NOISE EXPOSURE MITIGATION PLAN REPORT (D5)

airports authority of jamaica

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Executive Summary

This Noise Exposure Mitigation Plan Report is divided into two main sections: **Ambient Noise Monitoring** (Noise Exposure Maps and Land-Use Compatibility Analysis); and **Aviation Noise Contour Development.**

Ambient Noise Monitoring

Seven (7) noise meters with outdoor monitoring kits were set up at each monitoring location to collect data every second for twelve (12) days (March 13 – 24, 2020). The monitoring locations were as follows:

- Runway 12
- Runway 30
- Caribbean Maritime University (CMU)
- Port Authority Harbour Dept
- Harbour View - Martello Drive
- Port Henderson - Royal View Hotel
- Grand Port Royal Harbour Hotel

Runways 12 and 30 had the highest average daytime and night-time noise levels of all the stations surveyed. The Caribbean Maritime University (CMU) had the lowest daytime and night-time noise levels of all the stations surveyed but were still non-compliant with National Resources Conservation Authority (NRCA) Guidelines for Educational Institutions. All other stations had daytime and night-time noise values compliant with their respective NRCA Guideline values.

The Federal Aviation Administration (FAA)has established a Day-Night Average Sound Level (DNL) noise guideline (< 65 dBA) for land-use compatibility (residential, commercial, educational land-use zones). These are areas where people spend widely varying amounts of time in which quiet is a basis for use. All survey locations (residential, commercial and educational stations) were compliant with the 65 dBA FAA DNL guideline. Both airport runways (industrial stations) had noise values compliant with the 75 dBA DNL guideline.

Some of the maximum noise levels for each sampling day (during March 13-24 survey) were extracted and evaluated to determine if the noise was attributed to an aircraft. This was done by comparing date and time of aircraft arrival/departure and date/time of noise spike, in addition to listening to the recorded noise signature.

The data showed that three out of the five non-runway monitoring stations had noise levels attributed to aircrafts, which exceeded the respective NRCA guidelines. These three stations were: Grand Port Royal Harbour Hotel, Port Henderson Royal View Hotel and the CMU. The CMU and Grand Port Royal Harbour Hotel are the two closest receptors to the airport runways. A trend was noticed whereby departures from Runway 12 were the most frequent occurrence resulting in elevated noise levels at these two locations, which is expected since they are the closest. When an aircraft is departing and ascending it employs roughly 70% thrust power (depending on the weight/load of the aircraft), therefore noise levels would be at their highest during ascent. Grand Port Royal Harbour Hotel is in the direct departure flight path after an aircraft departs from Runway 12 and makes the right turn to loop around and head in a north north-westerly direction. Although CMU is not in the direct departure flight path from Runway 12 or 30, it is still in close enough proximity to the airport to detect elevated noise levels during departure, regardless of which runway the aircrafts depart from. CMU is also zoned as an educational institution, therefore the NRCA Noise Guidelines are much lower compared to the other residential and commercial locations and noise impact would be higher during class time.

Aviation Noise Contour Development

Three (3) scenarios were modelled for the noise contour modelling exercise:

1. Existing scenario (82 daily flight operations)
2. Future Baseline High (123 daily flight operations)
3. Future Vision 2030 scenario (180 daily flight operations)

For Scenario 1, the 75 L_{dn} level contour is 95% contained within the airport boundary. Other 5% extends to Port Royal Main Road. The 55 L_{dn} level does not affect any population centres around the airport. The 50 L_{dn} noise contours extend past the Portmore area, but this does not represent a noise problem. For Scenario 2, the 55 LDN noise contour extends past the Royal View Hotel in Port Henderson affecting an estimated 560 people. For Scenario 3, 55 L_{dn} noise contour extends past the Royal View Hotel in Port Henderson affecting an estimated 8,474 people.

The recommended noise mitigation strategy for departures from Runway 30 (when traffic and aircraft operational conditions permit) is that of Reduced Thrust Settings as a form of noise abatement. This involves engaging airlines to use reduced thrust takeoffs for night departures from Runway 30 when wind conditions do not allow departures from Runway 12. This is a common technique that airlines use because it increases engine life and reduces maintenance cost. Reduced thrust setting departures are aircraft-specific but many of the routes flown from Kingston to Miami and Ft. Lauderdale using Boeing 737-800 and Airbus A320 aircrafts, which permit the use of reduced thrust settings especially at night.

The extension of the runway will also help promote reduced thrust takeoffs because pilots will have longer Accelerate-Stop Distance Available (ASDA) in the future. This will decrease the noise over Port Henderson, Portmore and other areas to the Northwest.

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1 Introduction

1.1 Background

The Norman Manley International Airport (NMIA) is the major gateway linking Jamaica's capital city to destinations worldwide (NMIA, 2008). The primary airport for business travel to and from Jamaica and for the movement of air cargo, NMIA plays a critical role in the economic development of Jamaica. It caters to over 1.7 million passengers, with an approximate 4% average growth rate and handles over 70 percent (17 million kgs) of the Island's airfreight. The airport business network comprises over 70 companies and government agencies, with over 3,500 persons directly employed at the airport.

The airport property covers 228 hectares and is located on the Palisadoes Peninsula between the communities of Harbour View and Port Royal (NMIAAL, 2008). It consists of the existing runway areas, public terminal and aircraft apron facilities, public access road and car parks, airside commercial development lands and areas used for airport and airline support functions. In addition, the property includes approximately 3 hectares, to the east, opposite the roundabout at the main entrance road.

The NMIA, which is bordered by the Kingston Harbour (7th largest natural harbour in the world), is located on a gently sloping to flat terrain. The topography of the site ranges from sea level at the Harbour's shoreline to approximately 10 feet midway the peninsula. The site's geomorphic and geological characteristic indicates a younger sediment formation (quaternary), consisting of coarse stipple and sand.

The NMIA is situated within the Palisadoes and Port Royal Protected Area (P-PRPA) which was declared a protected area under the Natural Resources Conservation Authority (NRCA) Act on 18 September 1998. The area is approximately 13,000 ha (130 km^2) in size and comprises the tombolo (Palisadoes), offshore cays, reefs and mangroves. The area was given protected status owing to its historic and archaeological sites of educational and cultural significance; spiritual values; natural resources as a basis for the livelihood for residents and other communities; unique ecosystems (sand/ dune, coral reef, lagoon, seagrass beds); nesting sites for sea turtles, birds and fish; protection and shelter prospects for small vessels/ boats during storms and hurricanes; and ability to act as a major local and international gateway i.e. by sea (seaports) and air (airports).

This **Noise Exposure Mitigation Plan Report** is divided into two main sections:

1. Ambient Noise Monitoring (Noise Exposure Maps and Land-Use Compatibility Analysis)
2. Aviation Noise Contour Development

1.2 Terms of References

The Noise Exposure Mitigation Plan will contain the following:

1. Results of the NMIA noise survey, recommendations and implementation strategies.
2. Noise contour preparations against prevailing land use and compatibility issues on and within designated radii from NMIA.
3. Outlining of mechanisms that encapsulate the aspirations for the airport and also protect the long-term viability of the airport through combining land use planning and airport operational controls.

2 Ambient Noise Monitoring (Noise Exposure Maps and Land-Use Compatibility Analysis)

2.1 Literature Review

This review focuses on the noise impact from the operations of airports generally and more specific from the Norman Manley International Airport. It examines the possible impacts from noise pollution such as changes in the noise climate (environmental noise), nuisance factor and communication impacts.

2.1.1 Sound

Brüel & Kjær, a world leader in sound and vibration measurement and analysis states: Sound is such a common part of everyday life that we rarely appreciate all of its functions. It provides enjoyable experiences such as listening to music or to the singing of birds. It enables spoken communication with family and friends. It can alert or warn us; for example, with the ringing of a telephone or a wailing siren.

Sound also permits us to make quality evaluations and diagnoses — the chattering valves of a car, a squeaking wheel, or a heart murmur (Brüel & Kjær, 1984). Singal (2005) defines sound as an oscillation in pressure in an elastic medium, which is capable of evoking the sensation of hearing. Simply put it is any pressure variation in (air, water or other medium) that the human ear can detect.

2.1.1.1 The Physics of and Propagation of Sound

Sound propagation in air can be compared to ripples on a pond. The ripples spread out uniformly in all directions, decreasing in amplitude as they move further from the source.

Human audio frequency range (hearing range) from approximately 16 Hz up to 20,000 Hz (or 20 kHz) while the range from the lowest to highest note of a piano is 27.5 Hz to 4186 Hz. Sounds in the frequency range of 0.1 to 20 Hz are known as infra sounds, whilst frequency ranges above 20 kHz are known as ultrasound. The highest frequency of mechanical vibrations is found in atoms in the range of 10k million Hz. This is known as hypersonics. All three are inaudible to the human ear (Campbell, 2014).

Some persons will probably already have some idea of the speed of sound. There is a familiar rule for determining how far away a thunderstorm is from an observer. The observer would record the time period between seeing the lightning until hearing the thunder; and then assume 3 seconds per kilometre to determine the distance. This time interval corresponds to a speed of sound in air of 1,238 km h^{-1}. For acoustic and sound measurement purposes, this speed is expressed as ≈ 344 meters per second at 20°C. It is however higher in liquids and very high in solids (Campbell, 2014).

Chambers and Jensen (2004) suggested that in a free field, sound propagates with the velocity c (ms^{-1}) defined by:

- $c = 20.05\sqrt{T_k}$ ($m\ s^{-1}$) (Chambers and Jensen 2004, 454)
- Where T_k is temperature in Kelvin
- A simpler formula for the velocity of sound in air sufficiently accurate at normal temperatures, 0 – 30°C is;
- $c = 331 + 0.6T_c$
- Where T_c is the temperature in centigrade.
- An example of the application of these formulas are applied is given below;
- Determine the speed of sound at 20 °C.
- The Kelvin temperature (T_k) = 273.2 +20 = 293.2 K
- Therefore, the speed of sound $c = 20.05\sqrt{293.2} = 343\ ms^{-1}$

- $c = 331 + 0.6(20) = 343\ ms^{-1}$

With Jamaica being a tropical country, air temperature rarely reaches 20 °C or below but typically averages 27 °C. Historically the temperature at the Norman Manley International Airport, averages 27.2 °C and range from a low of 23.9 °C to a high of 30.0 °C. Therefore, the speed of sound within the study area is typically 347.3 ms^{-1} but ranges between 345.3 – 349 ms^{-1} depending on the time of day, month of the year or weather conditions.

2.1.1.2 Sound Pressure Levels and Loudness

Chambers (2004) indicated that sound waves produce changes in the density of air which in turn produces pressure changes. The parameter lending itself to quantification is sound pressure, the incremental variation in pressure above and below atmospheric pressure. The human ear can detect sound pressures ranging from as low as $2 \times 10^{-5}\ N/m^2$ the threshold of hearing, to over 200 N/m^2, the threshold of pain (Chambers, 2004). To give you an indication, one atmosphere pressure is equivalent to 101,325 N/m^2 or Pascals. Therefore, the human ear can detect much less than 1 atmosphere change in pressure that is approximately one billionth of atmospheric pressure.

To represent this wide pressure range, a logarithmic scale is used to report sound pressures. This is stated as decibels (dB), which is a dimensionless unit used to report sound pressure level (SPL or L_p). It is called a level because it is an expression of a logarithm of a ratio which is defined by the following equation (Chambers 2004):

$SPL = 20 \log (p / p_{ref})$ decibels (dB)

Where p is the measured root mean square sound pressure (N/m^2) and p_{ref} is the reference sound pressure, as 2×10^{-5} N/m^2.

Another reason for using dB is that the human ear tends to respond roughly in a logarithmic way to changes in stimulus intensity.

Loudness is a physical response of the human ear to sound pressure and intensity. It is a subjective evaluation of the intensity of the sound but is not dependent on the sound level alone but also on its frequency. Over the years numerous studies have been conducted on human perception of loudness of pure sounds and other sounds. Several authors developed various sets of equal loudness level contours commonly called envelopes of hearing (Kryter & Pearson, 1963); Robinson & Dadson, 1956; (Stevens 1957, 1961).

2.1.1.3 Weightings

The human ear does not respond to loudness non-subjectively. Instead the human ear and brain combine to have a subjective assessment of loudness using a complex relationship. It has been seen that the ear is not equally sensitive at all frequencies and is most sensitive between the 200 -300 Hz – 10 kHz range (Moller & Pedersen, 2004) and least sensitive at low frequencies (infra sound) and high frequencies (ultra sound and hypersonics) (Campbell, 2014).

To represent the subjectiveness of the human ear, weighting systems were developed for electronic circuits used to measure sound to vary with frequencies in the same manner as the ear. Three internationally standardized characteristics (IEC:651-1979), termed 'A', 'B' and 'C' weighting networks were developed. The 'A' network approximates the equal loudness curve at low SPL (40 Phon), the 'B' network corresponds to medium SPLs (70 Phon) and the 'C' network, which is more or less a linear behaviour, to high levels (100 Phon). (Singal, 2005, p. 44).

When sound pressure levels are weighted, they are expressed as dBA, dBB or dBC so as to distinguish them from one another. The dBA weighting is the most widely used for environmental measurements since the A weightings best approximates the human response. The dBB weighting is not used much, however the dBC is used for high amplitude tests for example in military test ranges.

2.1.2 Noise

Noise is an unwanted sound without agreeable musical quality. It is only when the effects of sound are undesirable that it may be termed as noise (Agarwal, 2009). It can be defined as unwanted /undesired sound or sound in the wrong place at the wrong time. It is considered a pollutant and can be measured. The definition of noise as unwanted sound implies that it has adverse effect on human beings and their environment, including land, structures and domestic animals. It can disturb natural wildlife and ecological systems (Agarwal, 2009).

However, the level of annoyance does not depend solely on the quality of the sound, but also our attitude towards it. The sound of his new jet aircraft taking off may be music to the ears of the design engineer but will be ear-splitting agony for the people living near the end of the runway. Sound does not need to be loud to annoy. A creaking floor, a scratch on a record, or a dripping tap can be just as annoying as loud thunder. Worst of all, sound can damage and destroy. A sonic boom can shatter windows, shake plaster off walls and cause furniture and crockery to rattle. But the most unfortunate case is when sound damages the delicate mechanism designed to receive it, the human ear.

The noise problems of the past are incomparable with those plaguing modern society; the roar of aircraft, the thunder of heavily laden lorries and the thumps and whines of industry provide a noisy background to our lives. But such noise can be not only annoying but also damaging to the health and is increasing with economic development (World Health Organization, 2009). Noise pollution has been described as the 'modern unseen plague' (Hume, 2010). It is generally accepted that the developed and developing countries are becoming noisier places (Hume, 2010). This is true of Jamaica, a developing country.

Typical Noise levels are listed in Table 2.1 below:

Table 2.1 Typical Noise Levels

SOUND SOURCE	SOUND PRESSURE LEVEL (dBA)
12 Gauge Shotgun Blast	165
Jet engine at 100'	140
Air Raid Siren at 50 feet	120
Maximum Levels at Rock Concerts (Rear Seats)	110
On Platform by Passing Subway Train	100
On Sidewalk by Passing Heavy Truck or Bus	90
On Sidewalk by Typical Highway	80
On Sidewalk by Passing Automobiles with Mufflers	70
Typical Urban Area	60-70
Typical Suburban Area	50-60
Quiet Suburban Area at Night	40-50
Typical Rural Area at Night	30-40
Isolated Broadcast Studio	20
Audiometric (Hearing Testing) Booth	10
Threshold of Hearing	0

Source: (NYC Mayor's Office of Environmental Coordination, January 2012 edition (REV. 6/5/13))

2.1.2.1 Descriptors Used in Noise Assessments

2.1.2.1.1 General Measurement Descriptors

There are a number of descriptors used in noise assessments. These include Equivalent Sound Levels (Leq), L_{max} and L_{min}. Very rarely noises are constant, noise levels generally fluctuate and the unit of sound pressure level (dBA) normally reflects the sound pressure level at one instant in time. To describe fluctuating sound levels, the L_{eq} was developed. This represents the fluctuating noise heard over a specific time period as if it was a steady unchanging noise. The L_{eq} represents the constant sound level in a specific situation and time period (e.g. 1hour ($L_{eq\ (1)}$) or 24 hours ($L_{eq\ (24)}$ conveys the same sound energy as time varying sound.

L_{min} is the lowest instantaneous noise level during a specific period of time. The L_{max} may also be referred to as the "peak (noise) level." L_{max} is the highest SPL measured over a time interval. It may also be referred to as the "peak (noise) level." L_{max} (maximum A-weighted RMS sound level) is the greatest RMS (root-mean square) sound level, in dBA, measured during the defined measurement period. It can also be described as the maximum instantaneous sound pressure level generated by a piece of equipment (Campbell, 2014).

2.1.2.1.2 Community Noise Level Descriptors

The following sound level descriptors are commonly used in community noise measurements:

1. Day - Night Average Sound Levels (L_{dn} or DNL) is a 24-hour equivalent continuous level in dBA where 10 dB is added to night-time noise levels from the hours of 10:00 p.m. to 7:00 a.m. before being averaged. It accounts for the moment to moment fluctuations in a weighted noise levels over a 24-hour period due to all noise sources. The L_{dn} represents the averaging of the Leq (1) over the 24-hour period with the penalty added.
2. Community Noise Equivalent Levels (CNEL) is a 24-hour equivalent continuous level in dBA where 5 dBA is added to evening noise levels from 7:00 p.m. to 10:00 p.m. and 10 dBA is added to night-time noise levels from 10:00 p.m. to 7:00 a.m.

Persons expect quiet environment at nights so that their bodies can get rest, recuperate and rejuvenate so that they can function at optimum the next day. It is the importance of this rest why the descriptors Ldn and CNEL place a penalty on the evening and night-time noise levels.

2.1.3 Effects of Noise

2.1.3.1 Biological

A review of studies conducted on environmental and industrial noise between the years 1993 – 1998 by Stansfeld et al. (2000) found that the question of whether environmental noise exposure causes mental ill-health is still largely unanswered. It found that recent community based studies suggested that high levels of environmental noise were associated with mental health symptoms such as depression and anxiety but not with impaired psychological functioning.

Noise and mental health studies before 1993 showed inconsistencies as it related to environmental noise and mental health outcomes. There were consistent results for less severe outcomes, namely psychological symptoms.

Three studies indicated that high levels of aircraft noise resulted in reports of `headaches', 'restless nights', 'irritability' and being 'tense and edgy' (Finke et al. 1974; Kokokusha 1973; OPCS 1971). However, Grandjean et al. (1973) conducted a study around three Swiss airports but made no explicit links between aircraft noise and health. They did not find any association between noise and symptoms. On the other hand The West London Survey found depression, irritability, waking at night and difficulty getting to sleep was more common as acute symptoms (within the last two weeks) in high aircraft noise exposed areas, but as chronic symptoms in low noise areas. Tarnopolsky, Watkins, and Hand (1980) postulated that the apparent contradiction may be explained by poorer pre-existing ill-health, probably related to high levels of social disadvantage rather than specifically to noise, in the low noise areas, leading to more chronic symptoms.

