

2011

The Kingston Metropolitan Area's (KMA) Ability to Respond to a Magnitude 6.5 or Above Earthquake

Nicole Warmington-Granston
Florida International University

Follow this and additional works at: https://digitalcommons.fiu.edu/drr_student

Recommended Citation

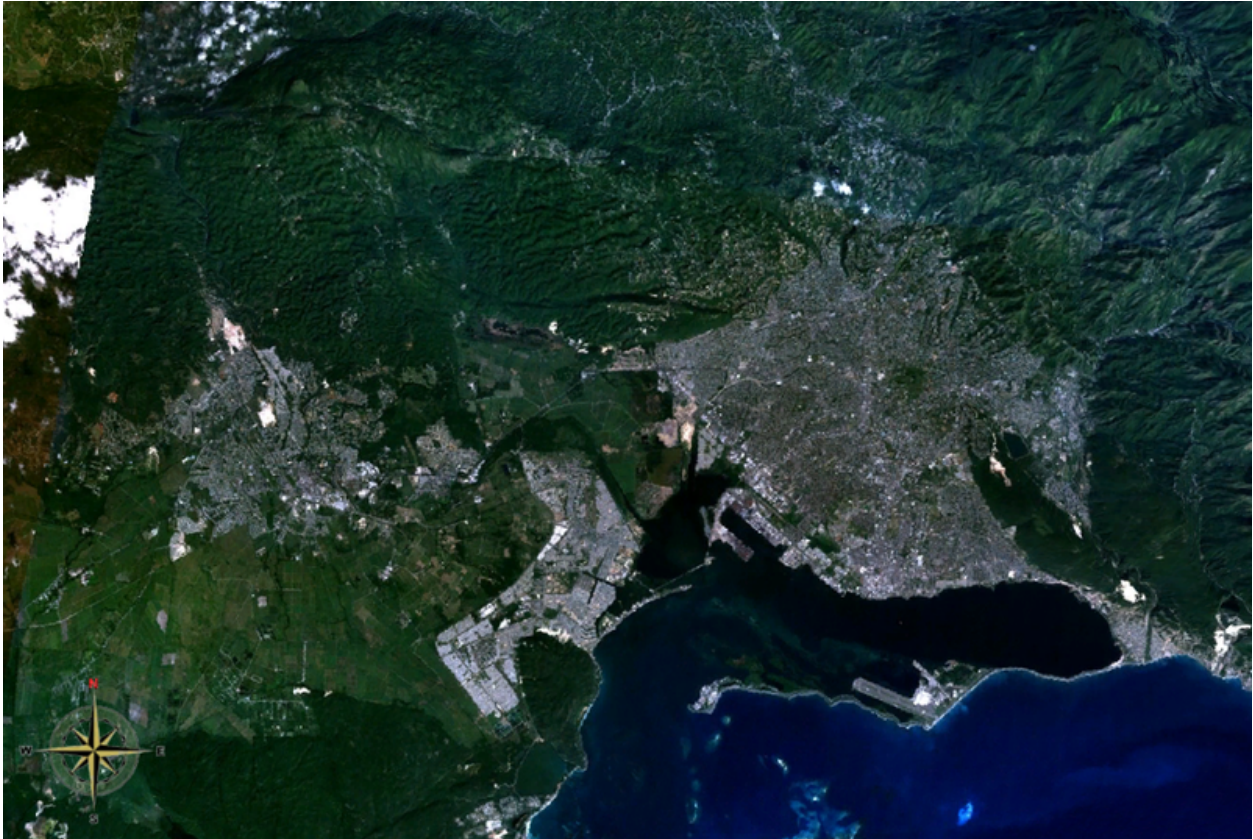
Warmington-Granston, N. (2011). The Kingston Metropolitan Area's (KMA) ability to respond to a magnitude 6.5 or above earthquake. Disaster Risk Reduction Program, Florida International University.

This work is brought to you for free and open access by the Extreme Events Institute at FIU Digital Commons. It has been accepted for inclusion in DRR Student Publications by an authorized administrator of FIU Digital Commons. For more information, please contact dcc@fiu.edu.

DISASTER RISK REDUCTION of the AMERICAS PROGRAM REPORT

On

The Kingston Metropolitan Area's (KMA) Ability to Respond to a Magnitude 6.5 or Above Earthquake



Nicole Warmington-Granston
PhD Student & Research Assistant
Disaster Risk Reduction Program
Florida International University

Submitted to:
Dr. Richard S. Olson
Dr. Juan Pablo Sarmiento
Dr. Gabriela Hoberman

The Structure of the Kingston Metropolitan Area

The Kingston Metropolitan Area (KMA) consists of the parish of Kingston and parts of the parish of St. Andrew, which includes “Six Miles to the west, Stony Hill to the north, Papine to the northeast and Harbour View to the east, [and] communities in urban and suburban Saint Andrew”¹. Kingston has the rare distinction of being a parish, city and capital. It is also considered the 7th largest natural harbour in the world. The parish of Kingston includes ‘downtown’, the Palisadoes Strip, where the Norman Manley International Airport is located and Port Royal. The KMA contains 22.2% of the population of Jamaica amounting to 579,137 persons as per the 2001 Census². ‘Downtown’ Kingston houses government ministries and agencies, businesses from the financial, industrial and commercial sectors, major shipping ports, oil refineries, the cement factory, power generation facilities, and low income residences³. The areas of St Andrew surrounding Kingston proper consists of a financial district, New Kingston, a few government ministries and agencies, the Mona Dam that provides water for the entire KMA, the majority of the country’s primary, secondary and tertiary education institutions and sporting facilities, as well as middle and upper income residential areas. In addition, the KMA includes “a significant portion of the island’s highway and railway infrastructure”⁴.

¹ Nicholas, Gina. 2003. Structure and Development of Kingston, Jamaica.

<http://www.smartyoung.com/cities/kingston/Default.htm>. (21 February 2010)

² Statistical Institute of Jamaica (STATIN). 2001. *Population Census 2001 Facts*.

<http://statinja.gov.jm/Popcensus.aspx>. (21 February 2010)

³ Natural Disaster Research et. al. 1999. *Final Report: Kingston Metropolitan Area Seismic Hazard Assessment*, pp. 2; Nicholas, Gina. 2003. Structure and Development of Kingston, Jamaica.

