Acquiring private wetland requires compensation, but keeping mangroves is still cheaper than replacing their protection with engineered shore structures.
- Basis: The Natural Environment, "Law, Policy, and Enforcement" and "Ecosystem Restoration in Reconstruction Planning".



2

Protect remaining unprotected primary forests, except in limited cases enumerated in law.

- Lead: NRCA
- Basis: The Natural Environment, "How Much Has Been Lost".

Built Environment



3

Revise design standards against a forward assessment of the hazard, beginning with how roofs are fastened.

- Details: Set the design wind speeds in the building code, the sizing of drains and culverts, and the design standard for the electricity grid against modelled projections that include Category 4 and 5 storms, review them on a fixed cycle, and publish the revised standards before the current rebuilding is finished. Specify how roofing sheets are to be fixed to the roof frame on every building, and inspect and retrofit existing houses to that standard, beginning with timber houses with sheet-metal roofs in the parishes most exposed to hurricane winds.
- Lead: Ministry responsible for the Building Act, with the Jamaica Institution of Engineers; municipal corporations as local building authorities for retrofits; OUR for the grid standard
- Basis: The Built Environment, “The Design Basis”, “Buildings”, and “Conclusion”.



4

Upgrade the electricity grid, under a gradual but sustained plan, to withstand a Category 5 hurricane instead of the current Category 3 threshold, beginning with the transmission network.

- Details: Decide now the standard to which transmission towers will be replaced, since standing towers of the same age as those that fell will need replacing within two decades, and build redundancy into the transmission lines across the east–west axis of the country. In distribution, set minimum foundation depths for poles, since most poles that fell failed at the base, and invest in alternative routes around damaged lines and in the capacity to isolate them.
- Lead: OUR, JPS
- Benefit: A break in a transmission line no longer splits the grid into disconnected systems, and outages are shorter.
- Cost: To be met publicly, either through an approved rate increase or a public capital expenditure allocation.
- Basis: The Built Environment, “Transmission” and “Distribution”.

Recommendations



5

Draft a wind standard for the frames that hold solar panels and require it in every contract for new utility-scale solar generation.

- Details: Require compliance to be certified before a plant is connected to the grid, and require the owner of any plant that fails in a storm to report publicly what failed.
- Lead: OUR, Generation Procurement Entity
- Basis: The Built Environment, “Generation”.



6

Relocate water treatment plants, water mains, and pumping equipment to locations less exposed to flooding, or raise equipment above flood level.

- Details: Water mains that cross rivers and gullies accounted for almost 80 percent of the cost of pipeline damage, and the main damage at pumping stations was to flooded motors, electrical equipment, and backup generators. The Dornoch Water Treatment Plant needs to be relocated.
- Lead: NWC
- Basis: The Built Environment, “Roads, Water, and Debris”.



7

Keep new construction, public and private, out of the most exposed locations, and raise or relocate houses that flood.

- Details: Refuse planning permission in sensitive coastal zones and flood-prone areas, and pair the refusal with incentives that make building elsewhere practical, including support for relocation and the denser use of brownfield land. Site new infrastructure and public facilities away from riverbanks and coastlines. Where flooding or storm surge reached houses at ground level, support raised floors or relocation to a safer site as part of reconstruction.
- Lead: NEPA, municipal corporations as local planning authorities, NARRA
- Basis: The Natural Environment, “Law, Policy, and Enforcement”; The Built Environment, “Residential Buildings” and “Roads, Water, and Debris”.



8

Plan the order and standard of reconstruction before the next storm.

- Details: Decide in advance where debris will be taken, which roads will be cleared first, and which agency is responsible for each stage. Repair public and commercial buildings in order of what their closure costs the economy, such as hotels and schools, rather than in order of the size of the repair bill. Rebuild roads from the road damage data rather than from the parishes with the worst housing damage, and to a better standard than before the storm, repairing the base beneath damaged surfaces as well as the surface itself.
- Lead: NARRA, ODPEM, NSWMA, NWA
- Basis: The Built Environment, “Non-Residential Buildings” and “Roads, Water, and Debris”.



9

Build a national record of buildings and infrastructure, and make the issue and renewal of utility licences conditional on contributing to it.