The frequency of noise determines its potential impact on humans:

Low frequency noise causes extreme distress to a number of people who are sensitive to its effects. Such sensitivity may be a result of heightened sensory response within the whole or part of the auditory range or may be acquired (Leventhall, 2003).

Early work (late 1950s to 1960s) on low frequency noise was started by the American Space programme as astronauts were experienced to these sounds in their launch vehicles (spaceships). These vehicles produced their maximum noise energies in the low frequency range. This occurred approximately two minutes after lift-off as the crew compartment experience boundary layer turbulence noise. Therefore, studies were conducted to determine what if any were the impact(s) on such an exposure. From these experiments two conclusions were drawn. The first was that short term exposure to noise of 140 to 150 dB in the frequency range of up to 100Hz was tolerable once the subject is experienced in noise exposure and was wearing ear protection. The second was that they could tolerate both broadband and discrete frequency noise in the range 1Hz to 100Hz at sound pressure levels up to 150dB.

Later work suggests that, for 24 hour exposure, levels of 120-130dB are tolerable below 20Hz. These limits were set to prevent direct physiological damage (Gierke and Nixon 1976; Mohr et al. 1965; Westin, 1975). It is important to note that these levels are below what would be experienced in a home from environmental, traffic, industrial and other noise sources.

After the mid-1960s there was a misconception that low frequency noise known as infrasound or the 'silent sound' was responsible for many misfortunes. An alternative explanation had not yet been found for example brain tumours, cot deaths and road accidents. This misconception was further fuelled by some press headlines during that:

1. The Silent Sound Menaces Drivers, *Daily Mirror*, October 19, 1969
2. Does Infrasound Make Drivers Drunk, *New Scientist*, March 16, 1972
3. Brain Tumours 'caused by noise', *The Times*, September 29, 1973
4. Crowd Control by Light and Sound, *The Guardian*, October 3, 1973
5. Danger in Unheard Car Sounds, *The Observer*, April 21, 1974
6. The Silent Killer All Around Us, *Evening News*, May 25 1974
7. Noise is the Invisible Danger - *Care on the Road (ROSPA)* August 1974 (Leventhall, 2003)

The WHO recognises low frequency noise as an environmental problem. In their publication on Community Noise; Berglund et al. (1999), made several references to this.

Low frequency noise occurs between 10 – 200Hz, while infrasound is noise from 20 Hz and below. It is widely thought that infrasound cannot be heard, however, it has been shown that frequencies below 20 Hz are audible. Tonality is lost below 16-18 Hz resulting in the loss of a key element on perception. Both low frequency noise and infrasound are produced by machinery (rotational and reciprocating), all forms of transportation and turbulence (Leventhall, 2003). Typical sources might be pumps, compressors, diesel engines, aircraft, shipping, combustion, air turbulence, wind and fans.

Attenuation of sound in air is very low at low frequencies. Other attenuating factors, such as absorption by the ground and shielding by barriers, are also low at these frequencies. The net result is that the very low frequencies of infrasound are not attenuated during propagation as much as higher frequencies, although the reduction in intensity due to spreading out from the source still applies. This is a reduction of 6dB for each doubling of distance. Wind and temperature also affect the propagation of sound.

Attenuation of low frequency noise in air or other medium is greater than that of infrasound because of the higher frequencies. As with infrasound, there is reduction of 6dB per doubling of distance due to spreading out of the wave and any other reduction which might occur due to absorption over the ground or by shielding. At low frequencies, air attenuations are a small contributor to losses, as a result, noise which has travelled over long distances is normally biased towards the low frequencies.

2.1.3.2 Annoyance

A central effect of noise is annoyance. Annoyance is defined as a feeling of discomfort which is related to adverse influencing of an individual or a group by any substances or circumstances. Annoyance expresses itself e.g., by malaise, fear, threat, trouble, uncertainty restricted liberty experience, excitability or defencelessness. With chronically strong annoyance, a causal chain may exist between the three steps: health - annoyance - disease (Niemann & Maschke, 2004). Noise annoyance encompasses broad psychological feelings which include irritation, discomfort, distress, frustration, and offence (among others) when it interrupts a person's psychological state or ongoing activities and interferes with an individual's quality of life (Seabi, 2013).

In the European Member States, noise from transportation is by far the most widespread source of noise exposure, causing most annoyance and public health concerns (Wolfgang, 2011). Over the years research has shown that environmental noise may have serious adverse effects on cognition and health (e.g., Stansfeld, et al., 2005). An important index of these effects is annoyance (e.g., Ouis, 2001).

The effect of annoyance on age is described by inverted U-shaped curves. The relatively young, as well as relatively old individuals, report less annoyance than people of intermediate ages do. The largest number of highly annoyed individuals was found in the middle-aged segment of the sample peaking around 45 years (van Gerven et al. 2009).

2.1.3.3 Cardiovascular Disease

The cardiovascular effects of noise have been the source of growing interest in recent years. This is because on the one hand evidence has increased that noise affects cardiovascular health. On the other hand, high blood pressure and ischemic heart diseases (including myocardial infarction) have a high prevalence in industrialized countries and are a major cause of death (Lopez, Mathers, Ezzati, Jamison, & Murray, 2006). The question at present is no longer whether noise causes cardiovascular effects, it is rather: what is the magnitude of the effect in terms of the exposure-response relationship (slope) and the onset or possible threshold (intercept) of the increase in risk (Wolfgang, 2011).

Most environmental epidemiological noise studies been carried out in The Netherlands, Sweden, the United Kingdom, Serbia and Germany. It is well understood that noise levels below the hearing damaging criterion cause annoyance, sleep disturbance, cognitive impairment, physiological stress reactions, endocrine imbalance, and cardiovascular disorders (Wolfgang, 2011). The general stress theory is the rationale for the hypothesis that noise affects the autonomic nervous system and the endocrine system, which in turn affects the homeostasis of the human organism.

In Sweden, traffic noise is an important environmental health issue. Almost two million persons in Sweden are exposed to average noise levels exceeding the outdoor national guideline of 55 ($L_{Aeq,24h}$). Despite efforts to reduce the noise burden, noise-related health effects, such as annoyance and sleep disturbances, are increasing (Bluhm & Eriksson, 2011). The majority of the studies in Sweden on cardiovascular outcomes have been on noise related to road or aircraft traffic with only a few studies on railway noise. Swedish studies on road traffic noise support the hypothesis of an association between long-term noise exposure and cardiovascular disease. However, the magnitude of effect varies between the studies and has been shown to depend on factors such as sex, number of years at residence, and noise annoyance. No association has been found between railway noise and cardiovascular diseases (Bluhm & Eriksson, 2011).

One proposed biological mechanism for the possible causative relation between noise and cardiovascular diseases is that noise causes the release of stress hormones, which in turn affect the cardiovascular risk factor pattern (Babisch, 2003; Bigert, Bluhm, & Theorell, 2005). Glucocorticoid hormone cortisol is the main secretory product of the neuroendocrine cascade and a good indicator of stress (Bluhm & Eriksson, 2011).

The Hypertension and Exposure to Noise near Airports (HYENA) project conducted by Jarup, et al., 2005 aimed at assessing the cardiovascular health effects of noise related to aircraft and road traffic. One of its aims was to investigate the use of saliva cortisol as a possible marker for noise induced stress. A subsample of 439 subjects of this project indicated that:

A significant elevation in morning saliva cortisol level was observed in women exposed to aircraft noise levels above 60 dB (LAeq,24h), in comparison to women exposed to noise levels lower than 50 dB (L Aeq,24h). No association between noise exposure and saliva cortisol levels was found in men (Selander , et al., 2009).

The study also found that employment status appeared to have a modifying effect on the response. Employed women had higher morning saliva Cortisol levels than did retired women, particularly among those with high exposure to aircraft noise (Selander , et al., 2009). This effect could be a result of disrupted sleep during the night and lack of recovery during the day due to employment. It could also be a result of stressful activities related to employment.

A subset of the HYENA study that looked at the Swedish portion found:

The Swedish part of this saliva cortisol study comprised of 85 study participants, who were selected to ensure a satisfying contrast in aircraft noise exposure. Among women, there was an increase of 1.09 nmol/l (95% CI - 0.12, 2.31) in the morning saliva cortisol level per 5 dB(A) increase in noise exposure. No association between noise exposure and saliva cortisol levels was found in men (Bluhm & Eriksson, 2011)

Two studies, one in Stockholm County and the other from the west of Sweden, saw no indication of an increased prevalence of hypertension related to railway noise exposure (Barregard et al. 2009). There was a clear association between self-reported annoyance and sleep disturbances and the estimated noise exposure levels with increased railway traffic. However, there were no differences in annoyance due to age or gender.

As it relates to road noise, there was an association between road traffic noise and hypertension in the HYENA project. A significant relationship between average road traffic noise exposure and risk of hypertension was found in men, but not in women (Bluhm & Eriksson, 2011). In the Swedish part of this investigation, a country-specific odds ratio (OR) of 1.3 (95% CI 1.0, 1.7) per 10 dB increase in road traffic noise exposure ($L_{Aeq\,24h}$) was found for hypertension (Bluhm & Eriksson, 2011). A statistically significant association was found between a road traffic noise exposure above 55 dB(A) and self-reported treatment for hypertension (Barregard, Bonde, & Öhrström, 2009).

Experimental studies on humans and epidemiological studies conducted on the adult and children population of Belgrade and Pancevo, Serbia started in 2002. The studies found that experimental exposure to noise [Leq = 89 dB (A)] had a hypodynamic effect, significantly lowering the cardiac index, cardiac work, and pump performance (P <0.01). The vasoconstrictive effect of noise was shown through the significant elevation of after-load (P <0.01). In a cross-sectional population study that was carried out on 2874 residents [1243 males and 1631 females] in Pancevo City, a significant odds ratio (adjusted for age, body mass index (BMI), and smoking habits) was found for self-reported hypertension (OR = 1.8, 95% CI = 1.0 - 2.4, P <0.01) in men with a high level of noise annoyance compared to those with a low level of noise annoyance. In another study on 2503 residents (995 men and 1508 women) residents of Belgrade, the proportions of men with hypertension in the noisy [(L night , 8h >45 dB (A)] and quiet areas [(L night , 8h <45 dB (A)] were 23.6% and 17.5%, respectively. The adjusted odds ratio (OR) for hypertension of the exposed group was 1.58 (95% CI = 1.03 - 2.42, P = 0.038), where men living in quiet streets were taken as a reference category.

Associations between road traffic noise and blood pressure were also investigated in 328 preschool children in Belgrade. The systolic blood pressure was significantly higher among children from noisy residences and kindergartens, compared to children from both quiet environments (97.30 +- 8.15 and 92.33 +- 8.64 mmHg, respectively, P <0.01). As a continuation of the study on preschool children, investigations were also carried out on 856 school children, aged between seven and eleven years, in Belgrade. It found that systolic pressure was significantly higher among children from noisy schools and quiet residences, compared to children from both quiet environments (102.1 +- 9.3 and 100.4 +- 10.4 mmHg, respectively, P <0.01) (Belojevic, et al., 2011).

Men living in the noisy areas had a higher risk of hypertension compared to men from quiet areas, after adjustment for the relevant factors. The proportions of men with hypertension in the noisy and quiet areas were 23.6 and 17.5%, respectively. The adjusted odds ratio (OR) for hypertension of the exposed group was 1.58 (95% CI = 1.03 - 2.42, P = 0.038) when men living in quiet streets were taken as a reference category. This relation was statistically insignificant for women (Belojevic, et al., 2011).

Since 1970, 14 Dutch studies were published which investigated the possible impact of road traffic (6 studies), aircraft noise (6 studies) and both aircraft and road noise (2 studies) exposure on the cardiovascular system. Within these studies a large variety of outcomes were investigated, ranging from blood pressure changes to cardiovascular mortality. The effect of road traffic noise exposure on hypertension was inconsistent and rather small with relative risk (RR) 5dB ranging from 0.96 to 1.02 (van Kempen, 2011). A wide range of effects were investigated. These were blood pressure, hypertension, use of anti-hypertensives and / or cardiovascular medicines, angina pectoris, myocardial infarction, consultation of GP / specialist, coronary heart disease, and cardiovascular mortality. The estimated RR 5dB ranged from 0.87 to 1.29. A positive association between aircraft noise exposure during the day-evening-night period and the prevalence of the use of cardiovascular medicines was found with an estimated RR 5dB ranged from 0.95 to 1.26. Three studies also investigated the effect of night-time exposure, where an RR 5dB ranging from 1.05 - 1.17 was found (van Kempen, 2011).

Other studies in the United Kingdom and Austria showed weak association with hypertension and road traffic noise in men and no such association in women, but positive associations with aircraft noise (Lercher, Botteldooren, Widmann, & Kammeringer, 2011; (Stansfeld & Crombie, 2011). The Dutch studies found a positive association between aircraft noise exposure during the day-evening-night period and the prevalence of the use of cardiovascular medicines.

Children are often considered a vulnerable risk group because they have less control over the environment than adults. The studies showed (primarily systolic) blood pressure increases in children exposed to aircraft and road traffic noise. The studies, however, were not always consistent (Wolfgang, 2011).

2.1.3.4 Sleep

During sleep the auditory system remains fully functional. Incoming sounds are processed and evaluated and although physiological changes continue to take place (World Health Organization, 2009), sleep itself is protected because awakening is a relatively rare occurrence. Sleep is an essential need for living creatures. It is needed for the restorative function where the body gets to repair and rejuvenate itself. Sleep deprivation can lead to a myriad of physical, psychological, emotional and mental problems. It also affects learning and memory functions. A sleep deprive individual may exhibit the following symptoms: irritability, cognitive impairment, memory lapse or loss, impaired moral judgement, severe yawning, hallucinations and impaired immune system.

While social surveys have found that annoyance is the most frequent effect of noise, noise induced sleep disturbances are regarded as the most deleterious (Griefahn & Spreng, 2004). The sleep-wake cycle is the most significant sign of the circadian rhythm, which develops during the first months of life in humans. Total sleep time alters dramatically during lifetime. A new-born baby sleeps up to 16 hours a day but as they grow older daily sleep time decreases rapidly. Young children exhibit 11 to 12 hours of sleep, school children approximately 10 hours, adults between 7 and 8 hours, whereas aged people sleep no more than 5 to 6 hours. The inter-individual variability is, however, huge, where sleep time ranges between 2 and 12 hours whereas the intra-individual sleep duration is rather stable (Griefahn & Spreng, 2004). Sleep can be broken down into two main portions: REM-sleep (paradoxical sleep, dream sleep) and non-REMsleep (NREM). REM and non-REM sleep alternate periodically, thus structuring sleep into 4 to 6 cycles of 90 to 100 minutes each (Griefahn & Spreng, 2004).

Sleep disturbances may be divided into:

1. Those related to underlying diseases thus requiring causal therapy; and
2. Sleep disturbances that are caused by environmental influences thus allowing prevention by an adequate design of the environment (Griefahn & Spreng, 2004).

Noise induced sleep disturbances are determined by the acoustic characteristics of the impinging noises as well as by individual and situational factors. The informational content, acoustic parameters and individual, biorhythmic, and situational characteristics all play a role in determining the impact of noise on an individual(s). The informational content of the noise is determined by the person(s) experience with the particular noise, and also the physical parameters of the noise. Over a period of time the informational content may change and become either less or more significant to an individual. This may result in habituation (a decrease in response to a stimulus after repeated presentations) as well as sensitization (Campbell, 2014).

The reaction to noise pollution is dependent on individuals' differences and traits. Persons who are sensitive to noise or have neurotic tendencies tend to have stronger reactions. The type of noise (Continuous/Steady, Intermittent or Impulse) and the age of persons determine the influence/reactions:

The temporal distribution of noises has a considerable influence on the reaction. Noise emissions from aircraft, rail and road traffic are same equivalent noise level, however, the intermittent noise form air and rail traffic disturbs much more than the noise from continuous caused by high- density road traffic. Stronger effects are also registered in aged people whose overall time awake is scarcely longer in noisy than in quiet nights but who attribute the time awake more often to noise intrusion. Contrary to a common belief, children are much (about 10 dBA) less sensitive than adults, whereas gender has no influence on the susceptibility to noise (Griefahn & Spreng, 2004).

Sleep disturbance, especially with regard to time to fall asleep and tiredness in the morning are commonly reported by persons exposed to low frequency noise (20 -200Hz). Owing to the low attenuation, low frequencies may propagate for long distances, with little attenuation apart from distance. Low frequencies will also pass with little attenuation through walls and windows. Low frequency noise causes structure borne vibrations which causes glass and plates to rattle which is in turn heard. This is also called the "plate and rattle effect" (Campbell, 2014).

Numerous studies have shown the low frequency at comparatively low sound pressure levels, disturbs sleep.

In 1999 Verzini et al. found that the energy content of 20 to 160 Hz was significantly related to sleep disturbance, concentration difficulties, irritability, anxiety and tiredness (quoted in Waye, 2004).

Ising and Ising (2002) found in children a significant correlation was found between the maximum levels of low frequencies in the noise, measured as L_{Cmax} , and urine cortisol levels sampled in the first half of the night, while no correlation was found between noise exposure and the excretion of urine cortisol in the second half of the night. The increase of cortisol during the first half of the night was furthermore significantly related to impaired sleep, memory and ability to concentrate (Ising & Ising, 2002).

Different indices have been used to describe various types of community noise exposure, and there is no general agreement on which should be preferred among the various integrated energy indices (LAeq, LDN, LDEN, and Lnight), statistical indices (L10, L50,...), or event indices (LAmax, Sound Exposure Level: SEL, Number of Noise Events: NNE,...) (Finegold, 2010).

The WHO Regional Office for Europe published Night Noise Guidelines for Europe (NNGL) in October 2009 (WHO 2009). They recommended a night time noise guideline ($L_{night, outside}$) of 40 dBA where lowest observed adverse effect level (LOAEL) for night noise is seen to prevent any adverse health effects from night time noise. An interim level of 55 dBA is recommended if the $L_{night, outside}$ cannot be immediately met. They also observed that below a level of 30 dB $L_{night,outside}$, no effects on sleep were observed except for a slight increase in the frequency of body movements during sleep due to night noise (World Health Organization, 2009).

There is no sufficient evidence that the biological effects observed at the level below 40 dB L night are harmful to health. However, adverse health effects are observed at the level above 40 dB L night, such as self-reported sleep disturbance, environmental insomnia and increased use of sleeping pills and sedatives (Rokho & Martin van den, 2010).

There are few studies on noise effect on sleep from non-traffic related sources. A review of these studies has indicated noise such as sounds made by neighbours, conversations, laughter, music, slamming doors, structural equipment, ventilation, heat pumps, animals, outdoor events, etc., had some definite effects while some were more inconclusive with others. More studies of all types of these selected ambient noise sources of appropriate quality for quantitative analysis are consequently needed (Omlin, Bauer, & Brink, 2011). Currently there are no studies conducted in Jamaica on the effect of night-time noise on sleep disturbance.