<http://www.smartyoung.com/cities/kingston/Default.htm>. (21 February 2010)

⁴ SMLAC. 2004. Seismic Microzoning of Major Latin American Cities by realistic modelling of seismic ground motion. <http://users.ictp.it/~sand/SMLAC/activities.html>. (21 February 2010)

The Seismology and Geology of the Kingston Metropolitan Area

Jamaica sits along an active fault line. According to the Natural Research Team (1999) and Risk Management Solutions (2010), Jamaica has a “significant strike-slip [fault] that [accommodates] the shifting between the North American and Caribbean plates.”⁵ The Enriquillo-Plantain Garden fault zone runs through Jamaica just “north of Kingston and west of the Blue Mountains”⁶. This is the same fault zone that runs south of Port-au-Prince, Haiti and has been blamed for the 12 January 2010 earthquake. Major earthquakes in Jamaica have struck along this fault line in the past. There was the Port Royal Earthquake of 7 June 1692 with a Moment Magnitude of 7.5⁷ that killed approximately 2000 people (25% of the Port Royal population), another 3000 dying immediately after the event due to disease and injury⁸. It also “caused extensive building damage and ground failure”⁹. In addition, there was the Downtown Kingston Earthquake of 14 January 1907 with a M 6.5¹⁰ that killed approximately 800 people, destroyed 80% of the infrastructure and caused an estimated £2,000,000 in damage¹¹.

⁵ Risk Management Solutions (RMS). 22 January 2010. *RMS FAQ: 2010 Haiti Earthquake and Caribbean Earthquake Risk*, pp. 12.

⁶ Natural Disaster Research et. al. 1999. *Final Report: Kingston Metropolitan Area Seismic Hazard Assessment*, pp. 10.

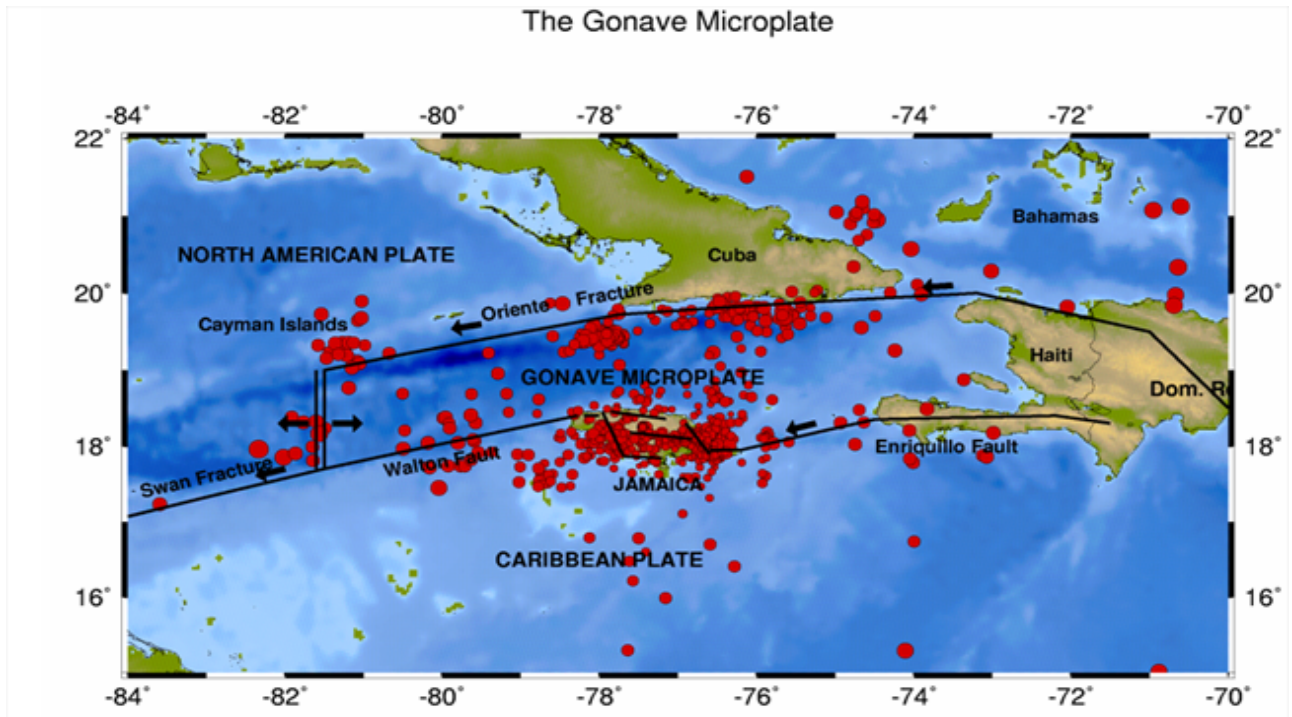
⁷ McCann, William. n.d. *Estimating the Threat of Tsunamigenic Earthquakes and Earthquake Induced-Landside Tsunami in the Caribbean*, <http://www.eird.org/deslizamientos/pdf/eng/doc15715/doc15715.pdf> (8 March 2010).

⁸ Ibid, Introduction, pp. 3; U.S. Geological Survey. 2009. *Historic Earthquakes: Jamaica 1692 June 7 UTC*, http://earthquake.usgs.gov/earthquakes/world/events/1692_06_07.php (8 March 2010).

⁹ Natural Disaster Research et. al. 1999. *Final Report: Kingston Metropolitan Area Seismic Hazard Assessment*, Introduction, pp. 3.

¹⁰ International Geoscience Programme (IGCP). 2005. *Annual Report of IGCP Project No. 487*, Annex 3 – Year 2005, Jamaica, pp. 48.

¹¹ The Jamaica Gleaner. 2002. *A Special Gleaner Feature on Pieces of the Past: Disaster – ‘The Earthquake of 1907’*. <http://www.jamaica-gleaner.com/pages/history/story0017.html> (8 March 2010).