- Details: Return the question on roof type to the census, map roof types across the island from satellite imagery, and establish the national register of disaster-exposed infrastructure and the risk information system that the PIOJ assessment recommends, beginning with an investigation of why buildings and networks failed during Melissa. Require each utility to supply the OUR with a mapped register of its relevant physical assets, and damage data within a set period after a disaster, and count failure to comply against the renewal of its licence. JPS, Digicel, and Flow did not supply the data requested of them after Melissa. Resilience standards should also be written into the new JPS licence, where they will be enforceable under section 9 of the Office of Utilities Regulation Act.
- Lead: OUR for utility licences; STATIN and PIOJ for the national record
- Basis: The Built Environment, “Rebuilding Without a Record”; Conclusion.

Recommendations

Public Services and Welfare



10

Require a costed and funded service continuity plan from every licensed utility provider as well as from every hospital and school.

- Details: The plans should include backup generation at every water treatment plant, pumping station, and hospital, planned as part of the grid's redesign, and an agreed list of the facilities other services depend on, to which JPS restores power first. The Ministry of Finance and the Public Service (MOFPS) should carry those plans as a dedicated line in the recurrent budget, with staff assigned to keep them up to date.
- Lead: OUR, Ministry of Health and Wellness, Ministry of Education, Ministry of Finance and the Public Service, NWC, JPS
- Basis: Introduction; Public Services and Welfare, "Dependence on the Grid" and "Conclusion".



11

Construct dedicated, multi-hazard shelters at strategic locations.

- Details: The shelters can be used for other purposes, but not for ones such as education that must continue after a disaster.
- Lead: ODPEM
- Basis: Introduction; Public Services and Welfare, "Education".



12

Establish a permanent digital relief management and claims platform, backed by a standing register of households.

- Details: Keep the claims platform built for ROOFS as a standing mechanism that can be switched on after each event, so that assistance is faster and there is a record of who received what; the CARE platform built for the pandemic was allowed to lapse. Maintain the JHDINA as a register updated between events, use the vulnerability information it records to direct relief, and set out in advance how relief will reach people who cannot travel to a distribution point or cannot prove their identity after losing their documents.
- Lead: Ministry of Labour and Social Security, ODPEM
- Basis: Fiscal Management, "How the Money Is Used"; Public Services and Welfare, "Relief Delivery and Welfare Support".



13

Open the dedicated National Disaster Fund account that the Disaster Risk Management Act has required since 2015, and appoint the Fund Committee and Chairman.

- Details: This will allow the statutory annual report to be written and submitted.
- Lead: Accountant General's Department, ODPEM
- Basis: Public Services and Welfare, "Where Planning Broke Down".

Fiscal Management



14

In the annual budget, make a minimum, mandatory contribution to the National Disaster Fund, and set a rule for replenishing the framework's lower tiers after a storm.

- Details: Both should be enacted by a legislated amendment to the fiscal responsibility framework. The annual contribution should be set by an analysis of public expenditure on past frequent, less severe climate events, adjusted for inflation, and the replenishment rule should set how quickly the Fund and the contingent credit facilities are restored after a draw. Limits should be imposed on the ability of an administration to draw on these funds for uses not contemplated in the legislation.
- Lead: Ministry of Finance and the Public Service, Parliament
- Basis: Fiscal Management, "The Framework After Melissa".



15

Establish real-time digital accounting, reporting, and audit protocols so that disaster funds are deployed quickly and transparently.

- Details: MOFPS should require standardised, regularly published reporting of disaster-related receipts and expenditure across all implementing agencies, closing the accountability gap the Auditor General has already identified and giving both Parliament and the public a live view of fund utilisation during a response. The Financial Instructions should be amended so that cash donations received for a declared disaster can be authorised for spending within days, with deadlines for the receiving agency to apply and for the ministry to respond, and one agency should be made responsible for verifying that repairs paid for from relief funds were completed.
- Lead: Ministry of Finance and the Public Service

Recommendations

- Basis: Public Services and Welfare, “Where Planning Broke Down”; Fiscal Management, “How the Money Is Used”.



16

Expand parametric insurance and catastrophe-bond capacity.

- Details: These instruments, designed for infrequent, high-severity losses, should be expanded while Jamaica’s fiscal record and improved credit standing can support better pricing when new catastrophe bonds are placed in the market, and coverage limits on Jamaica’s CCRIF policies should be raised.
- Lead: Ministry of Finance and the Public Service
- Basis: Fiscal Management, “Is the Framework Large Enough?” and “The Framework After Melissa”.