2.1.3.5 Cognitive Skills

A review of the literature on noise and health in vulnerable groups by van Kamp and Davies (2013) found that among 10-year-old schoolchildren in France, school noise exposure was associated with fatigue, headaches and higher cortisol level indicative of a stress reaction. These findings were also supported by a Swedish study (Wålinder , Gunnarsson , Runeson R, & Smedje , 2007), which found increased prevalence of fatigue, headache and reduced diurnal cortisol variability in relation with classroom Leq during school day levels between 59 and 87 dBA.

A cross-sectional study in Nigeria found at least some annoyance and concentration disturbance in 70% of the children frequenting a school near a major road (noise range: 68-85 dBA) (Ana , Shendell , Brown, & Sridhar, 2009). Fatigue and lack of concentration were the most prevalent noise-related health problems.

Parra et al. (2010) reported that in people over 60 years of age living in Bogota, road traffic noise was negatively related to both the physical and the mental dimension of health-related (HR) quality of life.

Based on the Road Traffic and Aircraft Noise Exposure and Children's Cognition and Health study (RANCH), research of exposures around three major European airports, found that exposure at home was highly correlated with aircraft noise exposure at school and demonstrated a similar linear association with impaired reading comprehension after adjustment for a range of confounders (Clark, et al., 2006). Kaltenbach , Maschke , & Rainer , (2008) found exposure to aircraft daytime noise of 50 dBA and over to be associated with learning difficulties in school children. Road traffic noise exposure at school was not associated with reading comprehension in the RANCH study (Clark, et al., 2006). Ljung, Sörqvist, & Hygge, (2009) concluded that road traffic noise impaired reading speed and basic mathematics but had no effect on reading comprehension or on mathematical reasoning. Klatte , Meis , Sukowsk, & Schick, (2007) found that serial recall of visually presented digits was severely disrupted by background irrelevant speech. Train noise exposure did not show comparable effects. Shield & Dockrell, (2008) related in and outside noise exposure at school with standard test scores for literacy, mathematics and science in children aged 7-11 years in London.

2.1.3.6 Learning

One of the main objectives of children is to learn. Most of this learning takes place through attending verbal auditory information. When there is high noise level either from external or internal sources, there is a reduction in the signal/noise ratio (the sound level of what is being communicated relative to the sound level of the background) which makes it more strenuous and difficult to grasp what is being communicated. The result is that the students cannot hear clearly what the teacher is saying because he/she is not speaking loud enough. Reverberation (reflected sound from ceiling and walls) can obscure the auditory sound information. The noise emitted from a power plant has the potential to affect (reduce) the signal/noise ratio in classrooms and as such may affect learning in schools.

WHO recommended a 35 dBA noise levels for community learning (school) environments (Ana , Shendell , Brown, & Sridhar, 2009). This is based on signal- to-noise ratio of +15 dB. That is the speech should be at least 15 dB above the background noise level to make it intelligible (95% speech intelligibility or better) (Bradley & Sato, 2008). This assumes that the normal conversation/speech level of 55 dBA.

The comprehension of a verbal communication depends on the linguistic and cognitive abilities of the person receiving the message. Adults and children with a good grasp of the language have the ability to fill in the gaps of an incomplete message and deduce its content. Younger children have greater difficulty understanding speech in even modest levels of ambient noise (Campbell, 2014).

Several authors have reported results showing that the ability to recognize speech in noise improves systematically with age. It is clear that children need quieter conditions and corresponding larger signal-to-noise ratios than adults to achieve high speech recognition scores and that the younger the children, the quieter the conditions should be (Bradley & Sato, 2008).

The inability of younger children to understand many of the words a teacher speaks must make it more difficult for children to learn new concepts. There is a growing literature of results indicating that increased noise levels are associated with a number of educational factors such as delayed reading ability, effects on memory and student behaviour (Bradley and Sato 2008). For children with hearing problems, learning difficulties, with a different native language etc., the problem of comprehending a verbal message is exacerbated.

Emerging evidence suggests that meaningful irrelevant speech does produce disruption in tasks in which meaning is used as the basis for retrieval. Evidence has suggested that noise in learning environments has considerable effect on the learning abilities and the general productivity of children in terms of their academic performance as compared to children in serene learning environments (Ana et al. 2009).

There are no studies conducted in Jamaica on the effect of noise on health. There are also no studies on noise emissions from various sources, noise annoyance, signal to noise ratios, the effects on children (cognitive skills, etc.).

2.1.4 Noise Guidelines and Standards

2.1.4.1 International

2.1.4.1.1 World Health Organization (WHO)

The WHO prepared the Guidelines for Community Noise in a response to the realization that an increasing number of persons are being exposed to noise levels that are considered detrimental to health as a result of urbanization and industrialization. The guidelines outlined in Table 2.2 are arranged according to specific environments and critical health effects and the need to protect health.

Table 2.2 Guideline values for community noise in specific environments

SPECIFIC ENVIRONMENT	CRITICAL HEALTH EFFECT(S)	L Aeq [dB(A)]	Time base [hours]	L Amax fast [dB]
Outdoor living area	Serious annoyance, daytime and evening Moderate annoyance, daytime and evening	55 50	16 16	- -
Dwelling, indoors Inside bedrooms	Speech intelligibility & moderate annoyance, daytime & evening Sleep disturbance, night-time	35 30	16 8	45
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	8	60
School classrooms & pre-schools, indoors	Speech intelligibility, disturbance of information extraction, message communication	35	during class	-
Pre-school bedrooms, indoor	Sleep disturbance	30	Sleeping time	45
School, playground outdoor	Annoyance (external source)	55	during play	-
Hospital, ward rooms, indoors	Sleep disturbance, night-time Sleep disturbance, daytime and evenings	30 30	8 16	40 -
Hospitals, treatment rooms, indoors	Interference with rest and recovery	#1		
Industrial, commercial shopping and traffic areas, indoors and outdoors	Hearing impairment	70	24	110
Ceremonies, festivals and entertainment events	Hearing impairment (patrons:<5 times/year)	100	4	110
Public addresses, indoors and outdoors	Hearing impairment	85	1	110
Music and other sounds through headphones/ earphones	Hearing impairment (free-field value)	85 #4	1	110

Impulse sounds from toys, fireworks and firearms	Hearing impairment (adults)	--	--	140 #2
	Hearing impairment (children)	--	--	120 #2
Outdoors in parkland and conservations areas	Disruption of tranquillity	#3		

- #1: As low as possible.
- #2: Peak sound pressure (not LAF, max) measured 100 mm from the ear.
- #3: Existing quiet outdoor areas should be preserved and the ratio of intruding noise to natural background sound should be kept low.
- #4: Under headphones, adapted to free-field values.

Source: (Berglund, Thomas, & Dietrich, 1999)

2.1.4.1.2 International Finance Corporation (IFC)/World Bank (WB)

The IFC is a member of the World Bank Group, has developed Environmental Health, and Safety (EHS) Guidelines to guide new developments in which there are investing in. These EHS guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP).

In addition to the guidelines, the IFC has a 3 dBA rule; which states that noise impacts should not exceed the levels presented in Table 2.3, or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site. An example is; if the noise level before the addition of the new noise source was 70 dBA, and the addition of the new source results in the cumulative (overall) noise level of 73 dBA; then the source is considered compliant as it relates to noise. This is allowed as most persons will not perceive a change in noise levels at 3 dBA.

Table 2.3 IFC/World Bank Noise Guidelines

RECEPTOR	ONE HOUR L_{Aeq} (dBA)	
	DAYTIME 07:00 - 22:00	**NIGHTTIME 22:00 - 07:00**
Residential; institutional; educational	55	45
Industrial; commercial	70	70

Source: (International Finance Corporation, 2007)

2.1.4.1.3 European Night Noise Guideline

The Regional Office for Europe of the WHO developed a health-based limit value as the Night Noise Guidelines (NNG) of 40 dB $L_{night,outside,}$ necessary to protect the public (Table 2.4), including most of the vulnerable groups such as children, the chronically ill and the elderly, from the adverse health effects of night noise. Health effects are observed at the level above 40 dB$L_{night,outside}$, such as self-reported sleep disturbance, environmental insomnia, and increased use of somnifacient drugs and sedatives (World Health Organization, 2009).

An interim target (IT) of 55 dB $L_{night,outside}$ (Table 2.4) is recommended in the situations where the achievement of NNG is not feasible in the short run for various reasons. It should be emphasized that it is not a health-based limit value by itself. Vulnerable groups cannot be protected at this level as at 55 dB, the cardiovascular effects become the major public health concern, which are likely to be less dependent on the nature of the noise (World Health Organization, 2009).

Table 2.4 Recommended night noise guideline for Europe (Source: World Health Organization, 2009)

GUIDELINE	GUIDELINE LEVEL
Night noise guideline (NNG)	$L_{night,outside}$ = 40 dB
Interim target (IT)	$L_{night,outside}$ = 55 dB

2.1.4.1.4 United States Environmental Protection Agency (USEPA)

The USEPA identified noise levels consistent with the protection of public health and welfare against hearing loss, annoyance and activity interference (Table 2.5). The established levels factors in the balance between costs and benefits associated with setting standards at particular noise levels, the nature of the existing or projected noise problems in any particular area, the local aspirations and the means available to control environmental noise (Office of Noise Abatement and Control 1974).

Table 2.5 Yearly average equivalent sound levels identified as requisite to protect the public health and welfare with adequate margin of safety

AREAS	INDOOR				OUTDOOR		
	Measure	Activity interference	Hearing loss considerations	To protect against both effects	Activity interference	Hearing loss considerations	To protect against both effects
Residential with Outside Space and Farm Residences	L_{dn} $L_{eq(24)}$	45	70	45	55	70	55
Residential with No Outside Space	L_{dn} $L_{eq(24)}$	45	70	45			
Commercial	$L_{eq(24)}$	a	70	70c	a	70	70c
Inside Transportation	$L_{eq(24)}$	a		a			
Industrial	$L_{eq(24)}$	a	70	70c	a	70	70c
Hospitals	L_{dn} $L_{eq(24)}$	45	70	45	55	70	55
Educational	$L_{eq(24)}$ $L_{eq(24)}$	45	70	45	55	70	55
Recreational Areas	$L_{eq(24)}$	a	70	70c	a	70	70c
Farmland and General Unpopulated Land	$L_{eq(24)}$				a	70	70c

Code: a – Since different types of activities appear to be associated with different levels, identification of a maximum level for activity interference may be difficult except in those circumstances where speech communication is a critical activity. c – Based on hearing loss. Source: (Office of Noise Abatement and Control, 1974)

2.1.4.2 Local

In Jamaica, there are two pieces of legislation that govern the regulation of noise pollution. These are the Noise Abatement Act and the National Resources Conservation Authority's (NRCA) Standard.

2.1.4.2.1 Noise Abatement Act (March 26, 1997)

This Act is otherwise known to the public as the "Night Noise Law". It defines public and private places, outlines what is considered annoyance, the time period in which these noise generating activities can take place, at what distance from a receptor it can take place and the penalties for contravening the Act.

A criticism of the Act is that it does not outline a quantitative noise level by which the Act is to be enforced but instead is subjective to the enforcer as it outlines if the noise is heard within 100m from the source in such a manner that its audible then it is reasonably capable of causing annoyance to persons in the vicinity (Government of Jamaica [GoJ] 1997).

2.1.4.2.2 National Resources Conservation Authority (NRCA)

There are two sets of Standards, first for the environment/occupational (Table 2.6) and the other for traffic. For the environment, areas are divided into zones which generally define the area (NRCA 1999).

Table 2.6 NRCA recommended zone noise limits

ZONE	7 a.m. to 10 p.m.	10 p.m. to 7 a.m.
Industrial	75	70
Commercial	65	60
Residential	55	50
Silence	45	40

Notes: The measurements are to be made at the property line from which the sound is emitted or at the nearest point possible beyond that line. If the source of the sound is on public property then measurements are to be made at a distance of between 3 m and 4 m from the source. This excludes the mechanical noise made by moving vehicles but includes other noise (such as music) from such vehicles. Source: (National Resoures Conservation Authority, 1999)

The zones are defined below:

Industrial Zone

Lands designated *Industrial Zone* shall generally be industrial where protection against damage to hearing may be required, and the necessity for conversation is limited. The land uses in this category would include, but not be limited to, manufacturing activities, transportation facilities, warehousing, mining, and other lands intended for such uses (National Resoures Conservation Authority, 1999).

Commercial Zone

Lands designated *Commercial Zone* shall generally be commercial in nature, areas where human beings converse and such conversation is essential to the intended use of the land. The land uses in this category would include, but not be limited to, retail trade, personal, business and professional services, government services, amusements, agricultural activities, and lands intended for such commercial or institutional uses (National Resoures Conservation Authority, 1999).

Residential Zone

Lands designated *Residential Zone* shall generally be residential areas where human beings sleep or areas where quiet is essential to the intended use of the land. The land uses in this category would include, but not be limited to, single and multiple family homes, hotels, prisons, religious facilities, cultural activities, forest preserves, and land intended for residential or special uses requiring such protection (National Resoures Conservation Authority, 1999).

Silence Zone

Lands designated *Silence Zone* shall generally be special areas where peace, tranquillity and extreme quiet is essential to the intended use of the land.

The land use in this category would include, but not be limited to, hospitals, educational institutions and courts. In order to ensure silence at such premises the zone should extend to an area of 100 metres around such institutions. Certain activities (e.g. the use of car horns and loudspeakers) are banned in a silence zone (National Resoures Conservation Authority, 1999).

For traffic, the noise limits for moving vehicles are outlined in Table 2.7. The measurements for moving vehicles should be made at a distance of 7.5 m from the centre of the roadway and using the FAST setting on the sound meter (National Resoures Conservation Authority, 1999). This is similar to the US Department of Transportation Federal Highway Administration REMEL curves pass by at 15m.

Table 2.7 NRCA noise limits for moving vehicles

VEHICLE	NOISE LIMIT
Motorbike	85 dBA
Motorcar	85 dBA
Small Commercial Vehicle	90 dBA
Large Commercial Vehicle	95 dBA

Source: (National Resoures Conservation Authority, 1999)

The limits for stationary vehicles are the same as in table 9 but the noise is measured at a distance of 7.5 m from the side of the vehicle and with the engine at half maximum revs. The definition of a small commercial vehicle is one of gross (unloaded) weight of less than 5000 kg (National Resoures Conservation Authority, 1999).

2.2 Approach and Methodology: Noise Measurements

Noise level readings were taken using Brüel & Kjaer (B&K) Type 2250 and 2270 with real time frequency analyser, connected to outdoor weatherproof kit. The octave band analysis (dBL scale) was conducted concurrently with the noise level measurements. Measurements taken were in the third octave which provided thirty-three (33) octave bands from 12.5 Hz to 20 kHz (low, medium and high frequency bands).

The noise meters were calibrated pre and post noise assessment by using a Brüel & Kjaer Type 4231 sound calibrator (Calibration Certificate can be seen in Figure 6.1 and Figure 6.2 in the Appendices). The Brüel & Kjaer analyser was programmed to log every second with signal recording set at various night-time and daytime threshold values according to the location. This feature allowed the sound level meter to record the noise at the time when the various thresholds were exceeded. This helped in identifying the source of the noise exceedance whether it be abnormal activity for example excessive barking of dogs, "crickets", loud music etc. Average noise levels over the measurement period was calculated within the B&K BZ 5503 Measurement Partner Suite. A windscreen (sponge) was placed over the microphone to prevent measurement errors due to noise caused by wind blowing across the microphone. The microphone of the meters was at a height of approximately 1.5m above ground. There were no vertical reflecting surfaces within 3 m (10 feet) of the microphone.

The averaged noise levels were compared with the National Resources Conservation Authority (NRCA) daytime and night-time noise guidelines, according to the land-use zone in which each noise station fell (Table 2.8).

Table 2.8 NRCA Recommended Zone Noise Guidelines

STATION	ZONE	Daytime (7 a.m. to 10 p.m.)	Night-Time (10 p.m. to 7 a.m.)
Airport Runway 12	Industrial	75	70
Airport Runway 30	Industrial	75	70
Caribbean Maritime University (CMU) - Petro Caribe Development Fund Building	Silence/Educational	45	40
Harbour - Port Authority Harbour Dept.	Commercial	65	60
Harbour View - Martello Drive	Residential	55	50
Port Henderson - Royal View Hotel	Commercial	65	60
Port Royal - Grand Port Royal Harbour Hotel	Commercial	65	60

Seven (7) noise meters with outdoor monitoring kits were set up at each location (see Table 2.9) to collect data every second for twelve (12) days (March 13 – 24, 2020). The Global Positioning System (GPS) locations for each noise monitoring station are listed in Table 2.10 and depicted in Figure 2.1.

Table 2.9. Showing noise meters deployed

(a) Harbour View Martello Drive

(b) Port Henderson Royal View Hotel

(c) Port Authority Harbour Dept.

(d) CMU Petro Caribe Development Fund Building

(e) Grand Port Royal Harbour Hotel

(f) Runway 30 (102m from centreline)

(g) Runway 12 (145.27 m from centreline)

Table 2.10 GPS locations of the noise stations in JAD2001

STATION	EASTINGS	NORTHINGS
Airport Runway 12 (145.27 m from centerline)	771407.609	643550.672
Airport Runway 30 (102m from centerline)	773872.501	642672.128
Caribbean Maritime University (CMU) - Petro Caribe Development Fund Building	774352.724	643996.575
Harbour - Port Authority Harbour Dept.	770825.401	646172.566
Harbour View - Martello Drive	779694.590	645052.406
Port Henderson - Royal View Hotel	764791.619	645816.657
Port Royal - Grand Port Royal Harbour Hotel	767045.404	643427.568

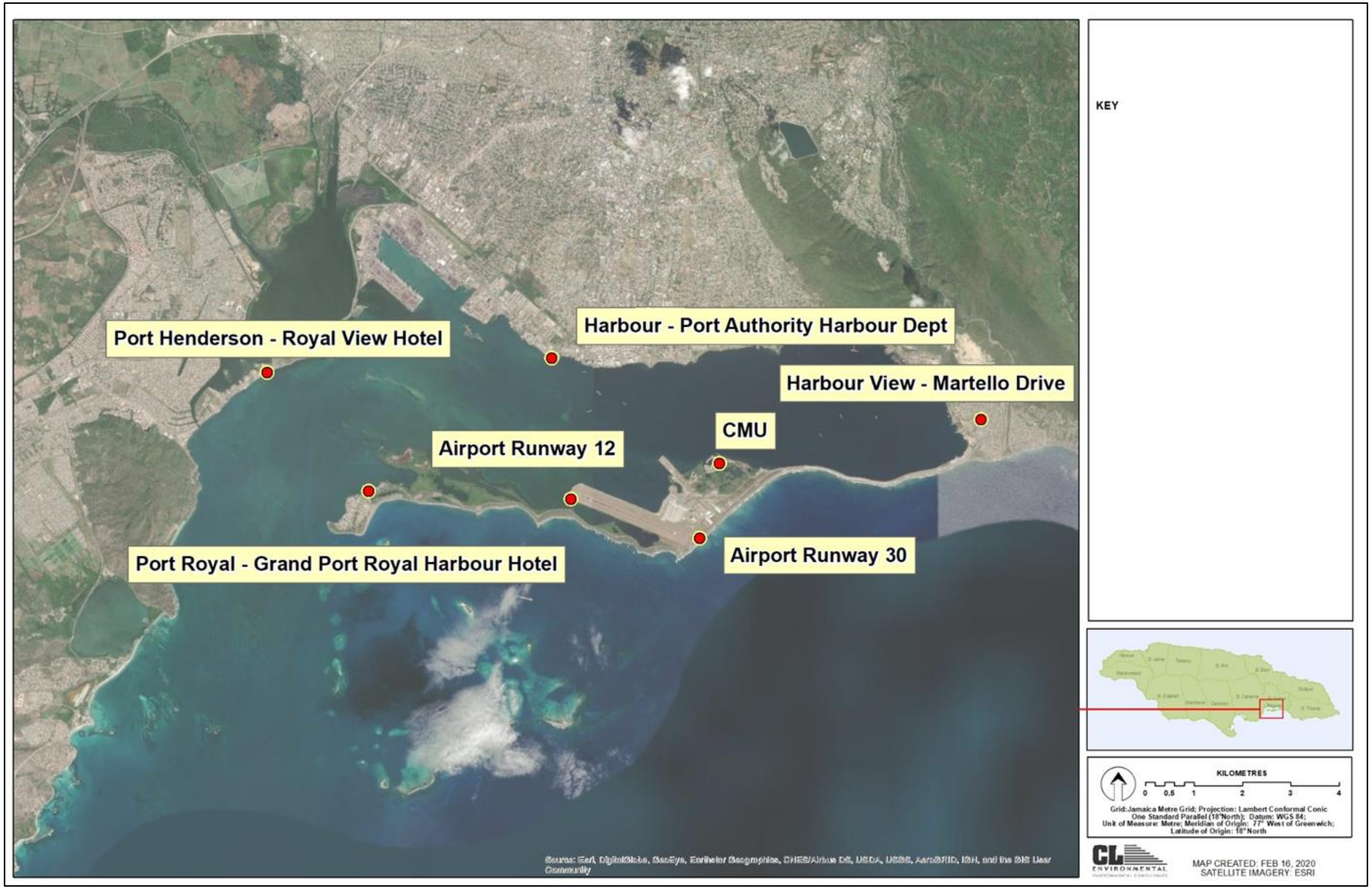

Figure 2.1 Map depicting the locations of the noise survey stations

2.3 Results

2.3.1 24-Hour Average Noise Levels

Table 2.11 shows the 24-hour average noise levels for each survey day at each location.