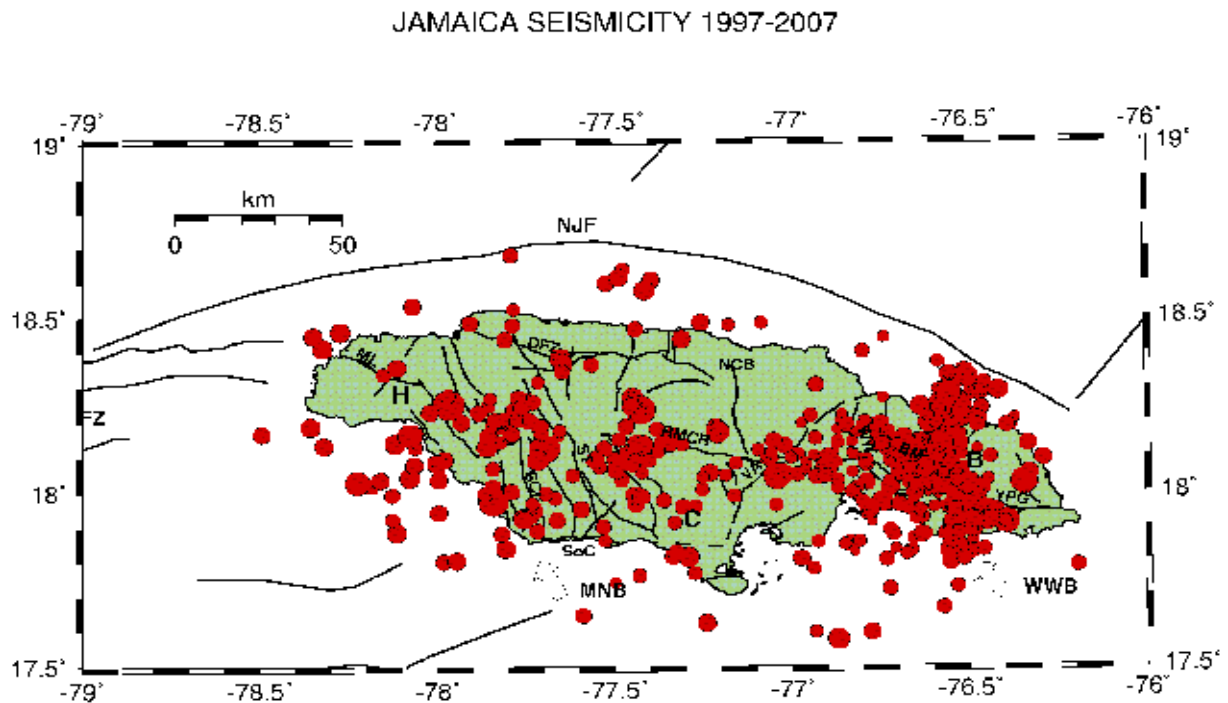
Source: University of the West Indies Earthquake Unit website. Map shows where the Enriquillo-Plantain Garden fault line cuts through the eastern part of Jamaica.

According to the University of the West Indies Earthquake Unit, “[about] 200 earthquakes are located in and around Jamaica per year, most of which are minor, having magnitudes less than 4.0. The most seismically active areas are the Blue Mountain block in eastern Jamaica and the Montpelier-Newmarket belt in western Jamaica”¹². John Shepherd noted that Kingston has experienced approximately 20 damaging earthquakes per century, more than any other part of the country¹³. He concluded that this was a result of the close proximity of Kingston to the Enriquillo-Plantain Garden fault line that runs through the Blue Mountains and

¹² Earthquake Unit. 27 July 2007. *Earthquakes in Jamaica*. <http://www.mona.uwi.edu/earthquake/jaequake.php>. (1 February 2010)

¹³ Shepherd, John. 1971. *A Study of Earthquake Risk in Jamaica and its influence on Physical Development Planning*.

the fact that the KMA is “built on terrain with unconsolidated soil that exacerbates the ground shaking”¹⁴.



Source: University of the West Indies Earthquake Unit website. Map shows that the multiplicity of tremors occur in the eastern region of Jamaica near the KMA.

The geology of the KMA consists of bedrock on the mountain side of St. Andrew and Liguanea Alluvium in the plains of Kingston and St. Andrew¹⁵. While land along the Palisadoes, Port Royal and Kingston Harbour are comprised of sand, coral, gravel, along with “artificial fill and man-made ground”¹⁶. The bedrock is made up of limestone and volcanic and sedimentary rocks, while the alluvium contains sand, gravel, silt and clay¹⁷.

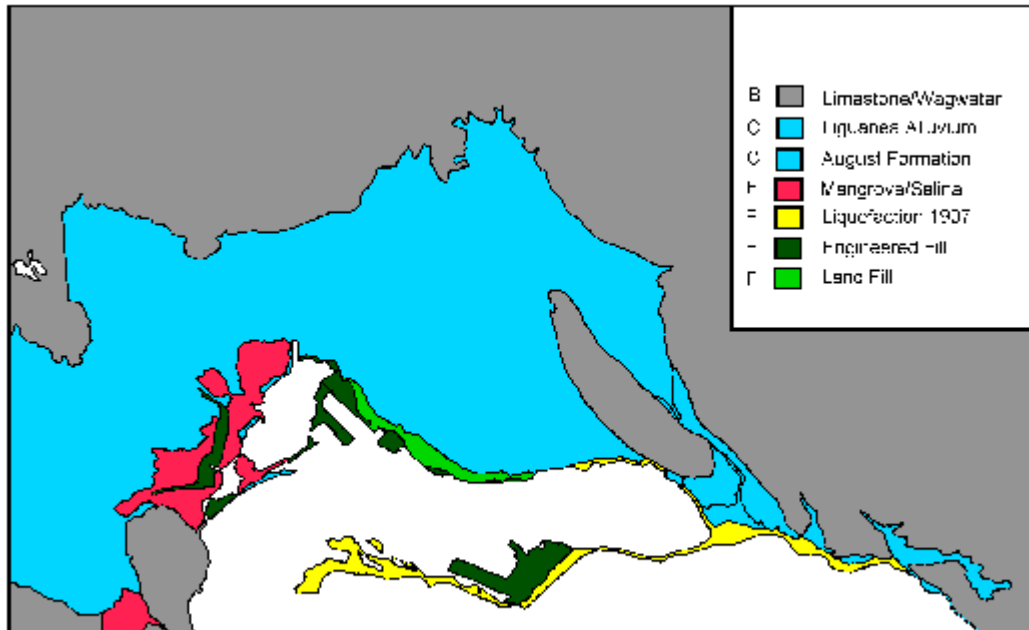
¹⁴ International Geoscience Programme (IGCP). 2005. *Annual Report of IGCP Project No. 487*, Annex 3 – Year 2005, Jamaica, pp. 48.

¹⁵ Natural Disaster Research et. al. 1999. *Final Report: Kingston Metropolitan Area Seismic Hazard Assessment*, pp. 8-9.

¹⁶ Ibid.

¹⁷ Ibid.

Soil Composition of the KMA



Source: Organization of American States (OAS). 1999. *Final Report: Kingston Metropolitan Area Seismic Hazard Assessment*, Chap. 4, pp. 14.

Much of these soil combinations produce instability and create the possibility of landslides and liquefaction. The combination of said factors results in the KMA having a higher probability of experiencing damage from earthquakes/tremors than the rest of the island.

Is Kingston Prepared for a Magnitude 6.5 or above Earthquake?

There have been conflicting reports about whether Kingston would be as devastated as Port-au-Prince was on 12 January 2010 if faced with an earthquake of similar magnitude. There are scholars and analysts that agree that there would be some devastation, but not to the same extent as Haiti given Jamaica's adherence to local and international building codes; however, others, such as Dr. Paul Mann, a geologist from the University of Texas, believes that this would not matter given that an earthquake of this magnitude would be the equivalent of a

thermonuclear bomb going off¹⁸. In order to know the extent of the damage Kingston might experience in a M 6.5 or above earthquake, a number of related factors must be assessed.