Endnotes

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- 61 PIOJ et al., *Assessment of the Effects and Impacts of Hurricane Melissa in Jamaica*, Table V 2, 101–2.
- 62 PIOJ et al., *Assessment of the Effects and Impacts of Hurricane Melissa in Jamaica*, Table V 3, 104. Destroyed dwellings (Level 4) as a share of dwellings assessed: Westmoreland 6,421 of 19,722; St. Elizabeth 2,394 of 16,147.
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- 64 PIOJ et al., *Assessment of the Effects and Impacts of Hurricane Melissa in Jamaica*, Table V 2, 101–102. Of 426,453 dwellings in the affected parishes, 32,153 (7.5 percent) had stone or brick walls with concrete roofs and 391,134 (91.7 percent) had sheet-metal roofs over concrete block, timber or plasterboard walls; the remainder are classed as other.
- 65 PIOJ et al., *Assessment of the Effects and Impacts of Hurricane Melissa in Jamaica*, 99. The assessment distinguishes minor damage (windows and doors), moderate damage (roofing sheets), severe damage (roof structures and metal sheets), and destruction.
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70 PIOJ et al., *Assessment of the Effects and Impacts of Hurricane Melissa in Jamaica*, 46. Five-day totals are compared with each parish's average October rainfall for 1991-2020. The highest totals, of 500 to 668 millimetres, were recorded at stations in St. Catherine, Manchester, Portland and St. Elizabeth.

71 PIOJ et al., *Assessment of the Effects and Impacts of Hurricane Melissa in Jamaica*, 104. The figure covers household goods in the affected dwellings and is counted within the J\$687.1 billion of housing damage.

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73 PIOJ et al., *Assessment of the Effects and Impacts of Hurricane Melissa in Jamaica*, 47–48. Black River was struck by hurricane-force winds, storm surge and flooding; Savanna-la-Mar by storm surge along the coast and hurricane-force winds. Storm surge is the rise in sea level that a hurricane's winds and low pressure push onto the coast, separate from the waves that travel on top of it: National Oceanic and Atmospheric Administration, "About Storm Surge," Meteorological Development Laboratory, <https://vlab.noaa.gov/web/mdl/about-storm-surge>.

74 Federal Emergency Management Agency, Recommended Residential Construction for Coastal Areas: Building on Strong and Safe Foundations, FEMA P-550 (Washington, DC: FEMA, n.d.).

75 PIOJ et al., *Assessment of the Effects and Impacts of Hurricane Melissa in Jamaica*, Table IX 5, 154; Table III 1, 79; Table X 5, 168; 92; Table VI 2, 115; Table V 3, 104. Hotels and other tourism properties combine tourism buildings and facilities (J\$187.4 billion) with other assets such as electrical systems, lifts, air-conditioning units and pumps (J\$35.0 billion). Shops are commerce-sector buildings and facilities (J\$17.7 billion); schools are education-sector damage (J\$19.5 billion); health facilities are health-sector infrastructure (J\$11.0 billion); cultural sites J\$5.0 billion; police stations J\$1.0 billion.

76 PIOJ et al., *Assessment of the Effects and Impacts of Hurricane Melissa in Jamaica*, 79, 81, 27, 154, 168. At least 534 public schools needed roofing repairs, followed by electrical repairs at 308, and the assessment describes roof damage as a major driver of education damage, exposing internal structures, furniture and electrical installations. Tourism damage was driven primarily by non-structural impacts to buildings and by water intrusion that ruined furniture and equipment; commerce damage was primarily roof damage and water intrusion rather than widespread structural failure.

77 PIOJ et al., *Assessment of the Effects and Impacts of Hurricane Melissa in Jamaica*, Table V1, 99: Losses of J\$6.6 billion against J\$699.2 billion of damage. See also, Table IX 1, 151; 27: Tourism losses of J\$265.2 billion against J\$315.4 billion of damage. Reduced stopover arrivals account for more than 96 percent of the losses, which the assessment expects to be most severe in late 2025 and throughout 2026 and to extend into 2027 on the South Coast.

78 PIOJ et al., *Assessment of the Effects and Impacts of Hurricane Melissa in Jamaica*, Table III 1, 79; 24–25. Education losses of J\$10.0 billion against J\$19.5 billion of damage. The assessment notes that closures were prolonged by the continued use of structurally resilient schools as shelters.