1. Overall, average noise levels (LAeq) for the entire 12-day assessment ranged from a low of 46.2 dBA (CMU) to a high of 60.7 dBA (Runway 12). Runway 12, which had the highest average noise level (60.7 dBA), had average daily noise levels ranging from a low of 57.4 dBA on March 22nd to a high of 63.3 dBA on March 13th. CMU, which was the quietest site (46.2 dBA), had average daily noise levels ranging from a low of 44.3 dBA on March 20th and 24th to a high of 51.7 dBA on March 13th.
2. Runway 30 had the second highest average noise level (60.3 dBA), with average daily noise levels ranging from a low of 57.4 dBA on March 22nd to a high of 63.1 dBA on March 13th, similar to Runway 12.
3. The Port Henderson Royal View Hotel had the third highest average noise level (56.2 dBA), with average daily noise levels ranging from a low of 52.3 dBA on March 24th to a high of 63.8 dBA on March 23rd.
4. The Port Authority Harbour Department had the fourth highest average noise level (54.9 dBA), with average daily noise levels ranging from a low of 49.8 dBA on March 22nd to a high of 59.3 dBA on March 17th.
5. The Grand Port Royal Harbour Hotel had the fifth highest average noise level (50.9 dBA), with average daily noise levels ranging from a low of 49.5 dBA on March 23rd to a high of 53.6 dBA on March 16th.
6. The residence at Martello Drive in Harbour View had the sixth highest average noise level (50.7 dBA), with average daily noise levels ranging from a low of 48.6 dBA on March 15th to a high of 57.2 dBA on March 19th.

Table 2.11 Showing 24-Hour Average Noise Levels for each location

DATE LOCATION	13.3.20 FRI	14.3.20 SAT	15.3.20 SUN	16.3.20 MON	17.3.20 TUES	18.3.20 WED	19.3.20 THURS	20.3.20 FRI	21.3.20 SAT	22.3.20 SUN	23.3.20 MON	24.3.20 TUES	OVERALL AVG LAeq
Airport Runway 12 (145.27 m)	63.3	62.9	60.3	62.2	60.4	60.5	62.2	61.4	61.1	57.4	59.6	57.7	**60.7**
Airport Runway 30 (102.0 m)	63.1	61.1	58.1	60.5	61.0	60.1	61.7	60.5	60.3	57.4	59.5		**60.3**
CMU - Petro Caribe Development Fund Building	51.7	44.8	47.1	**N/A**	**N/A**	**N/A**	46.7	44.3	**N/A**	45.9	44.9	44.3	**46.2**
Harbour - Port Authority Harbour Dept.	57.2	53.6	51.5	57.3	59.3	55.7	56.0	**N/A**	**N/A**	49.8	56.0	52.2	**54.9**
Harbour View - Martello Drive	51.1	50.5	48.6	49.6	51.8	49.7	57.2	49.6	49.4	49.6	50.5	50.3	**50.7**
Port Henderson - Royal View Hotel	55.9	55.9	55.1	55.5	54.8	**N/A**	**N/A**	56.3	**N/A**	**N/A**	63.8	52.3	**56.2**
Port Royal - Grand Port Royal Harbour Hotel	49.8	49.7	51.6	53.6	51.7	50.4	51.4	51.6	49.8	53.3	49.5	48.3	**50.9**

N/A – No data available

2.3.2 Minimum and Maximum Noise Level

Table 2.12 shows the minimum and maximum noise levels for each survey day at each location.

1. Runways 12 and 30 had the greatest range of all stations (75.6 dBA and 68.9 dBA respectively). The lowest minimum noise level at Runway 12 was 25.4 dBA on March 15th, while the highest maximum noise level was 101.0 dBA on March 13th. For Runway 30, the lowest minimum noise level was 33.3 dBA on March 13th, while the highest maximum noise level was 102.2 dBA on the same day.
2. The narrowest noise range (45.6 dBA) was observed at the Port Authority Harbour Department

Table 2.12 Showing minimum and maximum noise levels at each location

DATE / LOCATION	13.3.20 FRI		14.3.20 SAT		15.3.20 SUN		16.3.20 MON		17.3.20 TUES		18.3.20 WED		19.3.20 THURS		20.3.20 FRI		21.3.20 SAT		22.3.20 SUN		23.3.20 MON		24.3.20 TUES		OVERALL		RANGE
	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	
Airport Runway 12 (145.27 m)	101.0	27.0	95.0	26.7	93.5	25.4	98.6	27.7	96.5	27.6	97.1	26.6	100.3	28.0	99.3	28.0	98.8	27.0	95.7	27.7	95.9	29.8	92.8	31.3	**101.0**	**25.4**	**75.6**
Airport Runway 30 (102.0 m)	102.2	33.3	95.5	35.0	94.7	34.8	96.0	36.6	94.4	37.2	94.9	36.4	98.0	37.5	93.3	36.3	95.1	37.4	92.0	38.0	97.6	41.3	**N/A**	**N/A**	**102.2**	**33.3**	**68.9**
CMU - Petro Caribe Development Fund Building	83.9	33.9	76.9	35.1	75.0	35.1	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	75.3	35.2	70.9	34.6	**N/A**	**N/A**	78.5	34.8	71.1	34.4	70.8	36.2	**83.9**	**33.9**	**50**
Harbour - Port Authority Harbour Dept.	79.3	45.2	77.1	41.6	75.6	40.9	85.8	42.5	85.7	40.9	74.1	42.7	79.5	40.2	**N/A**	**N/A**	**N/A**	**N/A**	72.7	41.0	74.3	42.7	80.4	43.5	**85.8**	**40.2**	**45.6**
Harbour View - Martello Drive	77.3	35.9	76.6	35.6	80.6	36.2	84.3	36.7	86.5	36.0	80.4	36.1	76.6	36.5	79.4	34.7	81.0	36.6	76.1	35.4	77.7	36.5	84.4	37.1	**86.5**	**34.7**	**51.8**
Port Henderson - Royal View Hotel	85.9	37.6	88.6	40.0	77.8	40.2	84.2	39.8	83.2	40.0	**N/A**	**N/A**	**N/A**	**N/A**	84.0	41.3	**N/A**	**N/A**	76.4	23.6	80.9	21.3	76.1	24.5	**88.6**	**21.3**	**67.3**
Port Royal - Grand Port Royal Harbour Hotel	72.8	39.3	72.1	32.9	75.0	31.0	74.1	37.2	69.5	29.3	68.6	38.1	77.2	38.2	75.5	33.8	73.6	31.8	75.0	37.6	72.3	37.8	66.1	33.5	**77.2**	**29.3**	**47.9**

N/A – No data available

2.3.3 Sound Exposure Level (SEL)

1. The Sound Exposure Level (SEL) is the constant sound level that has the same amount of energy in one second as the original noise event. Table 2.13 shows the SEL for each survey day at each location.
2. Both runways had the highest SEL of all stations, with Runway 12 having the highest SEL of 96.7 dBA followed by Runway 30 with a SEL of 96.1 dBA. The stations with the lowest SEL was the CMU which had a SEL of 82.5 dBA. The commercial noise stations had overall SEL values ranging from 86.7 – 93.3 dBA. The residential station (Martello Drive) had a SEL value of 87.0 dBA.

Table 2.13 SEL for each location

DATE LOCATION	13.3.20 FRI	14.3.20 SAT	15.3.20 SUN	16.3.20 MON	17.3.20 TUES	18.3.20 WED	19.3.20 THURS	20.3.20 FRI	21.3.20 SAT	22.3.20 SUN	23.3.20 MON	24.3.20 TUES	OVERALL AVG SEL
Airport Runway 12 (145.27 m)	98.9	98.4	95.9	97.8	95.9	96.0	97.8	97.0	96.7	93.0	95.1	93.3	**96.7**
Airport Runway 30 (102.0 m)	98.7	96.7	93.7	96.1	96.6	95.7	97.3	96.0	95.8	92.9	95.1		**96.1**
CMU - Petro Caribe Development Fund Building	87.3	80.3	82.7	**N/A**	**N/A**	**N/A**	82.3	79.8	**N/A**	81.4	80.4	79.8	**82.5**
Harbour - Port Authority Harbour Dept.	92.8	89.1	87.1	92.9	94.8	91.2	91.5	**N/A**	**N/A**	85.4	91.5	87.8	**91.2**
Harbour View - Martello Drive	86.7	86.1	84.1	85.2	87.4	85.3	92.7	85.1	84.9	85.1	86.1	85.8	**87.0**
Port Henderson - Royal View Hotel	91.5	91.4	90.7	91.1	90.4	**N/A**	**N/A**	91.8	**N/A**	**N/A**	99.4	87.8	**93.3**
Port Royal - Grand Port Royal Harbour Hotel	85.4	85.2	87.1	89.2	87.2	86.0	87.0	87.2	85.4	88.9	85.0	83.9	**86.7**

N/A – No data available

2.3.4 Day-Night Average Sound Level (DNL)

The Federal Aviation Administration (FAA) has established a DNL (Ldn) noise guideline (Ldn < 65 dBA) for land-use compatibility (see Figure 2.2). Residential and other noise sensitive uses (areas where people spend widely varying amounts of time and other places in which quiet is a basis for use) are considered compatible land-use when the DNL is 65 dBA or less. The DNL within the confines of the airport is ≥ 75 dBA.

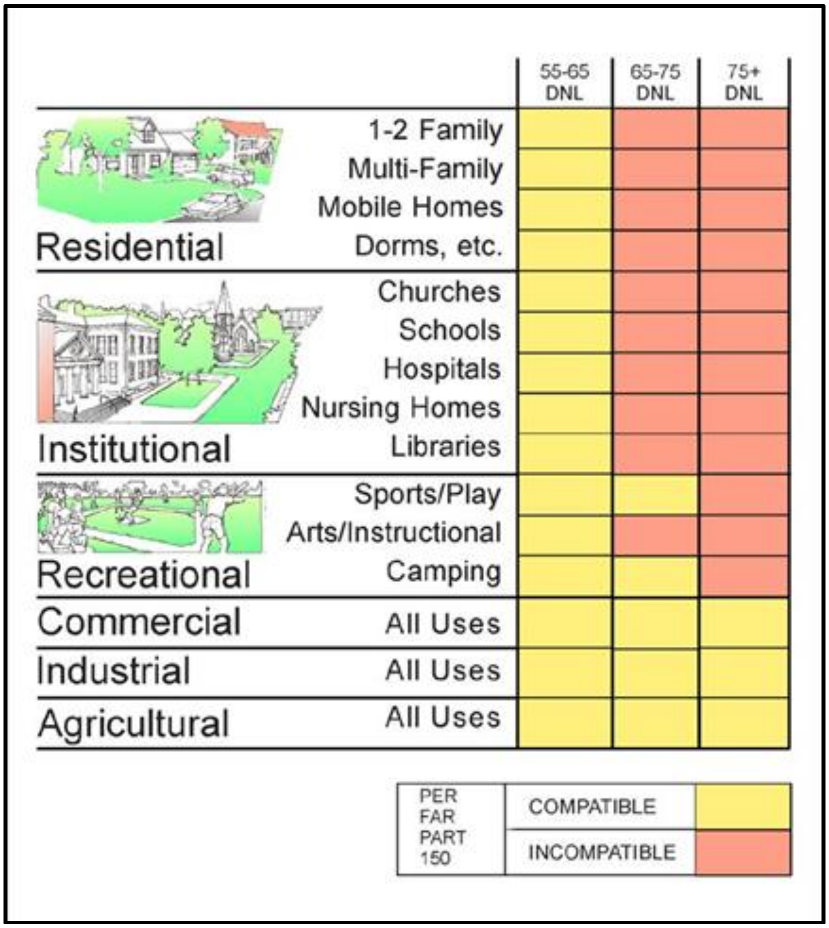

Figure 2.2 FAA Land-Use Noise Sensitivity Matrix

Table 2.14 shows the DNL for each survey day at each location. It shows that the residential, commercial and educational/institutional stations were compliant with the 65 dBA FAA L_{dn} guideline. Both airport runways had noise values compliant with the 75 dBA L_{dn} guideline.

Table 2.14 DNL for each location

DATE / LOCATION	13.3.20 FRI	14.3.20 SAT	15.3.20 SUN	16.3.20 MON	17.3.20 TUES	18.3.20 WED	19.3.20 THURS	20.3.20 FRI	21.3.20 SAT	22.3.20 SUN	23.3.20 MON	24.3.20 TUES	OVERALL AVG DNL
Airport Runway 12 (145.27 m)	67.1	70.5	65.2	65.0	66.6	64.0	64.6	63.7	64.3	57.7	59.9	58.3	**65.2**
Airport Runway 30 (102.0 m)	65.5	66.9	62.1	64.7	65.1	64.5	64.4	64.4	64.0	61.7	62.9	57.8	**64.1**
CMU - Petro Caribe Development Fund Building	56.0	50.3	54.9	45.8	48.7	50.5	50.8	48.9	**N/A**	52.0	49.2	50.1	**51.6**
Harbour - Port Authority Harbour Dept.	62.0	57.8	57.0	61.9	62.9	61.0	59.1	**N/A**	**N/A**	55.4	59.8	58.4	**60.1**
Harbour View - Martello Drive	56.0	54.6	53.1	53.5	55.3	54.3	58.2	53.0	54.8	53.2	54.6	55.8	**55.0**
Port Henderson - Royal View Hotel	60.8	62.1	60.5	60.5	59.8	**N/A**	**N/A**	60.8	**N/A**	55.8	64.0	55.8	**60.7**
Port Royal - Grand Port Royal Harbour Hotel	56.2	54.8	55.6	57.6	56.1	56.1	55.5	56.6	54.0	56.3	54.1	53.8	**55.7**

N/A – No data available

2.3.5 Community Noise Equivalent Levels (CNEL)

The CNEL levels can give an indication of the likelihood of community complaints about a noise source (see Figure 2.3).

Table 2.15 shows the CNEL for each survey day at each location. The calculated CNEL level at the residential station (Harbour View-Martello Drive) was compared with the guideline level that it is expected to have sporadic complaints from the community (range 55-65 dBA). This residential station was compliant with the US EPA Sporadic Complaints Guideline level.

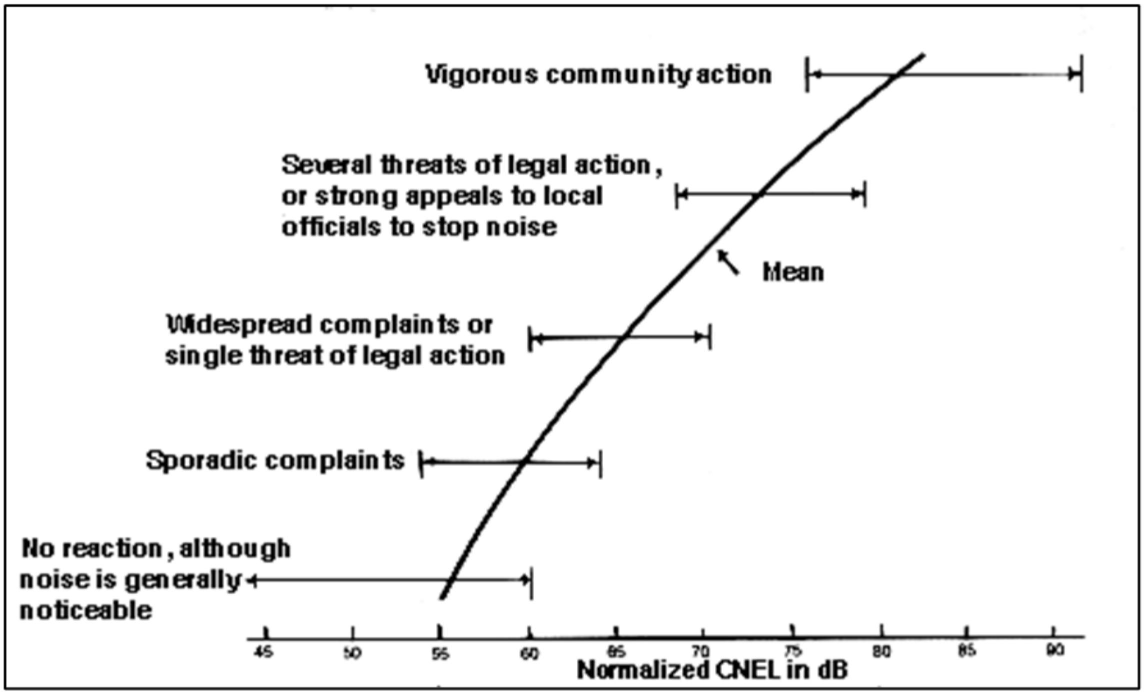

Figure 2.3 Anticipated community reaction versus normalized CNEL (dBA)

Table 2.15 CNEL for each location

DATE LOCATION	13.3.20 FRI	14.3.20 SAT	15.3.20 SUN	16.3.20 MON	17.3.20 TUES	18.3.20 WED	19.3.20 THURS	20.3.20 FRI	21.3.20 SAT	22.3.20 SUN	23.3.20 MON	24.3.20 TUES	OVERALL AVG CNEL
Airport Runway 12 (145.27 m)	67.6	70.8	65.7	65.6	66.8	65.1	65.1	64.6	64.2	60.1	61.3	58.3	**65.7**
Airport Runway 30 (102.0 m)	66.2	67.5	62.8	64.8	65.3	65.0	64.9	64.8	63.9	61.6	62.9	57.9	**64.5**
CMU - Petro Caribe Development Fund Building	56.8	51.1	55.0	48.3	48.6	50.6	51.0	49.0	**N/A**	52.0	49.2	50.2	**52.0**
Harbour - Port Authority Harbour Dept.	61.9	58.0	57.0	61.9	62.7	60.8	59.1	**N/A**	**N/A**	55.5	59.9	58.5	**60.1**
Harbour View - Martello Drive	**56.0**	**55.3**	**53.2**	**53.7**	**55.4**	**54.7**	**58.2**	**53.2**	**55.0**	**53.5**	**54.5**	**56.0**	**55.1**
Port Henderson - Royal View Hotel	61.0	62.2	60.5	60.7	60.1	**N/A**	**N/A**	61.0	**N/A**	56.4	64.0	56.1	**60.8**
Port Royal - Grand Port Royal Harbour Hotel	56.2	55.1	56.3	57.7	56.5	56.3	56.4	57.1	54.7	58.2	54.3	54.3	**56.3**

N/A – No data available

2.3.6 National Resources Conservation Authority (NRCA) Daytime and Night-Time Noise Standards

Table 2.16 shows the NRCA daytime (7am – 10pm) and night-time (10pm – 7am) noise values for each survey day at each location.