1. BUILDING CODE and INFRASTRUCTURE

At present, Jamaica has not passed legislation for an official national building code. The Jamaican government, after the devastating 1907 earthquake, demolished all the turn-of-the-century buildings and implemented a new standard that called for new buildings to be no more than 60 feet¹⁹. Since then, buildings have exceeded this height but mandates that they be reinforced with concrete and steel have also been established. A National Building Code has been on Jamaica's agenda since 1983²⁰. While a report has been published on the issue since then, legislation has been stalled on multiple occasions, the last being in 2005.

According to the KMA Seismic Report, the National Building Code as of 1999 conforms to the British Standards of Code and Practice, the Caribbean Uniform Building Code (CUBIC), the Recommended Lateral Force Requirements of the Structural Engineers Association of California (SEAOC) and recommendations from the Jamaica Bureau of Standards. Therefore, the requirements cover expected peak acceleration of 40% g and 10% probability of exceedence in 50 years and is equivalent to a distance of 16 miles for M 6.5 and 25 miles for M 7.0²¹. There have been further revisions to the National Building Code, the latest round started in 2005. According to David Chung, President of the Jamaican Institute of Engineers, "We are trying at this point to legislate the International Building Code. The engineers have done a lot of work on

¹⁸ Ridquist, Sigfrid. January 2010. 'Fault poses serious earthquake risk to Caribbean countries', <http://www.allvoices.com/contributed-news/5083767-fault-poses-serious-risk-to-caribbean-countries>. (18 February 2010)

¹⁹ Ibid; KMA Seismic Hazard Report, Conclusion

²⁰ Hall, Anthony. 7 February 2010. 'Call for National Building Code', <http://www.jamaica-gleaner.com/gleaner/20100207/news/news7.html>. (7 February 2010)

²¹ KMA Seismic Hazard Report, Conclusion, pp. 3

it since 2005...It is in the Office of the Prime Minister and it is something we need to push through”²². Jamaican contractors, planners, architects and engineers abide by these codes, and the City Engineer and his building officials attached to Kingston and St. Andrew Corporation (KSAC) only pass building plans and approve construction in accordance with these codes²³. However, given that there is no official law, it is open to interpretation as to the proper integration of prevention and multi-hazard construction practices, including earthquake resistance, into the building code. Failure to address these issues, some believe, will put many Kingstonians at risk. All experts demand that the National Building Code be made into law²⁴.

There are officially two arguments for and against the efficiency of the code and the devastation that the KMA would experience if hit by a M 6.5 or above earthquake. Some analysts believe that given the country’s superior construction culture, contractors’ adherence to the present code, plus the country’s greater resources relative to Haiti, Kingston can rest easier. Roger Musson, an advisor for the British Geological Survey, notes that in “wealthier countries, masonry is held together with steel rods known as rebar, or reinforcing bar. The pliable steel absorbs some of the movement of the earth and prevents brittle cement from crumbling and toppling.”²⁵ This is essentially the practice followed by Jamaican contractors when building both formal and informal structures. Michael Archer, past president of the Incorporated Masterbuilders Association, observes that “[when] you look at the damage in Haiti, you see little or no steel...Anyone who is building in Jamaica knows you have to find a mason and a steel man.

²² Hall, Anthony. 7 February 2010. ‘Call for National Building Code’, <http://www.jamaica-gleaner.com/gleaner/20100207/news/news7.html>. (7 February 2010)

²³ Kingston and St. Andrew Corporation (KSAC). 2008. ‘City Engineer’, http://ksacorp.gov.jm/index.php?option=com_content&task=view&id=69&Itemid=. (18 February 2010)

²⁴ Hall, Anthony. 7 February 2010. ‘Call for National Building Code’, <http://www.jamaica-gleaner.com/gleaner/20100207/news/news7.html>. (7 February 2010); The Jamaica Observer. 15 February 2010. ‘Pass the building code law now’, http://www.jamaicaobserver.com/editorial/editorial-for-feb-15_7420774. (15 February 2010)

²⁵ Randall, Tom and Meg Tirrell. 15 January 2010. ‘Haiti Quake Boosts Long-Term Risk of Jamaica Temblor (Update 1)’, <http://www.bloomberg.com/apps/news?pid=20601124&sid=aFUj1y6PA1Pk>. (18 February 2010)

Even though they are building an informal structure they know how to build in a formal sense”²⁶. Ronald Jackson, Director General of the Office of Disaster Preparedness and Emergency Management (ODPEM), echoed this sentiment. He states that “the difference is that when our squatters build a concrete structure, they build with steel, while in Haiti there wasn't much steel”²⁷.

Other experts paint a grimmer picture. To quote Franklin McDonald, Coordinator of the Institute for Sustainable Development, University of the West Indies, “Some of the buildings I see on the ground in Haiti were designed using proper building codes. We need to separate the buildings that fell down and compare them to Jamaica...The (Haitian) government ministries, the palace and other buildings were built in the 1920s by the Americans to building codes that were in effect at the time”²⁸. He argues that the KMA is not as earthquake resistant as many Jamaicans, both experts and the public, would want to believe. He states that “[we] have buildings in Kingston that we know are problematic. One very close to us [The Jamaica Gleaner Company]... is well known as a design that doesn't do well in earthquakes”²⁹. While Mr. Franklin McDonald’s concern is understandable, his argument rests on 1920 building codes. Jamaica presently abides by the most recent international building codes and as such cannot be compared to the dated structural laws followed by Haiti. The KMA’s major concern should rest with the informal settlements in and around the area. It is understood that they too, more often than not, follow the established building code, though there are some instances where establishments are built with substandard material. Steel and concrete blocks are sometimes pilfered from other

²⁶ Douglas, Luke. 27 January 2010. ‘Haiti Wake Up Call’, http://www.jamaicaobserver.com/environment/Earthquakes-preparedness-3_7353268. (27 January 2010).

²⁷ The Jamaica Observer. 15 February 2010. ‘Pass the building code law now’, http://www.jamaicaobserver.com/editorial/editorial-for-feb-15_7420774. (15 February 2010)

²⁸ Hall, Anthony. 7 February 2010. ‘Call for National Building Code’, <http://www.jamaica-gleaner.com/gleaner/20100207/news/news7.html>. (7 February 2010)

²⁹ Ibid.

construction sites or recovered from old or demolished buildings, and sometimes cement of the lowest quality is purchased because it is the cheapest to buy. While this may be true, ‘squatters’ take pride in their construction and will more often than not try to purchase or pilfer the best material possible.