79 PIOJ et al., *Assessment of the Effects and Impacts of Hurricane Melissa in Jamaica*, Table XII 1, 191; 198. Effects of J\$52.7 billion comprise J\$38.6 billion in damage, J\$9.7 billion in losses from undelivered electricity and J\$4.5 billion in additional costs. Using Office of Utilities Regulation data, the assessment puts the outage at about 14.7 million customer-days; spread across the 532,000 customers without power at the peak, that is about 28 days each. JPS serves approximately 701,670 customers.

80 PIOJ et al., *Assessment of the Effects and Impacts of Hurricane Melissa in Jamaica*, 250–51, 301; 31. The assessment notes that these cascading impacts extended beyond the maximum wind zone, citing commercial establishments in Savanna-la-Mar that remained closed for weeks because of sustained outages despite limited structural damage, and describes the failure of transmission and distribution as a major bottleneck for recovery.

81 PIOJ et al., *Assessment of the Effects and Impacts of Hurricane Melissa in Jamaica*, 192, 250, 301; Jamaica Public Service Company, Jamaica's Renewable Experience, Presentation, Caribbean Centre for Renewable Energy and Energy Efficiency, n.d., www.ccreee.org/wp-content/uploads/2021/05/Jamaicas-Renewable-Experience-Presentation.pdf. The assessment records that generation facilities otherwise sustained minimal direct damage.

82 PIOJ et al., *Assessment of the Effects and Impacts of Hurricane Melissa in Jamaica*, Table XII 3, 195. The estimate divides the plant's construction cost into components and applies an assumed percentage of damage to each: 70 percent for the panels, 30 percent

for the supports and for labour, and 20 percent for the inverters.

83 “InterEnergy to Rebuild Solar Park,” *Observer*, November 12, 2025, www.jamaicaobserver.com/2025/11/12/interenergy-rebuild-solar-park/.

84 Jamaica Information Service, “Jamaica Making Progress in Meeting 50 Per Cent Renewable Energy Target,” Jamaica Information Service, March 19, 2025, <https://jis.gov.jm/jamaica-making-progress-in-meeting-50-per-cent-renewable-energy-target/>; PIOJ et al., *Assessment of the Effects and Impacts of Hurricane Melissa in Jamaica*, 192. The system comprises 26 generating units with a combined capacity of close to 1,000 megawatts.

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86 PIOJ et al., *Assessment of the Effects and Impacts of Hurricane Melissa in Jamaica*, 191. JPS focused on restoring transmission first, then distribution and connections to customers.

87 PIOJ et al., *Assessment of the Effects and Impacts of Hurricane Melissa in Jamaica*, Table XII 2, 193–194. Plants in Kingston, St. Andrew, St. Catherine and Clarendon account for 674.8 of the 999.1 megawatts listed.

88 PIOJ et al., *Assessment of the Effects and Impacts of Hurricane Melissa in Jamaica*, 192. Transmission lines total about 1,200 kilometres, against about 20,534 kilometres of distribution lines.

89 PIOJ et al., *Assessment of the Effects and Impacts of Hurricane Melissa in Jamaica*, 191. The assessment attributes the destruction of wooden and concrete poles and steel transmission towers to winds of up to 185 miles per hour.

90 “Melissa Power Restoration Continues in Earnest; 33,000 Customers Still in the Dark, JPS CEO Tells PAAC,” *Gleaner*, January 27, 2026, <http://jamaica-gleaner.com/article/news/20260127/melissa-power-restoration-continues-earnest-33000-customers-still-dark-jps>.

91 PIOJ et al., *Assessment of the Effects and Impacts of Hurricane Melissa in Jamaica*, Table XII 7, 197; 195; Tables XII 4 and XII 5, 196. The network comprises 323,636 poles and 41,307 transformers (p. 192). Table XII 5 gives 35,600 poles and 2,891 transformers to be replaced; Table XII 4, which counts poles and towers by parish, gives 34,420 and 3,075. The estimate was made without a detailed damage report from JPS, which had been requested but not received (pp. 191, 194).

92 PIOJ et al., *Assessment of the Effects and Impacts of Hurricane Melissa in Jamaica*, 251, 301–3, 305. The assessment finds that “most of the damage observed in the electricity poles is a consequence of deficient attachments of these structures to the ground, and even if the poles remain on the ground, no major structural damage exists on these elements,” reports significantly better performance in concrete and composite poles than in wooden ones, and recommends that minimum foundation depths, attachment materials and detailing be defined, alongside a systematic review of transmission and distribution design and material standards aligned with island-wide wind-load zones.