Runways 12 and 30 had the highest average daytime and night-time noise levels of all the stations surveyed. Runway 12 had an average daytime noise value of 62.2 dBA and an average night-time value of 52.4 dBA. Runway 30 had an average daytime noise value of 61.7 dBA and an average night-time value of 55.4 dBA. Noise values on all survey days at these two locations were compliant with the respective NRCA daytime guideline value of 75 dBA and night-time guideline value of 70 dBA for industrial zones.

The highest daytime value at Runway 12 was 65.0 dBA on March 13th, while the highest night-time value was 63.7 dBA on March 14th. The highest daytime value at Runway 30 was 65.0 dBA on March 13th, while the highest night-time value was 59.2 dBA on March 14th, similar to Runway 12.

CMU had the lowest daytime and night-time noise levels of all the stations surveyed. CMU had an average daytime noise value of 46.8 dBA and an average night-time value of 44.2 dBA. These average noise values were however, non-compliant with the respective NRCA daytime guideline value of 45 dBA and night-time guideline value of 40 dBA for educational institutions. Both daytime and night-time noise values exceeded the respective NRCA noise guidelines on all survey days except for March 14th and March 24th. On March 14th, the daytime noise value of 44.9 dBA was compliant but the night time value of 43.2 dBA was not. On March 24th, the daytime noise value of 44.9 dBA was compliant but the night time value of 42.9 dBA was not.

Both the Port Authority Harbour Department and the Grand Port Royal Harbour Hotel had daytime and night time noise values on all survey days compliant with the respective NRCA daytime guideline value of 65 dBA and night-time guideline value of 60 dBA for commercial zones.

For the Harbour View Martello Drive residence, both daytime and night-time noise values were compliant with the respective NRCA residential noise guidelines (55 dBA daytime; 50 dBA night-time) on all survey days except for March 19th. On March 19th, the daytime noise value of 59.1 dBA was non-compliant, but the night-time value of 45.0 dBA was compliant with the NRCA guideline value.

For the Port Henderson Royal View Hotel, both daytime and night-time noise values were compliant with the respective NRCA commercial noise guidelines (65 dBA daytime; 60 dBA night-time) on all survey days except for March 23rd. On March 23rd, the daytime noise value of 65.8 dBA was non-compliant, but the night-time value of 43.4 dBA was compliant with the NRCA guideline value.

Table 2.16 NRCA daytime and night-time noise levels for each survey day at each location

DATE	13.3.20 FRI		14.3.20 SAT		15.3.20 SUN		16.3.20 MON		17.3.20 TUES		18.3.20 WED		19.3.20 THURS		20.3.20 FRI		21.3.20 SAT		22.3.20 SUN		23.3.20 MON		24.3.20 TUES		OVERALL	
LOCATION	NRCA DAY	NRCA NIGHT	NRCA DAY	NRCA NIGHT	NRCA DAY	NRCA NIGHT	NRCA DAY	NRCA NIGHT	NRCA DAY	NRCA NIGHT	NRCA DAY	NRCA NIGHT	NRCA DAY	NRCA NIGHT	NRCA DAY	NRCA NIGHT	NRCA DAY	NRCA NIGHT	NRCA DAY	NRCA NIGHT	NRCA DAY	NRCA NIGHT	NRCA DAY	NRCA NIGHT	NRCA DAY	NRCA NIGHT
Airport Runway 12 (145.27 m)	65.0	56.4	62.3	63.7	61.6	56.7	64.0	54.4	61.2	58.6	62.1	53.9	63.9	55.4	63.1	54.2	62.6	56.0	59.4	38.0	61.6	38.9	59.7	42.5	62.2	52.4
Airport Runway 30 (102.0 m)	65.0	53.8	62.0	59.2	59.5	54.3	62.1	54.4	62.6	55.3	61.6	55.3	63.3	55.6	61.8	56.7	61.7	56.1	58.6	54.1	61.0	54.5	**N/A**	**N/A**	61.7	55.4
CMU - Petro Caribe Development Fund Building	**53.0**	**48.3**	44.9	**43.2**	**45.6**	**48.8**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**48.0**	**43.0**	**45.5**	**40.8**	**N/A**	**N/A**	**46.3**	**45.0**	**46.1**	**41.5**	44.9	**42.9**	**46.8**	**44.2**
Harbour - Port Authority Harbour Dept.	58.6	53.1	54.9	49.8	52.3	49.8	58.7	52.7	61.0	52.4	56.8	52.5	57.6	50.3	**N/A**	**N/A**	**N/A**	**N/A**	50.8	47.6	57.6	49.8	52.6	51.3	56.1	50.9
Harbour View - Martello Drive	52.2	48.3	51.9	46.5	49.8	45.3	51.0	45.3	53.3	46.8	51.0	46.3	**59.1**	45.0	51.1	44.3	50.2	47.4	51.0	44.8	51.9	46.6	51.8	45.3	52.0	46.0
Port Henderson - Royal View Hotel	57.2	52.5	57.0	53.1	56.0	53.0	56.6	52.7	56.1	51.2	**N/A**	**N/A**	**N/A**	**N/A**	57.6	52.7	**N/A**	**N/A**	**N/A**	**N/A**	**65.8**	43.4	53.7	47.7	57.5	50.8
Port Royal - Grand Port Royal Harbour Hotel	50.5	48.4	50.8	46.5	53.0	47.1	55.0	49.7	53.1	47.0	51.5	47.6	52.8	47.4	52.8	48.3	51.1	45.8	55.0	46.5	50.7	46.2	49.3	45.9	52.1	47.2

N/A – No data available.

Values in **red** are non-compliant with respective NRCA Guideline

2.3.7 Noise Fluctuations with Aircraft Arrival and Departure Times

Table 6.1 in the Appendices shows the aircraft arrival and departure dates and times at NMIA during noise assessment. Some of the larger noise fluctuations at the various off-site (non-runway) noise monitoring stations can be attributed to noise from aircraft arrival and/or departure based on the date and time when the noise level went above the NRCA Land-Use Noise Guideline value for that particular station. The noise signature recorded also gives an indication whether the noise can be attributed to an aircraft.

The following sections discuss the noise fluctuations/spikes (if any) based on aircraft arrival and departure times at each station. It must be noted that the times of the spikes in noise levels observed at the various stations may not exactly coincide with aircraft arrival/departure times due to the fact that noise takes time to travel through space based on the distance from source to receptor. In addition, the times on the noise meters were not synchronized with the time at the airport Control Tower. The maximum noise level for each sampling day was extracted and evaluated to determine if the noise was attributed to an aircraft.

Other noise fluctuations observed (where the noise level went above the NRCA Land-Use Noise Guideline) that do not coincide with aircraft arrival/departure times, were due to other noise sources such as noise from motor vehicles, loud music, bird calls, dogs barking, crickets chirping and loud talking, based on the noise signature recorded during monitoring.

Information on aircraft model and the runway from which the aircraft departed or on which the aircraft landed, is also presented.

2.3.7.1 Grand Port Royal Harbour Hotel

Table 2.17 shows information on noise spikes related to aircraft noise at the Grand Port Royal Harbour Hotel. From the information gleaned, aircraft noise levels above the NRCA guidelines for this location (65 dBA daytime, 60 dBA night-time) tend to be prevalent when aircrafts are departing from Runway 12. There was one incident (March 16) where a departure from Runway 30 resulted in noise levels above the NRCA guideline. From the samples evaluated, there were no incidences of any arrivals on Runway 30 which resulted in noise levels above the NRCA Guideline.

Aircrafts contributing to these noise levels included small single-engine (DA40) and twin-engine crafts (DA42) as well as mid-sized corporate jets (C560). Larger commercial aircrafts such as the E145, B738 and B763 also contributed to the elevated noise levels, as well as a Jamaica Defence Force helicopter.

Non-aircraft noise sources at this station, which were above the NRCA Noise Guideline, were mainly attributed to the playing of loud music, calls from seabirds, barking of dogs, motor vehicles speeding along the Port Royal main road and honking from motor vehicle horns.

Table 2.17 Noise level spikes due to aircraft arrival and departures (Grand Port Royal Harbour Hotel)

Date	Noise Level (dBA)	Time of Noise Spike	Time of Aircraft Arrival/Departure	Arrival or Departure	Aircraft Model	Runway	Non-aircraft Noise Sources
March 13	68.6	4:12 pm	4:12 pm	Departure	JDF Heli	12	Loud music, Seabirds, Dogs barking, Motor vehicle noises,
March 13	65.4	7:32 pm	7:29 pm	Departure	C560	12	
March 15	65.1	2:06 pm	2:04 pm	Departure	E145	12	
March 16	67.3	8:53 pm	8:54 pm	Departure	DA40	30	

March 18	65.6	7:49 pm	7:48 pm	Departure	DA40	12	car horns honking
March 21	61.1	1:35 am	1:40 am	Departure	B738	12	
March 23	66.3	8:07 pm	8:04 pm	Departure	B763	12	
March 24	64.7	2:56 pm	2:56 pm	Departure	DA42	12	

N.B. Time of noise spike and time of arrival/departure may not coincide because of time taken for noise to travel through space based on the distance from source to receptor. Also, the times on the noise meters were not synchronized with the time at the airport Control Tower

2.3.7.2 Port Henderson Royal View Hotel

Table 2.18 shows information on noise spikes related to aircraft noise at the Port Henderson Royal View Hotel. From the information gleaned, aircraft noise levels above the NRCA guidelines for this location (65 dBA daytime, 60 dBA night-time) tend to be prevalent when aircrafts are departing from and arriving on Runway 12. There was also one incidence of departure from Runway 30 (on March 17) which resulted in elevated noise levels above the NRCA Guideline. From the samples evaluated, there were no incidences of any arrivals from Runway 30 which resulted in noise levels above the NRCA Guideline.

Aircrafts contributing to these elevated noise levels included small single-engine crafts (DA40) as well as mid-sized corporate jets (C560, C56X). Larger commercial aircrafts such as the L135, ATR42, A321 and B738 also contributed to the elevated noise levels.

Non-aircraft noise sources at this station, which were above the NRCA Noise Guideline, were mainly attributed to calls from seabirds, motor vehicles noises from the main road, trucks using engine brakes and honking from motor vehicle horns.

Table 2.18 Noise level spikes due to aircraft arrival and departures (Port Henderson Royal View Hotel)

Date	Noise Level (dBA)	Time of Noise Spike	Time of Aircraft Arrival/Departure	Arrival or Departure	Aircraft Model	Runway	Non-aircraft Noise Sources
March 13	67.1	10:38 am	10:35 am	Arrival	B738	12	Seabirds, Motor vehicle noises, Truck engine brakes, car horns honking
March 13	71.0	12:34 pm	12:35 pm	Arrival	B738	12	
March 13	68.3	4:09 pm	4:09 pm	Departure	C56X	12	
March 13	72.4	4:44 pm	4:46 pm	Arrival	ATR42	12	
March 13	70.9	6:23 pm	6:24 pm	Arrival	C560	12	
March 14	70.4	7:21 pm	7:21 pm	Departure	B738	12	
March 17	71.2	12:40 pm	12:41 pm	Departure	B738	12	
March 17	71.8	6:05 pm	6:03 pm	Departure	A321	30	
March 19	72.6	8:28 pm	8:26 pm	Departure	B738	12	
March 20	70.0	3:12 pm	3:13 pm	Departure	DA40	12	
March 20	72.8	8:41 pm	8:43 pm	Departure	L135	12	

N.B. Time of noise spike and time of arrival/departure may not coincide because of time taken for noise to travel through space based on the distance from source to receptor. Also, the times on the noise meters were not synchronized with the time at the airport Control Tower

2.3.7.3 Caribbean Maritime University

Table 2.19 shows information on noise spikes related to aircraft noise at the Caribbean Maritime University. From the information gleaned, aircraft noise levels above the NRCA guidelines for this location (45 dBA daytime, 40 dBA night-time) tend to be prevalent when aircrafts are departing from and arriving on Runway 12. There were also a few departures from

Runway 30 which had elevated noise levels above the NRCA guidelines. From the samples evaluated, there were no incidences of any arrivals on Runway 30 which resulted in noise levels above the NRCA Guideline.

Aircrafts contributing to these elevated noise levels included small twin-engine crafts (DA42), small commercial aircrafts (E120) and large commercial aircrafts such as the E145, A320, A321 and B738.

Non-aircraft noise sources at this station, which were above the NRCA Noise Guideline, were mainly attributed to calls from birds, dogs barking, crickets chirping (during the night-time), loud talking and construction noises. March 13th was the final day of regular school and activities before a lockdown of the campus due to Covid-19.

Table 2.19 Noise level spikes due to aircraft arrival and departures (Caribbean Maritime University)

Date	Noise Level (dBA)	Time of Noise Spike	Time of Aircraft Arrival/Departure	Arrival or Departure	Aircraft Model	Runway	Non-aircraft Noise Sources
March 14	51.1	1:59 pm	1:59 pm	Departure	E145	12	Bird calls, Dogs barking, Crickets chirping, Loud talking, Construction noises (power saw-March 13 only)
March 14	48.2	2:09 pm	2:11 pm	Departure	E120	12	
March 14	57.2	2:20 pm	2:21 pm	Departure	A321	12	
March 14	59.2	4:01 pm	4:03 pm	Arrival	A320	12	
March 15	48.2	11:14 am	11:14 am	Departure	B738	30	
March 15	55.5	12:43 pm	12:42 pm	Departure	B738	30	
March 19	48.6	8:15 am	8:15 am	Departure	A321	12	
March 19	47.8	10:29 am	10:30 am	Arrival	B738	12	
March 19	51.5	7:03 pm	7:06 pm	Arrival	B738	12	
March 22	58.3	2:10 pm	2:10 pm	Departure	A321	30	
March 23	50.0	3:00 pm	3:00 pm	Departure	DA42	12	

N.B. Time of noise spike and time of arrival/departure may not coincide because of time taken for noise to travel through space based on the distance from source to receptor. Also, the times on the noise meters were not synchronized with the time at the airport Control Tower

2.3.7.4 Port Authority Harbour Department

Although noise levels at this location exceeded the respective NRCA guidelines (65 dBA daytime, 60 dBA night-time), none of the noise spikes were found to be attributed to aircrafts. Instead, the following noise sources were contributing to the elevated noise levels: motor vehicles, truck engine brakes, vehicle horns honking, seabird calls, emergency vehicle sirens, marine traffic noise and noise similar to gunshots.

2.3.7.5 Harbour View – Martello Drive

Although noise levels at this location exceeded the respective NRCA guidelines (55 dBA daytime, 50 dBA night-time), none of the noise spikes were found to be attributed to aircrafts. Instead, the following noise sources were contributing to the elevated noise levels: motorcycles, motor vehicles, truck engine brakes, vehicle horns honking, dogs barking, crickets chirping, birds chirping and construction noises (power saw).

2.3.7.6 Runways 12 and 30

Noise levels at the airport boundaries by Runways 12 and 30 exceeded the NRCA guidelines (75 dBA daytime, 70 dBA night-time) whenever aircrafts departed or landed at that specific runway. All noise which exceeded the NRCA guidelines at Runway 12 was attributed to aircrafts. At Runway 30 however, in addition to aircraft noise, motor vehicle noises along the Port Royal main road also caused noise levels to exceed the NRCA guidelines throughout the monitoring period.

2.3.7.7 Comparison of Stations which Exceeded NRCA Guidelines

Table 2.20 gives an indication of the percentages of aircraft and non-aircraft noise sources which exceeded the respective NRCA Land Use Noise Guidelines at each monitoring location. These percentages are based off the sample of maximum noise levels extracted and evaluated.

Table 2.20 Percentage of Noise Sources contributing to exceedance of NRCA Noise Guidelines

Location	% of Noise from Aircraft	% of Noise from Non-Aircraft Sources
Airport Runway 12	100%	0%
Airport Runway 30	100%	0%
CMU - Petro Caribe Development Fund Building	42%	58%
Port Authority Harbour Dept	0%	100%
Harbour View - Martello Drive	0%	100%
Port Henderson - Royal View Hotel	44%	56%
Grand Port Royal Harbour Hotel	30%	70%

2.4 Summary and Conclusion

Three out of the five non-runway monitoring stations had noise levels attributed to aircrafts, which exceeded the respective NRCA guidelines. These three stations were: **Grand Port Royal Harbour Hotel, Port Henderson Royal View Hotel and the Caribbean Maritime University (CMU).** The CMU and Grand Port Royal Harbour Hotel are the two closest receptors to the airport runways. A trend was noticed whereby departures from Runway 12 were the most frequent occurrence resulting in elevated noise levels at these two locations, which is expected since they are the closest. When an aircraft is departing and ascending it employs roughly 70% thrust power (depending on the weight/load of the aircraft), therefore noise levels would be at their highest during ascent. Grand Port Royal Harbour Hotel is in the direct departure flight path after an aircraft departs from Runway 12 and makes the right turn to loop around and head in a north north-westerly direction. Although CMU is not in the direct departure flight path from Runway 12 or 30, it is still in close enough proximity to the airport to detect elevated noise levels during departure, regardless of which runway the aircrafts depart from. CMU is also zoned as an educational institution, therefore the NRCA Noise Guidelines are much lower compared to the other residential and commercial locations and noise impact would be higher during class time. However, Friday March 13th was the final day of regular school activities before a lockdown of the entire campus due to Covid-19.