2. PUBLIC ADMINISTRATION

Public Administration in Jamaica is concentrated and decentralised. It is concentrated in the sense that all the government ministries in addition to the Office of the Prime Minister and the legislature (Gordon House) are either located in ‘Downtown’ Kingston or New Kingston. Many of the government offices in Downtown Kingston were built prior to Independence but have on occasion been renovated to include some of the new standards expressed in the building code. According to Maurice Mason, an environmental economist from the Institute for Sustainable Development at the University of the West Indies, (UWI), Mona, if a M 6.5 earthquake were to hit the KMA, “[government] buildings would sustain, at best, \$3.4 billion in damage...and the entire country would need a total of US\$30 billion (\$2.1 trillion) to recover”³⁰. There are some government buildings that are not sound and can pose a severe threat to people. In addition, he expressed concern about liquefaction, as “the soil type of Kingston and St Andrew is more prone to liquefaction than other types of soil in other parts of the island because of its sandiness.”³¹ There have been discussions on moving Gordon House from Downtown Kingston to a location above or around New Kingston but this is yet to be resolved. However, in the event of an earthquake devastating the home of the Legislature, most Cabinet and House papers and files are also stored physically or electronically at the Jamaica Information Service

³⁰ Manning, Gareth. 29 June 2008. ‘Earth Matters – Decentralise Emergency Services, say planners’, <http://www.jamaica-gleaner.com/gleaner/20080629/news/news1.html>. (18 February 2010)

³¹ Ibid.

(JIS) offices. Also, Vale Royal, located on the outskirts of New Kingston, has on occasion been used for unofficial meetings of government. One expects that a study of the renovation technology used for this building be carried out and the necessary adjustments made so that it can withstand such an earthquake in order for official business to be conducted unhindered.

It is decentralised in the manner that all public services are not only being carried out by ministry officials and staff. The country, during the late 1990s, created autonomous government agencies to carry out the day-to-day public services in the KMA and the rest of the country. Each government agency either has a branch in each parish or one that services a specific region of the country in order that if there are any problems at the central office the work of the state will continue. For example, under Jamaica's Tax Administration System there have been the establishment of new and restructured tax departments and offices³². In the case of the Inland Revenue Department (IRD), there are three branches in the KMA, a branch in most of the capital cities across the country and a customer care centre in May Pen, Clarendon³³, which is some distance away from the KMA. In the event that the KMA is devastated, branch managers can override the central system to access information from the KMA with the permission of the Head Office³⁴. For example, tax payers can go to any other branch island-wide to carry out their transactions as long as they have the necessary documentation³⁵. This is also true for other government agencies.

Additionally, Jamaica has heavily invested in e-government. The United Nations Public Sector Report notes that Jamaica is second only to Trinidad in the e-government and e-

³² Tax Administration, Jamaica. 2008. 'Jamaica's Tax Administration System'.
http://www.jrs.gov.jm/home_template.php?page=depunits#IRD. (24 February 2010)

³³ Ibid.

³⁴ Need to find a quote. This requires further research.

³⁵ Tax Administration, Jamaica. 2008. 'Frequently Asked Questions'.
http://www.jrs.gov.jm/home_template.php?page=FAQs&id=84&cid=4 (8 March 2010).

participation indices given its willingness to provide high quality information and grant access to government files and papers³⁶. Again, the work of government will continue given the level of protection and availability of government files. It is assumed that Ministers and their staff will be able to access essential information from anywhere if the central offices in the KMA are negatively affected by a serious earthquake³⁷. The only probable hindrance to this plan of action is access to electricity. The majority of the country's power plants, which provide electricity for nearly all of the country, are located in the KMA. However, given Jamaica Public Service Company's (JPSCo.), the island's sole electric company's, past experience with a M 5.4 earthquake on 13 January 1993, their knowledge of the frequency of hurricanes and high insurance costs attached to these events, it has been "proactive and taken appropriate mitigation measures"³⁸ JPSCo. has become very proficient in reconnecting the island's electricity (in as short as a day to a week) after a number of disasters since 1993, and as such, this will prove to be a minor glitch in re-establishing the public administration system.

3. HEALTH CARE SERVICES and DISASTER RESPONSE

There is much question about whether the disaster response teams and health services will be as effective and efficient as many would hope. This problem stems from the fact that both services are highly centralised. There have been calls from the ODPEM, experts, academics and other public sector officials for the government to decentralise these operations. Director General for the ODPEM in 2005, Dr. Barbara Carby, noted that "we do not do enough systemic

³⁶ United Nations. 2004. *Jamaica: Public Administration Profile*.

<http://unpan1.un.org/intradoc/groups/public/documents/un/unpan023200.pdf>. (15 February 2010)

³⁷ Will need to do further research on the type of server and networking used by the Jamaican government to determine the ability of Ministers and their staff to access information in the event of a disaster.

³⁸ KMA Seismic Hazard Report, Conclusion, pp. 3; Ahmad, Rafi. 2001. Earthquakes in Jamaica are inevitable but earthquake disasters need not be? http://www.mona.uwi.edu/uds/GEOHAZARDS_2001/EQprep-20010612b.html. (24 February 2010)

vulnerability analysis programmes. We are not prepared for a major earthquake in Jamaica.”³⁹ She went on to say that one of the most vulnerable sectors is the health sector as “[hospitals] may be unable to cope due to lack of blood supply along with insufficient equipment and supplies”⁴⁰. By extension, the earthquake could be made worse by the structural and non-structural vulnerabilities found in Jamaica’s healthcare system, which could lead to the closure of vital health facilities and inability to evaluate patients when they are most in need⁴¹. Structural damage to health facilities in the KMA may place a greater burden on those facilities outside the area, many of which are ill-equipped to carry the services offered by KMA facilities. If there is no proficient support for addressing these vulnerabilities, then the sector may be at great risk. Risks associated with this situation include potential loss of life or injury to patients and staff, property loss, and interruption or loss of essential functions⁴².

Additionally, she noted that while there are shelters in the area in the event of a destructive earthquake, she opines that most were not built with earthquakes in mind. She also shows concern for the response and rescue capabilities of the Jamaican Fire Brigade. She found that “the fire service under normal circumstances faces serious problems of material, equipment constraints and training. They will need considerable support after a major earthquake. Training of the population in search and rescue will ease the pressure on the fire service”.⁴³ Therefore, she

³⁹ Jamaica Information Service (JIS). 12 January 2005. ‘Country not Adequately Prepared for a Major Earthquake – Dr Carby’, http://www.jis.gov.jm/land_environment/html/20050112t090000-0500_4597_jis_country_not_adequately_prepared_for_major_earthquake___dr___carby.asp. (18 February 2010)

⁴⁰ Ibid.