93 “How JPS Weathered Hurricane Melissa with One Set of Digital Grid Management Tools,” *Renewable Energy World*, April 9, 2026, www.renewableenergyworld.com/power-grid/outage-management/how-jps-weathered-hurricane-melissa-with-one-set-of-digital-grid-management-tools/; PIOJ et al., *Assessment of the Effects and Impacts of Hurricane Melissa in Jamaica*, 302–3, 306. The assessment finds that “the prolonged outages following Melissa were largely driven by insufficient network redundancy” and lists inadequate sectionalising capacity among the weaknesses to address.

94 PIOJ et al., *Assessment of the Effects and Impacts of Hurricane Melissa in Jamaica*, 199, 251, 301, 306. Physical restoration depended entirely on JPS; the volume of repairs caused extended delays around the high-intensity wind corridor; JPS mobilised more than 400 international line workers; and restoration was constrained by limited surge resources in crews, equipment and materials.

95 PIOJ et al., *Assessment of the Effects and Impacts of Hurricane Melissa in Jamaica*, 182–83, 187. Tables XI 2 and XI 3, 182–183. Transport-sector damage totalled J\$29.6 billion. The ratings are from National Works Agency assessments conducted in 2025. The National Works Agency estimates that at least twice the affected main-road length, some 6,844 kilometres, was affected on the municipal network.

96 PIOJ et al., *Assessment of the Effects and Impacts of Hurricane Melissa in Jamaica*, 104–183. Tables XI 3 and V 3. Shares are calculated from the parish damage figures in each table. Westmoreland, St. Elizabeth, St. James and St. Ann, the four parishes with the most housing damage, account for 32 percent of road damage.

97 PIOJ et al., *Assessment of the Effects and Impacts of Hurricane Melissa in Jamaica*, 183–84. The assessment also found landslides and embankment failures predominantly in areas with saturated soils, and notes that damage of this kind reduces the level of service and shortens a road’s remaining service life.

98 PIOJ et al., *Assessment of the Effects and Impacts of Hurricane Melissa in Jamaica*, 201. St. James and Trelawny account for some 77 percent of damage to facilities belonging to the National Water Commission and private operators.

99 PIOJ et al., *Assessment of the Effects and Impacts of Hurricane Melissa in Jamaica*, 206, Table XIII 5. Damage to the plant is estimated at J\$0.5 billion, 24 percent of the sector's damage, with a further J\$0.1 billion for the access bridge. The costing includes relocating the plant to a less vulnerable site.

100 PIOJ et al., *Assessment of the Effects and Impacts of Hurricane Melissa in Jamaica*, 207–8. The three sections are the 600-millimetre treated water main through Lilliput Gully and the 800-millimetre raw water main across the Great River in St. James, and the pipeline to Davis Town in Trelawny, together costing J\$300 million to restore.

101 PIOJ et al., *Assessment of the Effects and Impacts of Hurricane Melissa in Jamaica*, 206, 251. The assessment cites the United Nations Development Programme estimate, compares it with average annual waste generation of 1.1 million tons, and records that the debris blocked roads, delaying the restoration of water supply, electricity, telecommunications and transport; it also records the clearing of blocked culverts, side drains and gullies.

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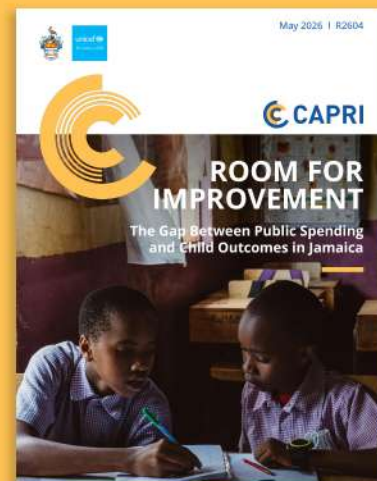
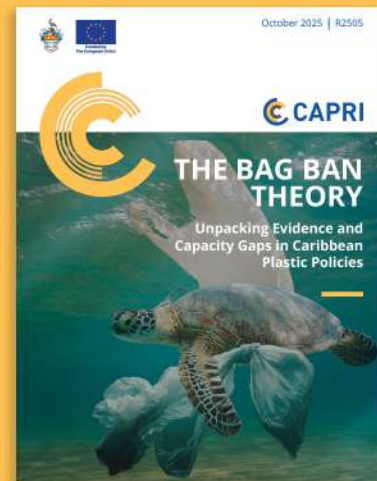
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