Port Henderson Royal View Hotel is also in the Runway 12 and 30 departure flight path, as well as the Runway 12 arrival flight path. Elevated noise levels at this location were mainly attributed to both arrivals and departures to and from Runway 12, as well as departures from Runway 30. As previously mentioned, a lot of thrust power is needed when an aircraft departs and ascends, hence the elevated noise from the aircraft upon reaching in the vicinity of this monitoring location. A large commercial aircraft approaching to land at Runway 12 will be at an altitude of approximately 610 m (2,000 ft.) when it is directly over the Port Henderson Royal View Hotel. Even though the aircraft engines are not producing any thrust power for landing, the aircraft altitude is still low enough to cause significant noise impact at this location. Aircraft arrivals onto Runway 30 would not have any noise impact at this location since it is not in the arrival flight path.

The Port Authority Harbour Department does not fall within any of the arrival flight paths, however, it falls within the Runway 12 departure flight path. However, when an aircraft takes off from Runway 12, ascends and loops back around to head in a north north-westerly direction, the altitude of the aircraft by the time it reaches Port Authority Harbour

Department (approximately 1,830 m/6,000 ft. for large commercial aircrafts), is too high to have a significant noise impact at this location. Noise can still be heard from aircrafts flying over Port Authority Harbour Department after departure from Runway 12, however, the data collected showed that the noise levels did not exceed the NRCA Guidelines.

Harbour View Martello Drive does not fall within the departure or arrival flight path for aircrafts, hence no elevated noise levels at this location were attributed to aircrafts. Aircraft departure and arrival flight paths can be seen in Figure 2.4 and Figure 2.5 respectively.

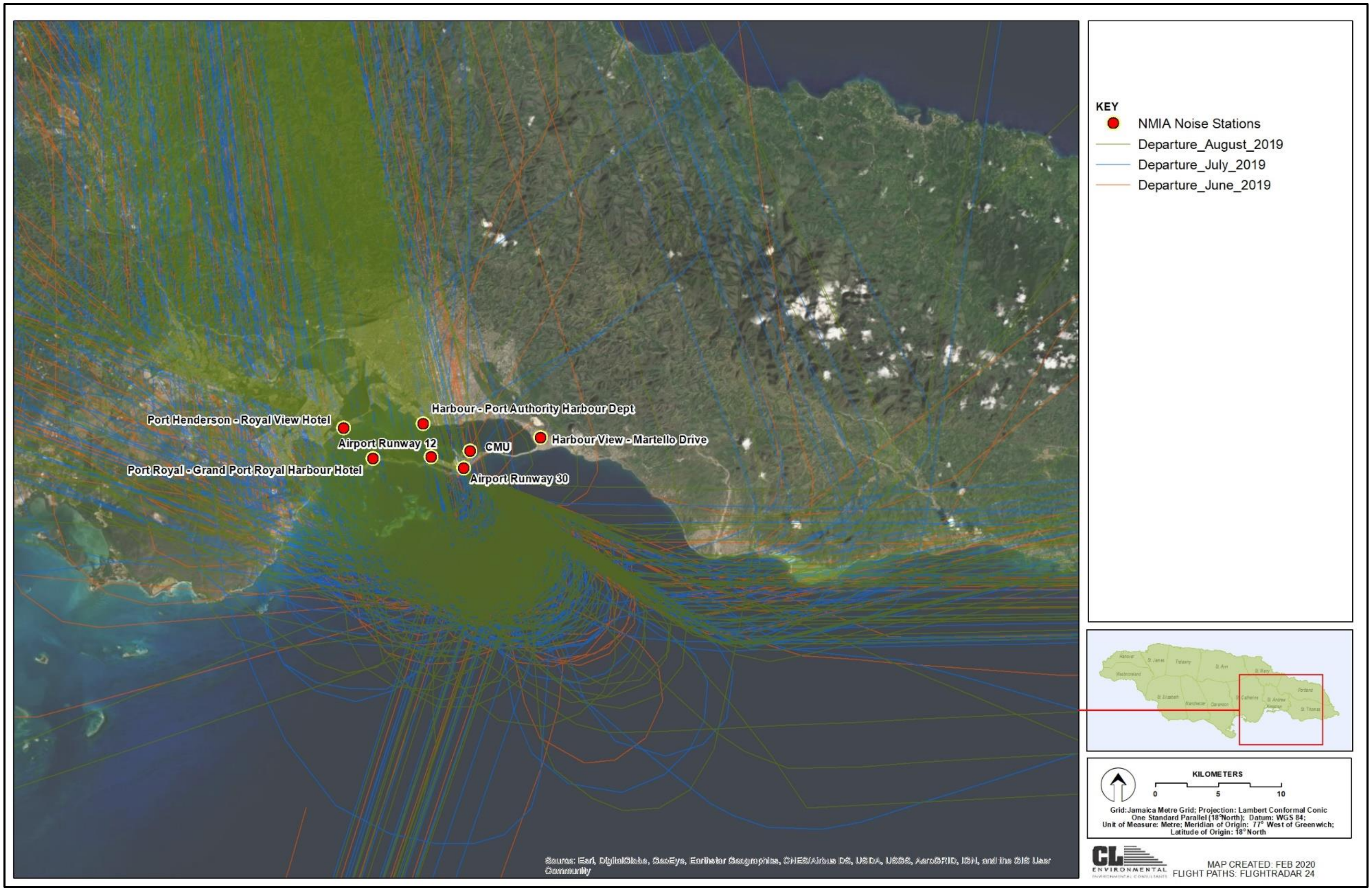

Figure 2.4 Aircraft departure flight paths at NMIA

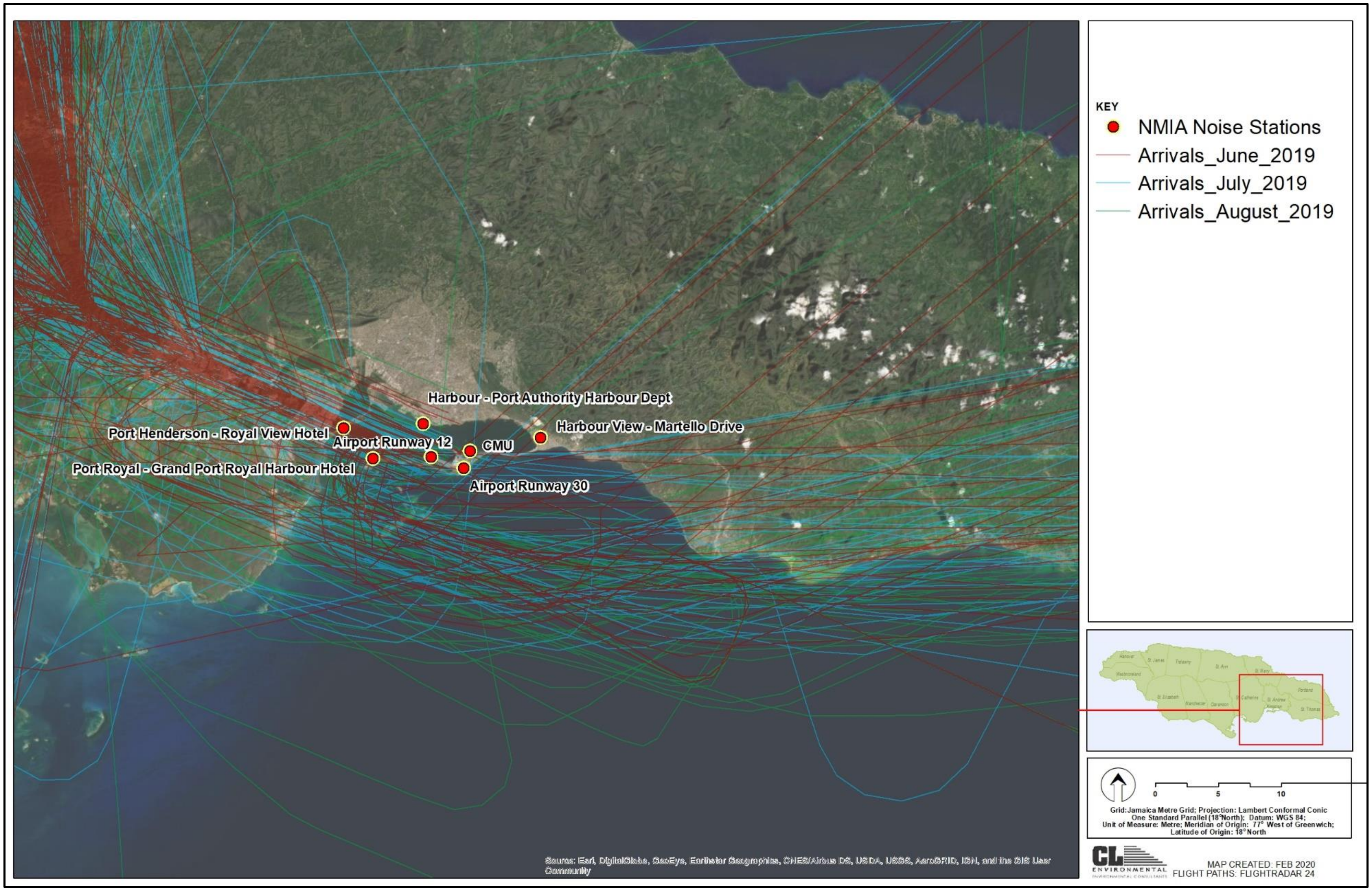

Figure 2.5 Aircraft arrival flight paths at NMIA

Regarding the types of aircrafts and noise impact on the various receptors, the smaller single-engine and twin-engine crafts, as well as mid-sized corporate private jets still produce high noise regardless of their size. In fact, the larger commercial passenger aircrafts tend to have quieter engines compared to some of the mid-sized corporate private jets. These smaller aircrafts also fly at a lower altitude upon approach to land at Runway 12, compared to a large commercial aircraft, therefore, the noise impact would still be great on a receptor such as Port Henderson Royal View Hotel for example.

3 Aviation Noise Contour Development

3.1 Introduction

The Normal Manley International Airports Limited (NMIAL) is a limited Liability company incorporated under the Companies Act of Jamaica, and a wholly owned subsidiary of the Airports Authority of Jamaica. NMIAL required an examination of noise exposure and land use so that the airport could undertake to address noise and land use compatibility matters. This included the development of noise contours for the Norman Manley International Airport (NMIA). The main objective of this study is to develop a noise contour and emissions inventory of aeronautical operations at the airport.

The Norman Manley International Airport (NMIA) is located 4.6 kilometers from the downtown area of Kingston, Jamaica (see Figure 3.1). The airport reference point coordinates are: 17.935667 latitude and -76.787500 longitude. The airport elevation is 3 meters above mean sea level. The airport has a single runway with dimensions 2,716 x 46 meters oriented Southeast-Northwest. The runway ends are labeled 12 and 30 corresponding to their orientations with respect to the magnetic North (112 degrees and 292 degrees, respectively). Runway 12 has Instrument Landing System (ILS). Runway 30 is a non-precision approach runway. Both ends have approach lights (HIRL) and Precision Approach Path Indicator guidance (PAPI). The airport does not have ICAO-compliant Runway End Safety Areas (RESA).

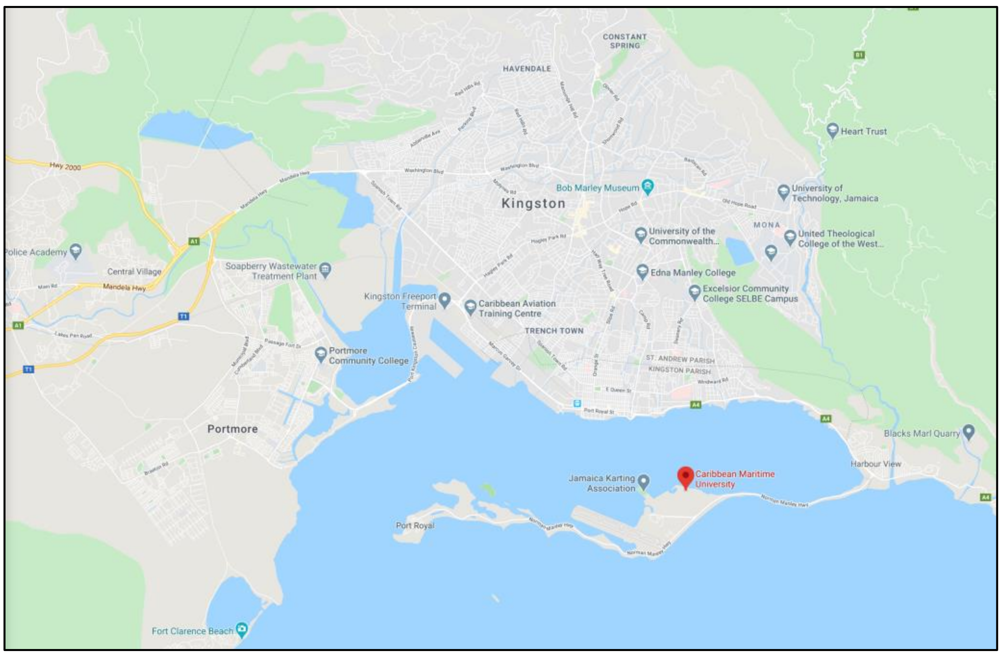

Figure 3.1 Location of the Normal Manley International Airport. Source: Google Maps.

The purpose of this study is to execute a noise study for the airport that is compliant with the International Civil Aviation Organization (ICAO) guidelines. The study was performed using the Aviation Environmental Design Tool (AEDT version 3c) - a model developed by the United States Federal Aviation Administration (FAA) Office of Energy and Environment (FAA 2020). The results of this study are also useful in establishing the level of compliance of NMIA with recommended legislation pertaining to the control of noise pollution.

A study commissioned by the Natural Resources Conservation Authority to review local and international noise regulations recommended the adoption of a legal framework based on the Indian Noise Pollution (Regulation and **Control) Rules, 2000.**

Table 3.1 presents the Ambient Air Quality Noise Standards in Jamaica. The standard specifies LAEQ levels for day and night for areas zoned as industrial, commercial, residential and silent zones. The airport is within proximity to the Caribbean Maritime University (CMU) considered a Silence Zone.

Table 3.1: Recommended Noise Framework for Jamaica

(Ambient Air Quality Standards and Noise)*

Area Zone	Daytime Limits (dBA)	Nighttime Limits (dBA)
Industrial Area	75	70
Commercial Area	65	55
Residential Area	55	45
Silence Zone	50	40

* From The Noise Pollution (Regulation And Control) Rules, 2000, The Central Pollution Control Board (CPCB), Ministry of Environment and Forests, Government of India.

3.2 Approach and Methodology

The noise analysis comprises of two parts: 1) a noise survey (Section 2) and; 2) computer noise model of aeronautical operations. The following paragraphs describe the process to estimate noise metrics around the airport.

3.2.1 Noise Survey Analysis

Noise data was collected using Bruer and Kjaer class 1 hand-held analyzer Type 2250/2270. A-weighted broadband noise measurements provide information on levels at seven locations around the airport meeting the following criteria:

- Aircraft/Airport Noise Areas (airport airside areas in the vicinity of both runway ends),
- Facilities/communities close to Aircraft noise areas, and
- Facilities/communities falling within the flight path.

Figure 3.2 shows the locations of seven sites selected to monitor noise activity. The specific locations were determined in consultation with NMIAL. Noise sites include the Caribbean Maritime University (CMU), Port Royal (Grand Royal Harbour Hotel), Harbour View (Martello Drive), Port Authority Harbour Department, Port Henderson (Royal View Hotel), and two locations in the vicinity of Runways 12 and 30. Table 3.2 shows the exact geographical locations of the sites.

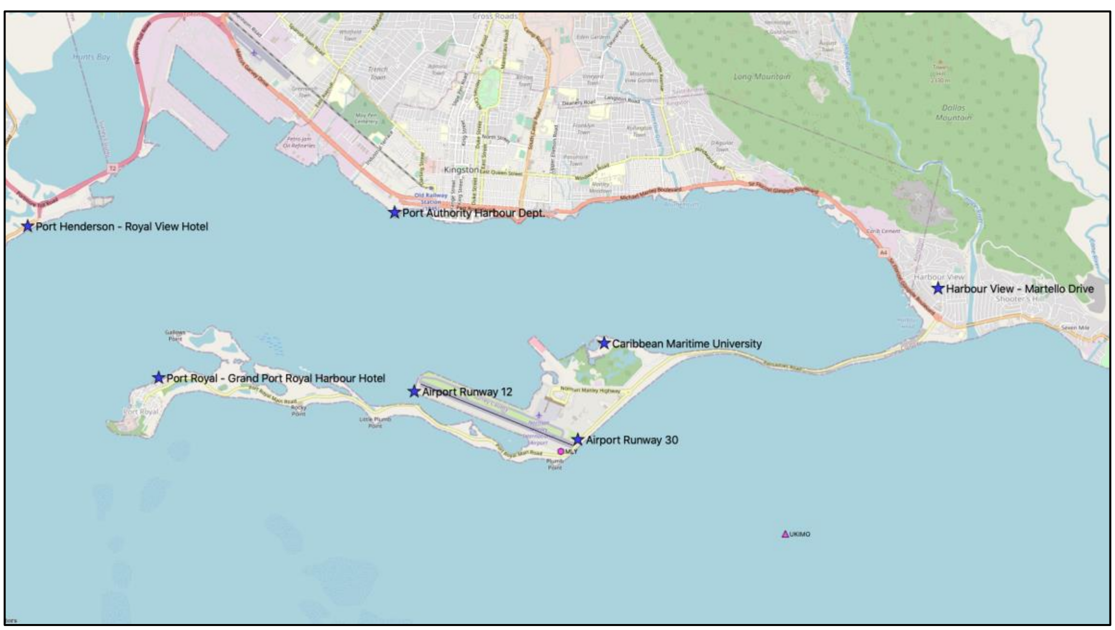

Figure 3.2: Location of Noise Monitors Nearby the Normal Manley International Airport. Noise Monitors Located at Stars in the Map. Source: OpenStreet Map.

Table 3.2: Geographical Coordinates of Noise Monitoring Sites.

Noise Monitor Location Name	Longitude (degrees)	Latitude (degrees)
Harbour View - Martello Drive	-76.720	17.954
Port Henderson - Royal View Hotel	-76.859	17.963
Port Authority Harbour Dept.	-76.803	17.965
Caribbean Maritime University	-76.771	17.946
Port Royal - Grand Port Royal Harbour Hotel	-76.839	17.941
Airport Runway 30	-76.775	17.932
Airport Runway 12	-76.800	17.939

We collected and analysed noise measurements in conjunction with other relevant data such as time of day, weather conditions, flight schedule, and source of noise (e.g., aircraft type). The duration of ambient measurements was 24-hrs (7:00 AM to 7:00 AM). We collected 14 days of data for each site to study noise level variations for periods with varying air traffic. The Bruer and Kjaer hand-held analyzers collect numerous noise metrics, including Day-Night Average Sound Level (L_{DN}) and Equivalent Continuous Sound Pressure Levels (LAeq). Figure 3.3 shows a 24-hour sample data of the Equivalent Continuous Sound Pressure Level (LAEq) collected near runway threshold 12. LAeq values above 60 dBA represent aviation operations. Table 3.4 shows a summary of LAeq values recorded at the seven locations selected for the study. Table 3.3 contains the numerical values of LAeq data collected. As expected, the LAeq values at Runway 30 are higher than those recorded for Runway 12 and other locations. The runway 30 threshold site is affected by departure operations on runway 12, which overfly the runway threshold 30 at low altitude. Aircraft produce higher noise levels on takeoff than during landing. The average value of LAeq at CMU is 46.4 dBA. However, LAeq values at CMU range from 51.2 to 44.04 dBA. The computer noise model predicts 44.8 dBA at that location, with 82.4 daily flights. The noise model predictions are in the range of observed LAeq values.