⁴¹ Mason, Maurice. 2005. *A Socioeconomic Impact Assessment of the 1907 Earthquake on the Jamaican Economy*, Paper presented at the 2008 National Disaster Management Conference: Furthering the Risk Reduction Agenda – Landslides and Earthquakes, pp. 58

⁴² National Society for Earthquake Technology (NSET). n.d. *Non-structural Assessment of Hospitals in Nepal, Annex #2: Significance of Non-Structural Damage*, pp. 42. http://www.disaster-info.net/safehospitals_refdocs/documents/english/ReferenceDocsByCountry/Nepal/NonStructVulnAssessHospNepal.pdf, (5 May 2010).

⁴³ JIS. 12 January 2005. ‘Country not Adequately Prepared for a Major Earthquake – Dr Carby’, http://www.jis.gov.jm/land_environment/html/20050112t090000-0500_4597_jis_country_not_adequately_prepared_for_major_earthquake___dr___carby.asp. (18 February 2010)

was left to conclude that Jamaica, in general, and the KMA, more specifically, has emergency facilities that are below par. She also presented a picture of a public that neglects to participate in earthquake and mitigation exercises, which she finds to be a formula for a disastrous outcome after an earthquake event.

By 2006, however, the ODPEM had stepped up efforts to prepare persons who live and work in the KMA. There were a series of workshops and earthquake drills. The first workshop was used to train Safety Wardens in their roles and responsibilities. The second was to include all other groups and persons, most specifically those in the business sector in the heart of KMA (New Kingston), so as to ensure full participation in the drill⁴⁴. Nineteen assembly points for the 120 businesses were located⁴⁵. It was said that initial support for the effort was low, however, thousands of persons eventually participated in the scheduled earthquake drill held on 7 June 2006. It was found that most people stuck to the plan and the Safety Wardens carried out their roles and responsibilities relatively well⁴⁶. While the emergency services may have some deficiencies, these are made up for by the human capital and skills acquired as they become sensitised to respond to disaster events. There will be a lower loss of life as a result.

By 2008, the new Director General of ODPEM, Ronald Jackson, echoed Dr. Carby's concern. He believes that too many of the country's critical care services, particularly health care and disaster response services, are located in the KMA, a potentially disastrous situation due to

⁴⁴ JIS. 28 April 2006. 'Training Workshops in Preparation for New Kingston Earthquake Drill', http://www.jis.gov.jm/land_environment/html/20060427T130000-0500_8705_JIS_TRAINING_WORKSHOPS_IN_PREPARATION_FOR_NEW_KINGSTON_EARTHQUAKE_DRILL.asp. (18 February 2010)

⁴⁵ JIS. 5 June 2006. 'Safe Assembly Points Identified for New Kingston Earthquake Drill', http://www.jis.gov.jm/agriculture/html/20060602t120000-0500_9015_jis_safe_assembly_points_identified_for_new_kingston_earthquake_drill.asp. (18 February 2010)

⁴⁶ JIS. 9 June 2006. 'Thousands take Part in Earthquake Drill in New Kingston', http://www.jis.gov.jm/land_environment/html/20060608t090000-0500_9053_jis_thousands_take_part_in_earthquake_drill_in_new_kingston.asp. (18 February 2010)

its close proximity to the Enriquillo-Plantain Garden fault zone. Mr. Jackson's concern is understandable given that 80% of the country's critical care services are located in the KMA. According to the Jamaica Gleaner, this includes "two of three Type One hospitals, head offices of the National Emergency Response Unit and the ODPEM."⁴⁷ According to Charles Granston, a local pharmacist and President and Managing Director of PharmNet Jamaica, Ltd., "a Type One or more correctly a Type A hospital is a comprehensive hospital. This means it carries out all the services of a fully equipped hospital. Radiology, CT scans, MRIs, blood labs and all diagnostics are carried out in this hospital."⁴⁸

Though Type A hospitals go through periodic renovations in accordance with the building code, there has been said to be some "inefficiencies at enforcing the building code"⁴⁹. Due to insufficient data, environmental economist Maurice Mason believes that "there exist great uncertainty (sic) to the seismic durability of hospitals and its ability to maintain the logistics of a functioning hospital in the event of a magnitude 6.5 earthquake"⁵⁰. These factors can heighten the structural and non-structural vulnerabilities discussed earlier. If the two Type A hospitals in the KMA, the University Hospital of the West Indies (UHWI) and the Kingston Public Hospital (KPH), are damaged during an earthquake, there will be added pressure on the only other Type A hospital, Cornwall Regional Hospital, located on the other end of the island. There are Type B and C hospitals island-wide, but they are ill-equipped to carry out the services provided in Type A hospitals. They are restricted to "limited diagnostic capabilities that vary depending on the hospital and it is for this reason when unable to service a patient they are regularly transferred to

⁴⁷ Manning, Gareth. 29 June 2008. 'Earth Matters – Decentralise Emergency Services, say planners', <http://www.jamaica-gleaner.com/gleaner/20080629/news/news1.html>. (18 February 2010)

⁴⁸ Interview with Mr. Charles Granston, pharmacist, conducted by author on 25 February 2010.

⁴⁹ Mason, Maurice. 2005. *A Socioeconomic Impact Assessment of the 1907 Earthquake on the Jamaican Economy*, pp. 58

⁵⁰ Ibid.

the nearest Type A Hospital”⁵¹. In addition, there are Type A private hospitals in the KMA. The problem is there is little data available on what impact the event of a M 6.5 or above earthquake would have on them.

Given the gravity of the shortcomings in the healthcare system, the best option for the country is to decentralise. The debate arises as to how decentralised the critical care system should be. Dr. Carol Archer, a physical planner, noted that “[we] need to decentralise service provision, and by decentralising, that means some of the key agencies need to be outside of Kingston.”⁵² This, she believes, will allow for a better response from emergency agencies to needs that arise if the capital becomes severely crippled. Desmond Hall, who is also a physical planner, believes that it is not necessary to decentralise to the degree that Dr. Archer suggests. He believes that the Jamaican government should, instead of spreading out its emergency services, simply upgrade those institutions located outside of the KMA. For example, Type B and C hospitals, such as The Spanish Town Hospital, St. Ann’s Bay Hospital and The Port Antonio Hospital, located in the parishes closest to the KMA, should be refurbished to provide all the services a Type A hospital would in order to optimise essential services.

Whatever route chosen, Director General Jackson seems to agree with the need for decentralisation. He wants to ensure that the state will survive such an event and declares that “[it] makes all sense if you look at a major event happening and your government operations are stymied, it will give the sense that there is nobody in charge of the country and you are not able to get the systems of governance up and running. It can't be that all our government entities are located in the most seismic zone.”⁵³

⁵¹ Interview with Mr. Charles Granston, pharmacist, conducted by author on 25 February 2010.

⁵² Manning, Gareth. 29 June 2008. ‘Earth Matters – Decentralise Emergency Services, say planners’, <http://www.jamaica-gleaner.com/gleaner/20080629/news/news1.html>. (18 February 2010)

⁵³ Ibid.

4. WATER and SANITATION SERVICES

Water and sanitation services are essential after a disastrous event. If not properly maintained, they can exasperate the effects of a M 6.5 or higher earthquake by producing a number of health hazards. Many of the pipes that service the area were laid prior to Independence. Hence it can be assumed that they are brittle, with the potential to burst, releasing refuse, increasing vulnerability to disease among the population, particularly those located in the low income communities in and around Downtown Kingston that already have problems related to water and sanitation. Additionally, old and new potable water distribution pipes could also be severely damaged. Maurice Maso found that “[large] diameter pipes...are expected to experience joint failures and wrinkling from compression, especially where alluvial soils are located. Small diameter pipes used mainly for localized distribution [could] also experience failures”⁵⁴.

For the middle and upper income communities to the north, the average home is fitted with at least a medium to large water tank, which lasts two weeks, on average, to ensure the continued comfort and survival of the residents. The main problem with these tanks is that they may not be as strong, and if not fitted properly, can result in their capsizing or bursting when placed under pressure⁵⁵.

The KMA is serviced by the Mona Dam/Reservoir, which lies to the east of the area and is thus closer to the Enriquillo-Plantain Garden fault. There is concern over the location of this reservoir due to fear of possible liquefaction⁵⁶. Water services are offered by the government-run National Water Commission (NWC). The former Director General of ODPEM, Dr. Carby,

⁵⁴ Mason, Maurice. 2005. *A Socioeconomic Impact Assessment of the 1907 Earthquake on the Jamaican Economy*, pp. 55

⁵⁵ Jamaica Information Service (JIS). 12 January 2005. ‘Country not Adequately Prepared for a Major Earthquake – Dr Carby’, http://www.jis.gov.jm/land_environment/html/20050112t090000-0500_4597_jis_country_not_adequately_prepared_for_major_earthquake__dr__carby.asp. (18 February 2010)

⁵⁶ Mason, Maurice. 2005. *A Socioeconomic Impact Assessment of the 1907 Earthquake on the Jamaican Economy*, pp. 55

expressed concern over water and sanitation if the KMA was to be hit by a devastating earthquake. She states

“...most our major water storage is located in Kingston and St. Andrew, particularly in Kingston they are close and we could lose both depending on the epicentre of the earthquake... Some 99 per cent of the NWC's facilities depend on power, and if there is no power, there is no water. Trying to truck water, even just to urban areas of Kingston, the NWC does not deliver enough water. Provisional potable water is going to be a serious problem after a major earthquake, if we do not address this situation immediately”⁵⁷.

Environmental economist Maurice Mason also supports this position, also noting that water distribution and sanitation are dependent on electrical power stations. He states that in the KMA

“...water systems are dependent on pumps to maintain pressure, so that a loss of power will quickly cause a drop in water pressure and flow. This can be critical for fire control and suppression after an earthquake. Gravity-feed water systems – water treatment facilities – require electric power for their control and operation; there loss of water quality and safety are expected from prolonged loss of power”⁵⁸.

Due to the experience demonstrated by JPSCo. in previous events, better performance is expected in the restoration of water supply to the KMA.

5. HOUSING and SCHOOLS

Housing is of concern because the location and quality of materials used to build homes can determine the effect an earthquake has on KMA citizens. Housing in Jamaica consists mainly of single-family homes with one to two stories on reasonable plots of land. However, in recent years there has been a growing proliferation of “high intensity structure[s], three or four floors, apartments and gated communit[ies]”⁵⁹. Before formal housing structures are constructed, builders often follow the proper channels. Land surveyors, building surveyors and inspectors, as well as architects and contractors operate in accordance with the National Building Code. First,

⁵⁷ Jamaica Information Service (JIS). 12 January 2005. ‘Country not Adequately Prepared for a Major Earthquake – Dr Carby’, http://www.jis.gov.jm/land_environment/html/20050112t090000-0500_4597_jis_country_not_adequately_prepared_for_major_earthquake___dr___carby.asp. (18 February 2010)

⁵⁸ Mason, Maurice. 2005. *A Socioeconomic Impact Assessment of the 1907 Earthquake on the Jamaican Economy*, pp. 44

⁵⁹ Ibid, pp. 50.

the land purchased has to be certified that it is tenable to build a house on. The location of housing construction is determined by the Housing Act of Jamaica,⁶⁰ which ensures that homes are not built in areas of high vulnerability to floods or landslides associated with natural disasters. The KSAC then approves the building plans, whether for new construction or renovation, under the Housing and Local Improvements Acts respectively, as well as the National Building Code⁶¹. After which a KSAC building engineer inspects the finished home to ensure it meets all safety standards. If built to code, the home should be able to withstand various natural hazards.

Informal housing settlements, on the other hand, pose a major problem because even though most are built to code, their location is often untenable. Squatters tend to build on captured land, for which they do not know the dangers or vulnerabilities. In addition, homes in these areas are usually built extremely close to one another, whereby the swaying associated with an earthquake could possibly cause more damage than if they were built to regulation. Overcrowding in such an area can also pose a problem, because if substandard material is used, homes can collapse on the residents, resulting in a higher death toll than warranted.

Some experts paint a less stellar picture of the potential effects a M 6.5 or above earthquake on the formal and informal housing sectors in Jamaica. Maurice Mason argues that direct damage may be worsened by

- “poor construction regulations;
- architectural design;
- structural miscalculations;

⁶⁰ Kingston and St. Andrew Corporation (KSAC). 2008. ‘City Engineer’, http://ksacorp.gov.jm/index.php?option=com_content&task=view&id=69&Itemid=. (18 February 2010)

⁶¹ Ibid.

- construction management;
- construction processes;
- and material quality”⁶².

His research found that household construction is largely unregulated. Most of these factors listed can be blamed on large developers subcontracting construction out to smaller companies that generally are not certified by a national body⁶³. He states that there are a number of uncertified contractors, developers, and unskilled workers whose services can effectively lead to a lower quality of housing, and by extension, an increased risk of avoidable damages. Moreover, Mason found that this practice continues because “the construction phase [is] not monitored sufficiently by the state”⁶⁴.