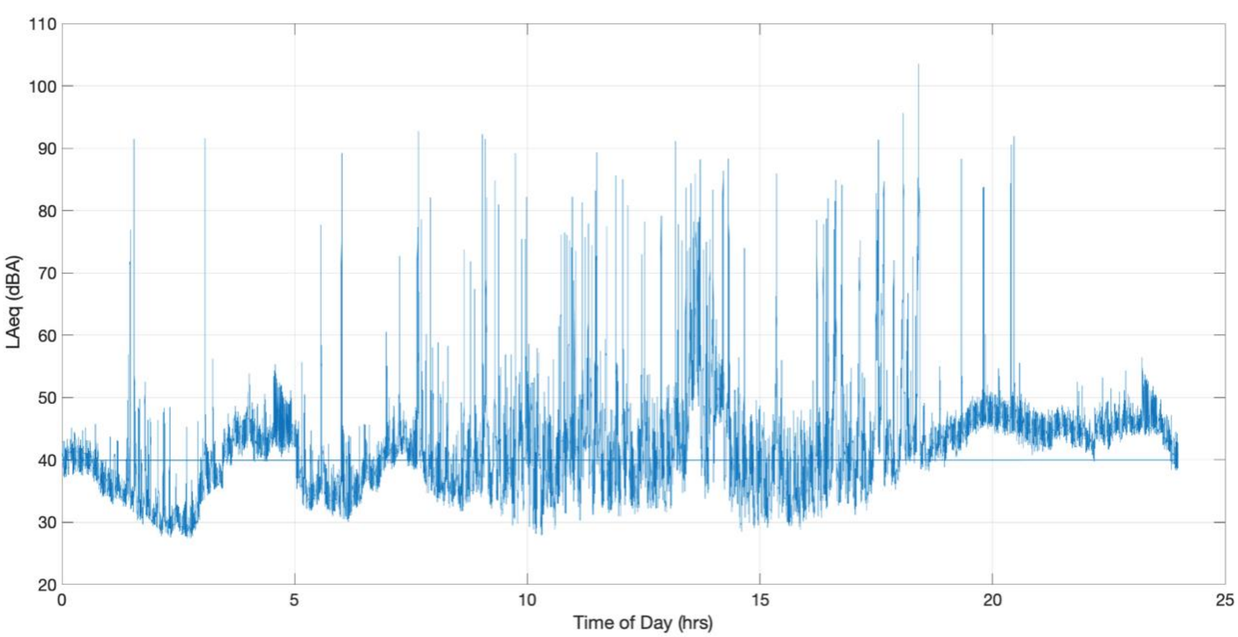

Figure 3.3: Sample LAeq Data Collected Near the Runway End 12 (Data Collected on March 12 and 13, 2020).

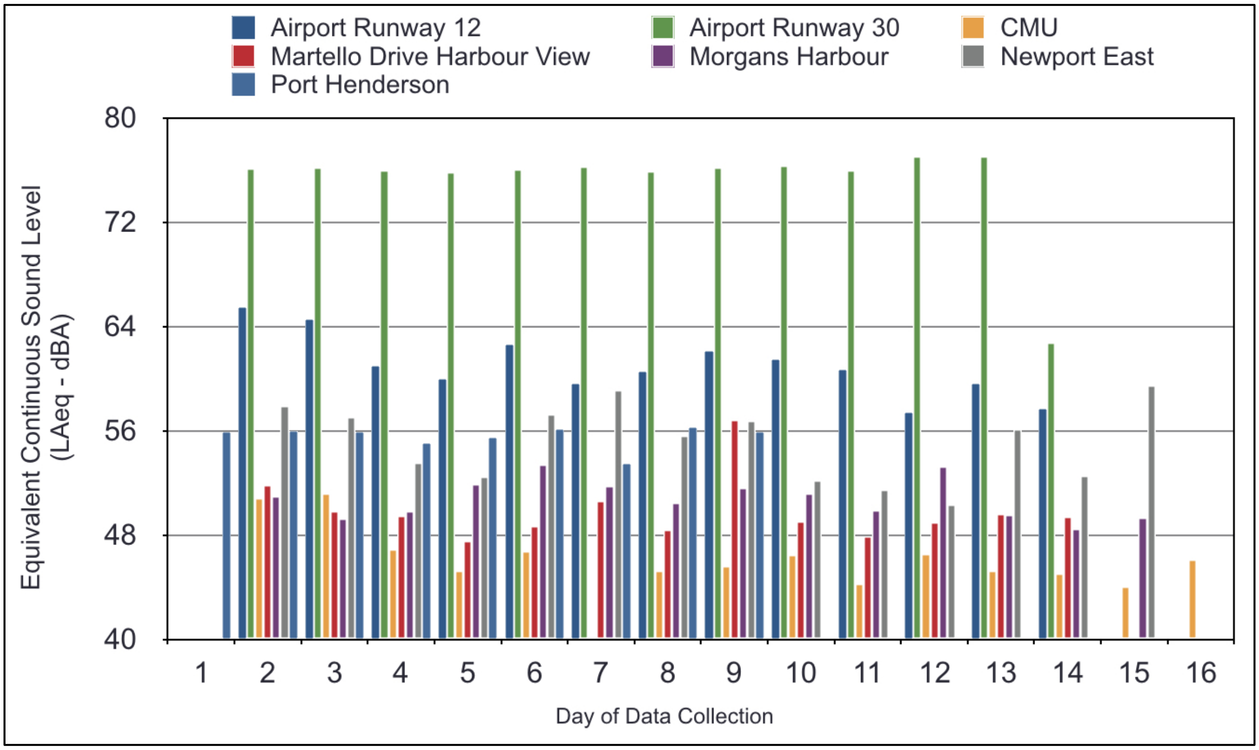

Figure 3.4: Equivalent Continuous Sound Pressure Level (LAeq) Data Collected at Seven Sites. Data Collected Between March 12 and March 25, 2020.

Table 3.3: Equivalent Continuous Sound Pressure Level (LAeq) Data Collected at Seven Sites.

Day	Airport Runway 12	Airport Runway 30	CMU	Martello Drive Harbour View	Morgans Harbour	Newport East	Port Henderson
1	*						55.89
2	65.45	76.10	50.85	51.83	50.95	57.87	55.98
3	64.58	76.19	51.22	49.86	49.25	57.03	55.87
4	60.97	75.95	46.87	49.47	49.81	53.56	55.07
5	59.99	75.83	45.25	47.51	51.93	52.46	55.45
6	62.63	76.05	46.75	48.67	53.43	57.28	56.08
7	59.59	76.23		50.61	51.73	59.15	53.50
8	60.58	75.88	45.28	48.40	50.44	55.65	56.23
9	62.11	76.17	45.58	56.86	51.59	56.79	55.91
10	61.47	76.32	46.45	49.06	51.21	52.20	
11	60.71	75.95	44.25	47.90	49.92	51.47	
12	57.42	77.02	46.56	48.98	53.26	50.32	
13	59.59	77.02	45.25	49.60	49.53	56.13	
14	57.71	62.79	45.03	49.37	48.46	52.52	
15			44.04		49.33	59.47	
16			46.11				

Note: blanks in the table represent days with incomplete data.

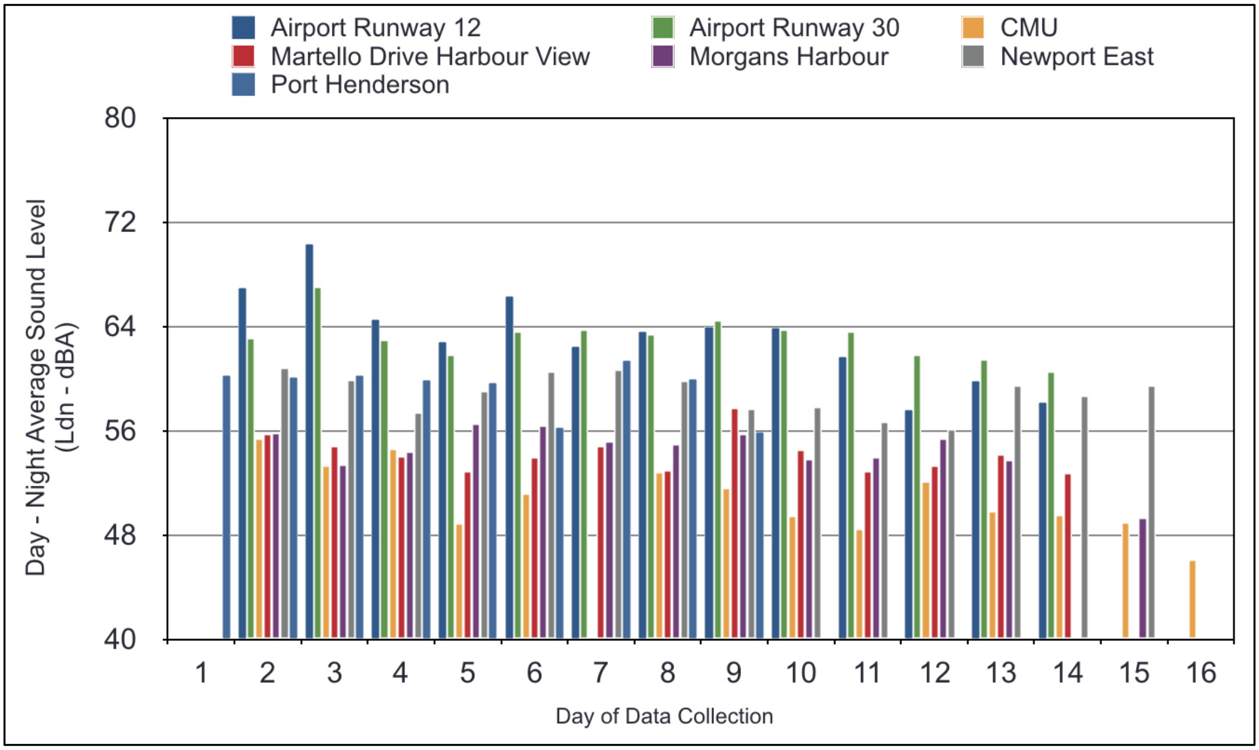

Figure 3.5: Day-Night Average Sound Level (L_{DN}) Summary Data Collected at Seven Sites. Data Collected Between March 12 and March 25, 2020.

Table 3.4: Day-Night Average Sound Level (L_{DN}) Summary Data Collected at Seven Sites.

Day	Airport Runway 12	Airport Runway 30	CMU	Martello Drive Harbour View	Morgans Harbour	Newport East	Port Henderson
1							60.24
2	66.97	63.14	55.43	55.76	55.86	60.82	60.10
3	70.31	67.08	53.33	54.86	53.38	59.93	60.29
4	64.57	62.96	54.58	54.02	54.40	57.37	59.89
5	62.81	61.80	48.89	52.93	56.51	59.02	59.70
6	66.33	63.59	51.21	53.97	56.43	60.55	56.29
7	62.45	63.75		54.82	55.21	60.69	61.38
8	63.60	63.39	52.80	52.98	54.96	59.85	59.94
9	64.01	64.48	51.60	57.76	55.73	57.66	55.91
10	63.93	63.75	49.46	54.53	53.84	57.81	
11	61.72	63.62	48.48	52.91	53.97	56.68	
12	57.59	61.86	52.08	53.36	55.41	56.10	
13	59.84	61.46	49.81	54.17	53.77	59.45	
14	58.17	60.55	49.51	52.79		58.71	
15			48.95		49.33	59.47	
16			46.11				

Note: blanks in the table represent days with incomplete data.

The average value of L_{DN} at Port Henderson is 59.3 dBA. The low value is 55.9 and the highest value is 61.4 dBA. The noise contours for the baseline scenario predict L_{DN} ~54 dBA at Port Henderson. This is below the lower bound of the L_{DN} values recorded by the noise meters. It is important to put in context the fact that at Port Henderson there are almost twice the number of noise events recorded by the survey compared to the predictions of the model. Figure 3.6 and Figure 3.7 illustrate the number of noise events recorded at various sites. Figure 3.7 shows the cumulative number of noise events recorded in the survey. Note that there are numerous noise events unrelated to aviation activity at all sites except for the two locations near the runway ends. The additional noise events recorded at sites off the airport increase the values of L_{DN}. Figure 3.6 shows that Port Henderson had 129 noise events recorded by the noise meters on March 12, 2020. On the same day, the noise meter near runway 12 (i.e., the closest runway end to Port Henderson) recorded 73 noise events. The additional 56 noise events recorded at Port Henderson on March 12, 2020 could explain the difference in the L_{DN} noise levels recorded by the noise meter and the L_{DN} level predicted by the noise model.

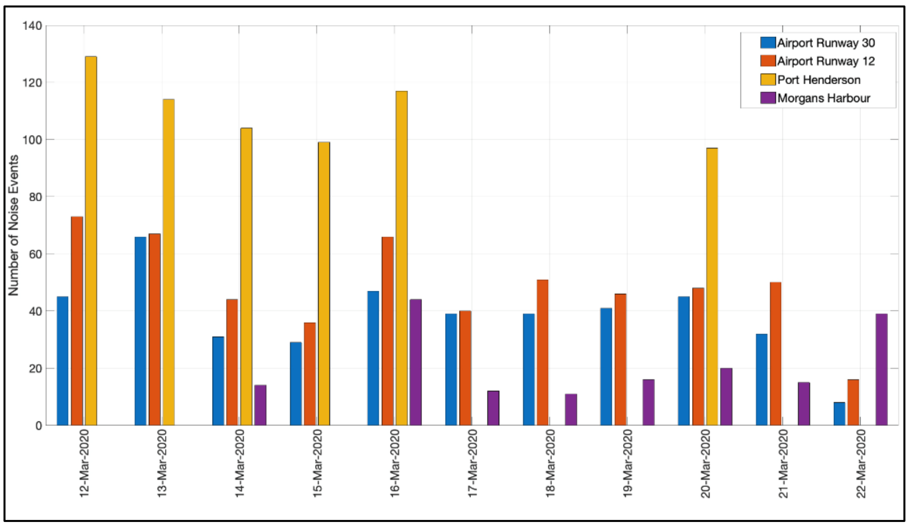

Figure 3.6: Number of Noise Events Detected by Noise Meters at Four Sites. Data Collected Between March 12 and March 22, 2020.

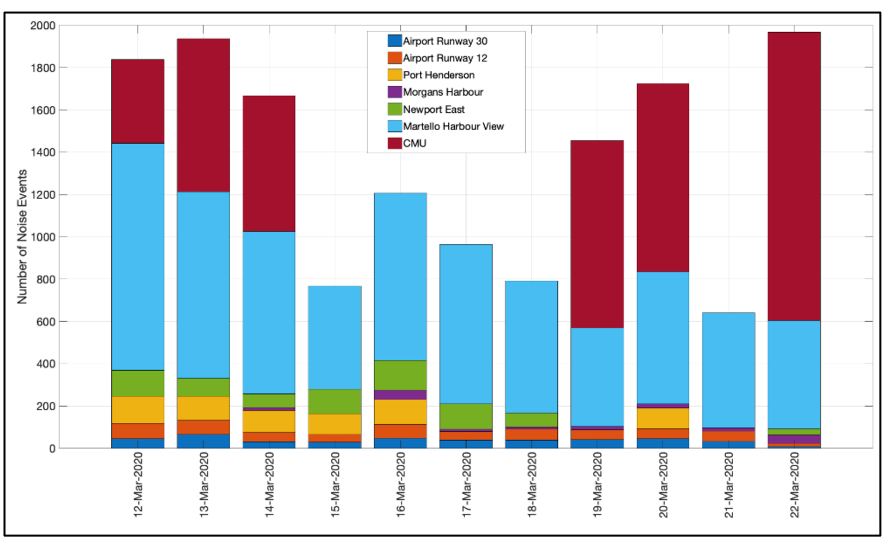

Figure 3.7: Number of Noise Events Detected by Noise Meters at Seven Sites. Data Collected Between March 12 and March 22, 2020.

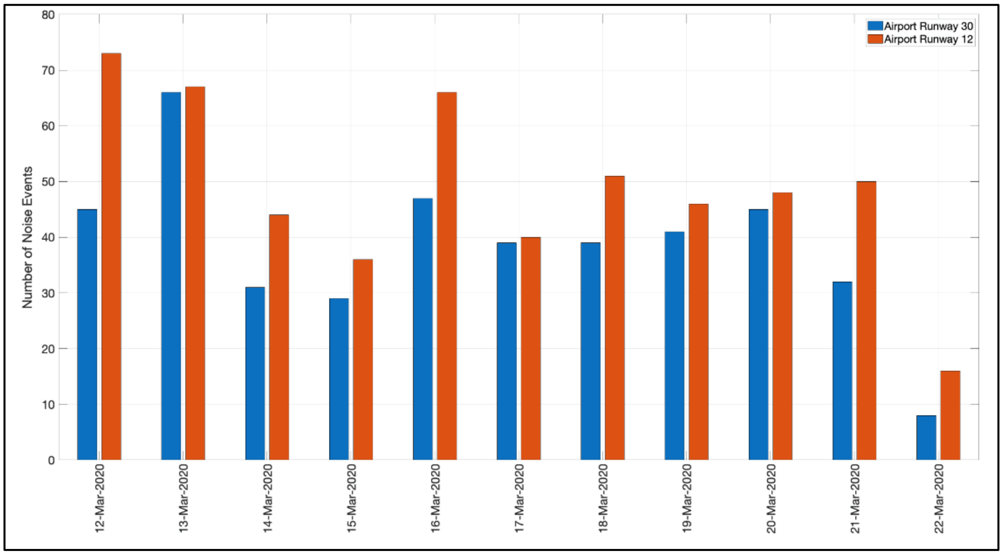

Figure 3.8: Number of Noise Events Detected by Noise Meters at Runway Thresholds. Data Collected Between March 12 and March 22, 2020.

3.2.2 Noise Contour Development Process

The process to develop noise contours is delineated by ICAO (2008) in document 9910 - Recommended Method for Computing Noise Contours around Airports and ICAO document 9829 AM/451 - Guidance on the Balanced Approach to Aircraft Noise Management (2008). The first step is to gather field data to build credible arrival and departure flight paths in and out of the airport. The data-gathering steps include the definition of flight track geometry, speed profiles, and thrust settings if different from nominal. The second step is to construct single flight events. Then accumulate flights per flight path and aircraft type (step three). The fourth step is to estimate noise contours. The final step is to assess the impact on the population around the airport.