Schools are said to be the most up to code structures in the KMA. According to the Ministry of Education and Youth, schools are safe, can withstand tremors and remain intact.⁶⁵ They are designed for use as shelters in the short run after natural disasters, namely earthquakes and hurricanes. Lauriston Wilson, Director of Project Management in the Ministry, assures that they are built to the most recent building codes, including the National Building Code, CUBIC and the SEAOC code. Additionally, he noted that buildings were “of column and beam-type designs with infilled walls.”⁶⁶ To quote Mr. Wilson, “the walls, we make them non-load-bearing, because in the effect of a powerful earthquake the walls may fall out, but the building as such,

⁶² Mason, Maurice. 2005. *A Socioeconomic Impact Assessment of the 1907 Earthquake on the Jamaican Economy*, pp. 50

⁶³ Ibid.

⁶⁴ Ibid, pp. 53.

⁶⁵ JIS. 15 January 2007. ‘School Buildings will Withstand Earthquakes - Education Ministry’, http://www.jis.gov.jm/education/html/20070112T110000-0500_11015_JIS_SCHOOL_BUILDINGS_WILL_WITHSTAND_EARTHQUAKES___EDUCATION_MINISTRY.asp. (18 February 2010)

⁶⁶ Ibid.

will not collapse”⁶⁷. Hence, in the event that a strong earthquake occurs, students, who have been participating in yearly earthquake drills during ‘Earthquake Week’ held island-wide each January, will be sensitised as to what to do. By extension, schools may be disrupted in the short run as they act as shelters for displaced people, but in the medium to long run, they will be fully operational and the education of students will not be hindered.

6. COMMERCIAL, FINANCIAL AND INDUSTRIAL SECTORS

These are the most vulnerable sectors in the KMA. Apart from Tourism, these are the heart of economic life in Jamaica. They are located in the New Kingston and Downtown Kingston vicinity. Downtown Kingston, particularly the Kingston Wharves, acting as the major port for the country’s imports and exports, could potentially become paralysed in the event of a major earthquake. Many of the buildings in the vicinity, which house customs and transshipment goods, are very old and in need of demolishing. Their collapse is one likely possibility. To be more specific, damage could include:

- “failure of piers,
- mechanical equipment, piping,
- Collapsed cranes
- Spilled container units”⁶⁸

Such damage would be the result of liquefaction, along with the age and structural design of the buildings and equipment.

In addition, the country’s sole oil refinery, Petrojam, could also be significantly affected given its location along the Kingston Harbour. According to Maurice Mason, Petrojam is built on

⁶⁷ Ibid.

⁶⁸ Mason, Maurice. 2005. *A Socioeconomic Impact Assessment of the 1907 Earthquake on the Jamaican Economy*, pp. 48

alluvial soil, which will result in a great deal of shaking due to liquefaction⁶⁹. Additionally, he suspects that fires would result from a M 6.5 or above earthquake. He asserts that “there will be fires at the refinery at different locations; warehouses and tanks are at great risk of fire [and damage to infrastructure]. Fires of this type and magnitude are beyond the fire fighting capacity to handle”⁷⁰. It, and the surrounding area, will likely experience the effects of air, water and soil pollution. Mason opines that

“...[the] contents of the damaged tanks...will emit volatile organic compounds...into the atmosphere thus causing further air pollution. An emission of sulphur dioxide is expected from the content of burnt oil products. The Kingston Harbour is expected to be seriously polluted by oil, oil products and fuel originating from the refinery”⁷¹.

In effect, the residents, particularly those from the low-income communities, employees, businesses in the surrounding area, and marine life, will likely suffer the long-term consequences of exposure to these toxins. Petrojam provides fuel to JPSCo., petrol stations, and a number of other businesses. Such significant damage would paralyse other sectors, not only in the KMA, but throughout the rest of the country.

The Norman Manley International Airport, though able to withstand the effects of a moderate earthquake, would likely be closed off due to the threat of tsunami or liquefaction facing the Palisadoes roadway, a small strip of land connecting mainland Kingston to Port Royal.⁷² The severity of a M 6.5 or above earthquake may lead to pavement cracking and moderate building damage, particularly in the control tower and terminal area⁷³. Without access, relief efforts may be slowed considerably, and trade would be halted, putting the country into economic turmoil. The bright spot, however, rests in the fact that the country has another

⁶⁹ Ibid, pp. 48.

⁷⁰ Ibid.

⁷¹ Ibid.

⁷² KMA Seismic Hazard Report, Conclusion, pp. 3-4.

⁷³ Mason, Maurice. 2005. *A Socioeconomic Impact Assessment of the 1907 Earthquake on the Jamaican Economy*, pp. 50

international airport, The Donald Sangster International Airport, to the west of the country in Montego Bay, as well as smaller air strips that would allow rescue personnel and goods to reach the KMA. Also, commerce would pick up sooner than expected if other ports, namely those on the North Coast, could be used dually as transshipment centres and tourist arrival ports. The building of major highways across the land would also ease the movement of goods and personnel from one point to the other.

New Kingston may fare better given the newer buildings and the continual renovations carried out on them. However, if a lack of electricity and fuel persists, the banking sector would fundamentally be hampered since major banks such as the Bank of Nova Scotia (BNS) and the National Commercial Bank (NCB) depend on generators to carry out business in the event of a loss in electricity. Moreover, there would be further economic loss as the transport, storage and communications sectors, the most vulnerable sectors and second largest contributors to GDP⁷⁴, experience significant setbacks. In all, Dr. Dirk Hollnack expects “direct damage to be 15% of the 2005 infrastructure within the Jamaica economy,”⁷⁵ the majority of which would happen within the KMA. Economist Maurice Mason also estimates that direct losses would amount to US \$5.55 billion, which, when claims were made, would leave the insurance sector insolvent, forcing the Jamaican government to render US \$3.5 billion to rebuild the KMA and the local economy⁷⁶.

⁷⁴ Ibid, pp. 61

⁷⁵ Ibid, pp. 62

⁷⁶ Ibid, pp. 62-63

Conclusion

If the KMA were exposed to an earthquake of similar characteristics to the one in Port-au-Prince, it may not experience as much damage. Its superior culture of construction is one factor. However, one has to err on the side of caution and note that there are a significant number of buildings within the KMA that are considered highly vulnerable, especially those within the lower income communities and Downtown Kingston. Expert advice needs to be kept in mind, particularly calls to further decentralize services, both governmental and emergency, away from the KMA, as well as calls for the Jamaican government to finally pass legislation turning the building code into law so as to solidify all the recent improvements. While the KMA has to work around the geology and seismology of the area, the risks associated with an earthquake cannot be overcome unless the citizens participate in regular training exercises in order to know what to do in such an event. The ODPEM, NGOs, community actors, and the Jamaican government need to step up these efforts if they want to reduce the negative effects of a potential M 6.5 or above earthquake.