3.2.3 Airport Flight Track Data

We collected detailed flight tracks using publicly available data from FlighAware.com. An Application Programming Interface (API) facilitated the data collection process. Commercial flight data spanning seven months (June 2019 to January 2020) was compiled and developed into a database. FlightAware includes partial information for commercial flights only. Additional airport activity was estimated using the airport Air Traffic Control (ATC) tower records. A total of 4,627 arrivals and 3,297 commercial flights obtained from FlightAware were studied to understand arrival and departure patterns at the airport. Figure 3.9 shows the commercial aircraft arrivals collected for the study. Figure 3.10 shows the commercial aircraft departures collected for the study.

We conducted a detailed analysis of the vertical profiles for commercial flight arrivals and departures to the NMIA airport. The information obtained is used to construct core flight patterns used in the airport noise model. The vertical profiles are also useful to estimate altitudes above populated areas in Surrey and Middlesex Counties. Figure 3.11 shows the mean arrival altitude of overflying populated areas. The side scale shows altitudes above mean sea level conditions in feet. Figure 3.11 shows that arrival traffic to NMIA runway 12 overflies Portmore a height ranging between 1500 to 2200 feet. In 2019, 96.1% of all operations at NMIA used Runway 12.

Figure 3.12 shows the mean altitude of departure flights above populated centers. The side scale of the graphic show altitudes above sea level conditions in feet. Figure 3.12 shows that departures from runway 30 are able to climb between 2,000 to 3,500 feet before overflying populated areas such as Portmore and Central Village. Figures 8 and 9 can inform communities affected by overflights.

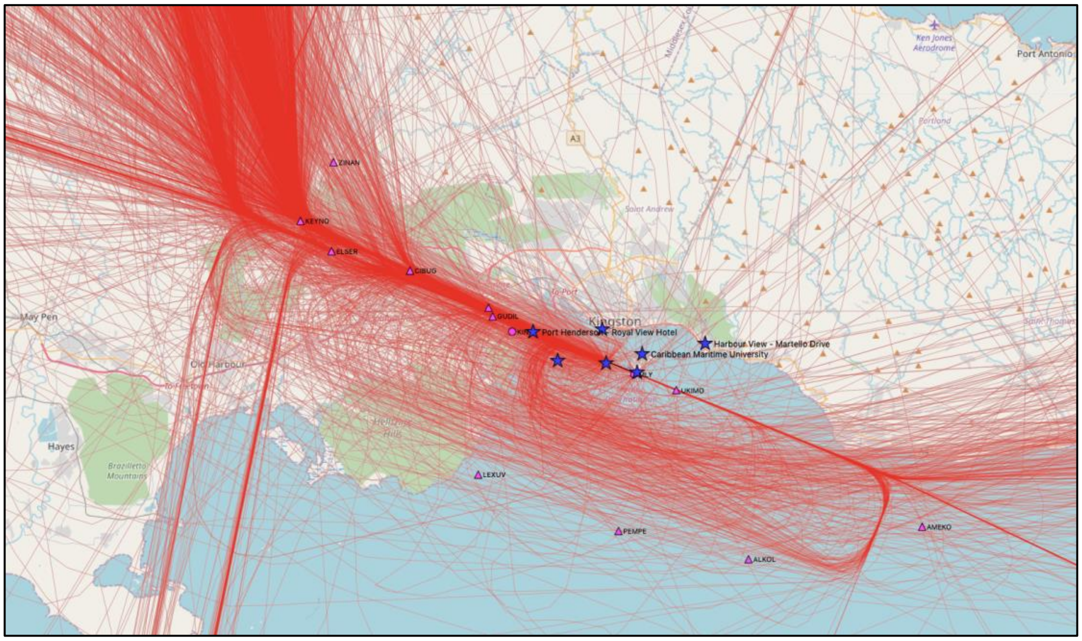

Figure 3.9: June 2019 to January 2020 Commercial Flight Arrival Tracks at Normal Manley International Airport.

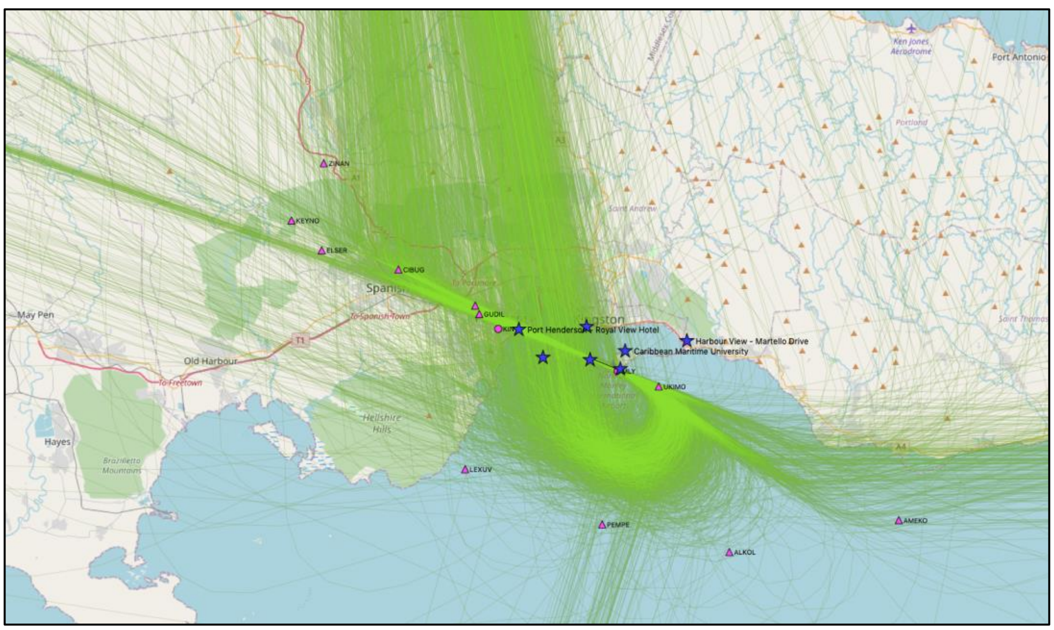

Figure 3.10: June 2019 to January 2020 Commercial Flight Departure Tracks at Normal Manley International Airport.

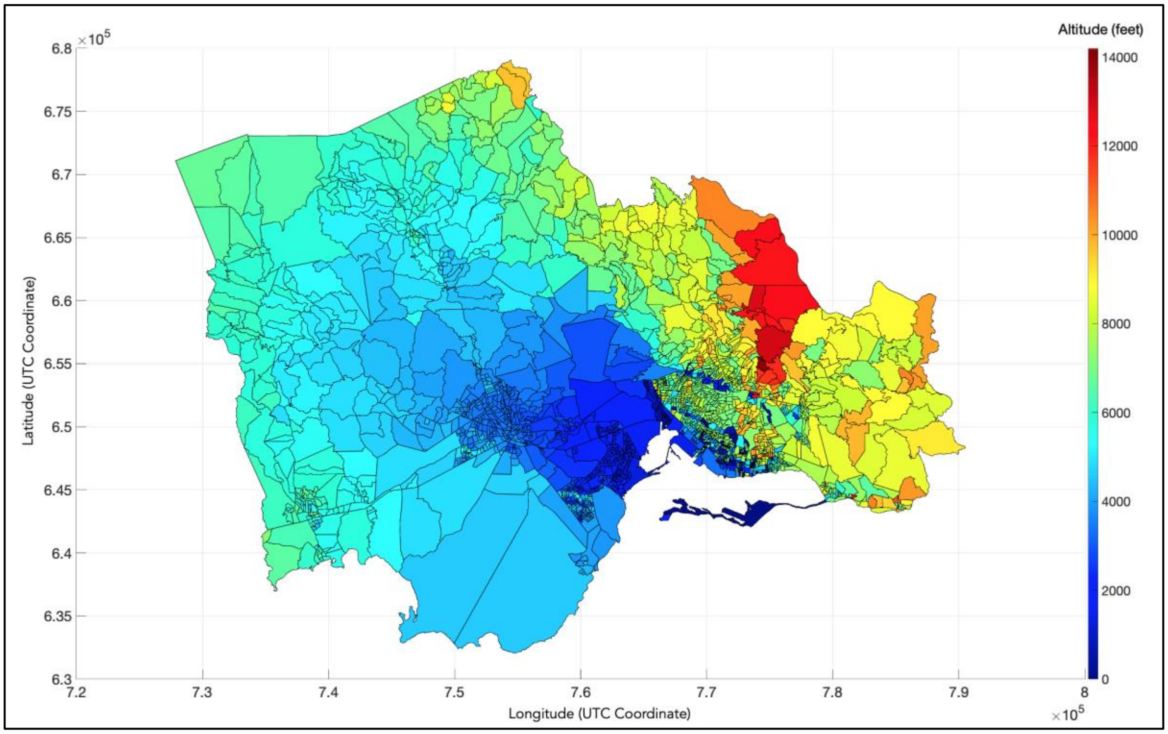

Figure 3.11: Estimated Mean Arrival Flight Altitudes over Populated Areas around Normal Manley International Airport.

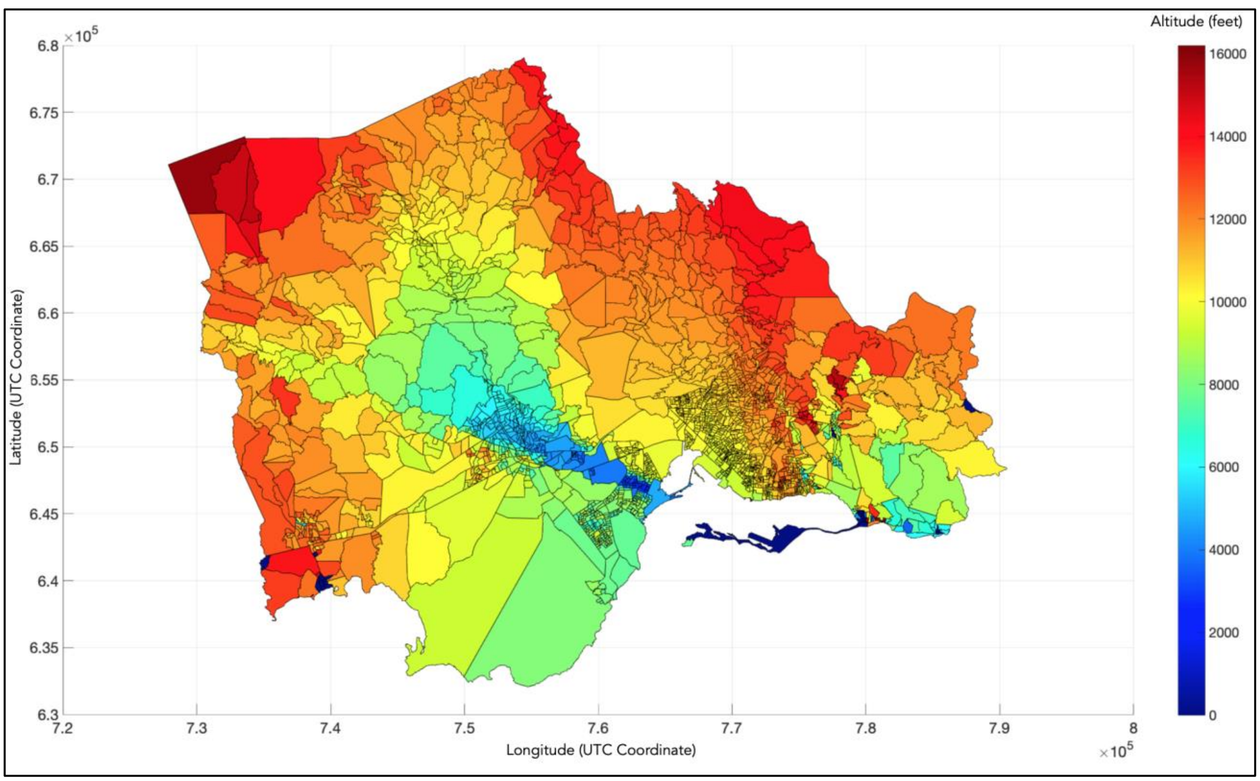

Figure 3.12: Estimated Departure Flight Mean Altitudes over Populated Areas Around Normal Manley International Airport.

3.2.4 Airport Operations

The NMIA ATC control tower provided three years of tower activity (a total of 80,991 records) for years 2017-2019. We also have tower activity records for years 2008-2010 of the previous noise study. Figure 3.13 shows the number of annual operations at NMIA for two periods of time: 2008-2010 and 2017-2019. Several trends are evident at the airport. The number of operations at NMIA increased by 26% since the year 2017. The fraction of operations using runway 12 has also increased. In the period between 2008-2010, 8.2% of the operations at MNIA used runway 30. In the period 2017-2019, 6.2% of the operations used runway 30. In 2019, only 3.9% of the operations used runway 30. The implications of such an operational imbalance is the asymmetry of the noise contours at NMIA. A higher number of operations on runway 12 reduce the noise exposure to communities West-Northwest of the airport because aircraft arrivals generate less noise than departures.

Runway 12 offers precision approach procedures. Runway 30 is a non-precision runway. Pilots and airlines favor precision runways as they provide improved vertical and lateral guidance on approach with an added margin of safety. Figure 3.14 shows the breakdown of flight operations by runway and by the time of day. The calculation of community noise metrics such as Ldn assumes nighttime operations are equivalent to ten daytime operations of the same aircraft. Between 2017 and 2019, the number of nighttime operations on runway 12 increased 42.8%. According to the tower data, in 2019, 27.4% of the operations at NMIA are nighttime events. For noise modeling, nighttime events occur before 7:00 AM and after 22:00 hrs.

3.2.5 Aircraft Fleet Mix

The aircraft fleet mix has evolved since the last noise study in 2011. Airlines operate newer generation narrow-body aircraft to NMIA compared to a previous study conducted nine years ago. New generation aircraft produce less noise compared to older commercial aircraft. Figure 3.15 shows the aircraft fleet mix operating at the airport in 2019. The number of aircraft shown in Figure 3.15 represents those with more than 0.5% of the total operations at NMIA. Twenty-six percent of the traffic at NMIA are Diamond DA-40 single engine aircraft operated by the Jamaica Defense Forces (JDF). Narrow-body aircraft such as the Boeing 737-700/800 and Airbus A320/A321/A319 family make 38.5% of the fleet. Two percent of the traffic at NMIA are helicopters presented on the table by the Bell 206L. In Figure 3.15 three aircraft types require substitution in the AEDT 3c. For example, AEDT 3C does not have the acoustic profiles of the Diamond DA-40. We use the noise profile of the Cessna 182 as a substitute for the DA-40. We adopt substitution aircraft for the Pilatus PC-12 and the Aerospatiale ATR-42.

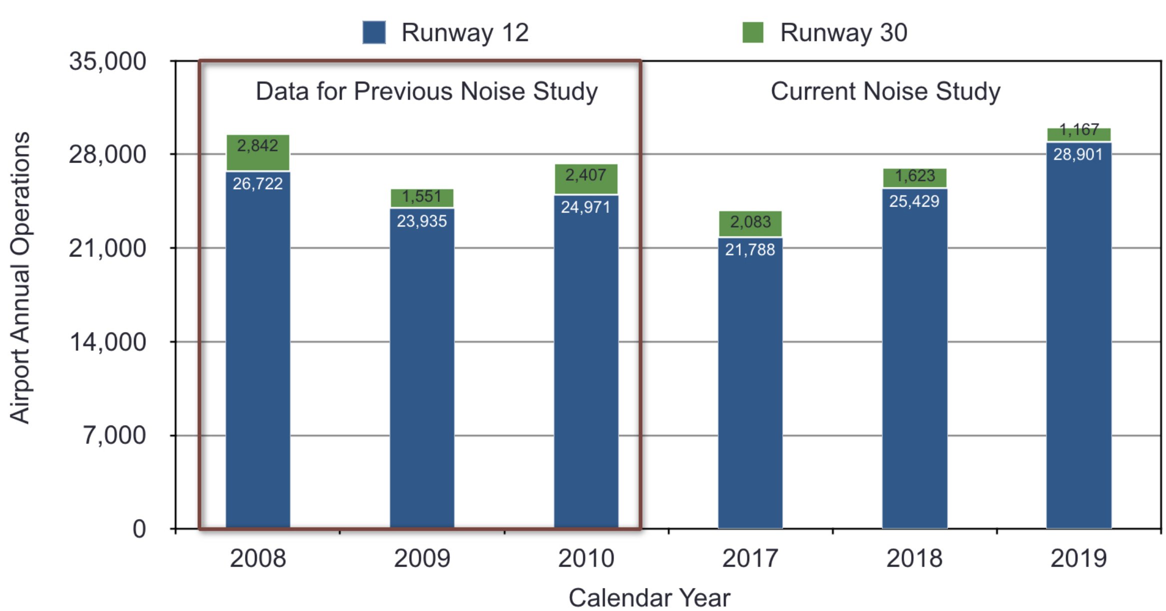

Figure 3.13: Annual Flight Operations at Normal Manley International Airport. Source: Data Provided by NMIA ATC Control Tower.

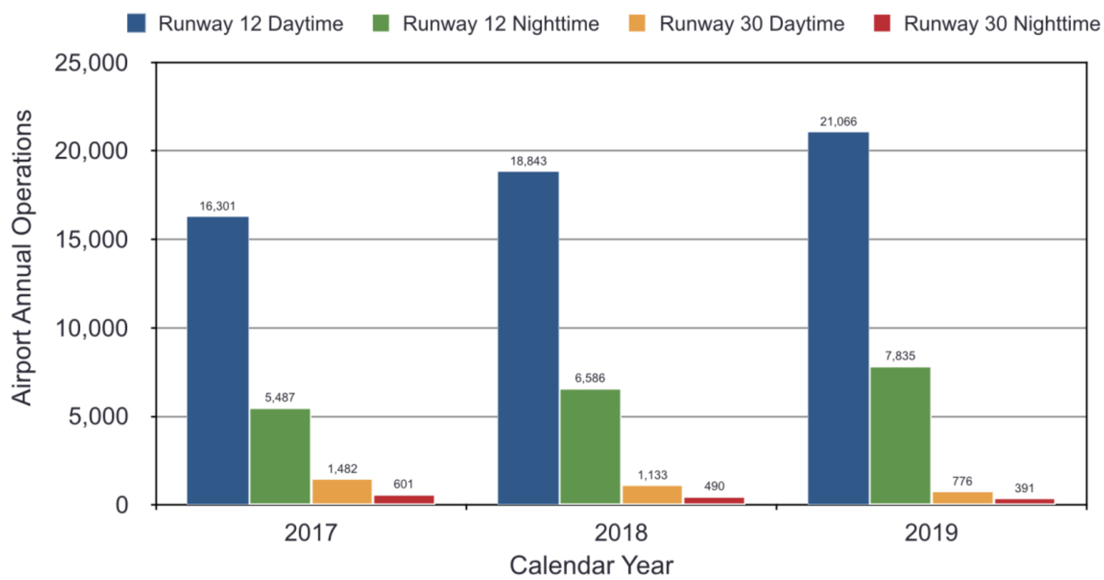

Figure 3.14: Daytime and Nighttime Flight Operations at Normal Manley International Airport. Source: Data Provided by NMIA ATC Control Tower.

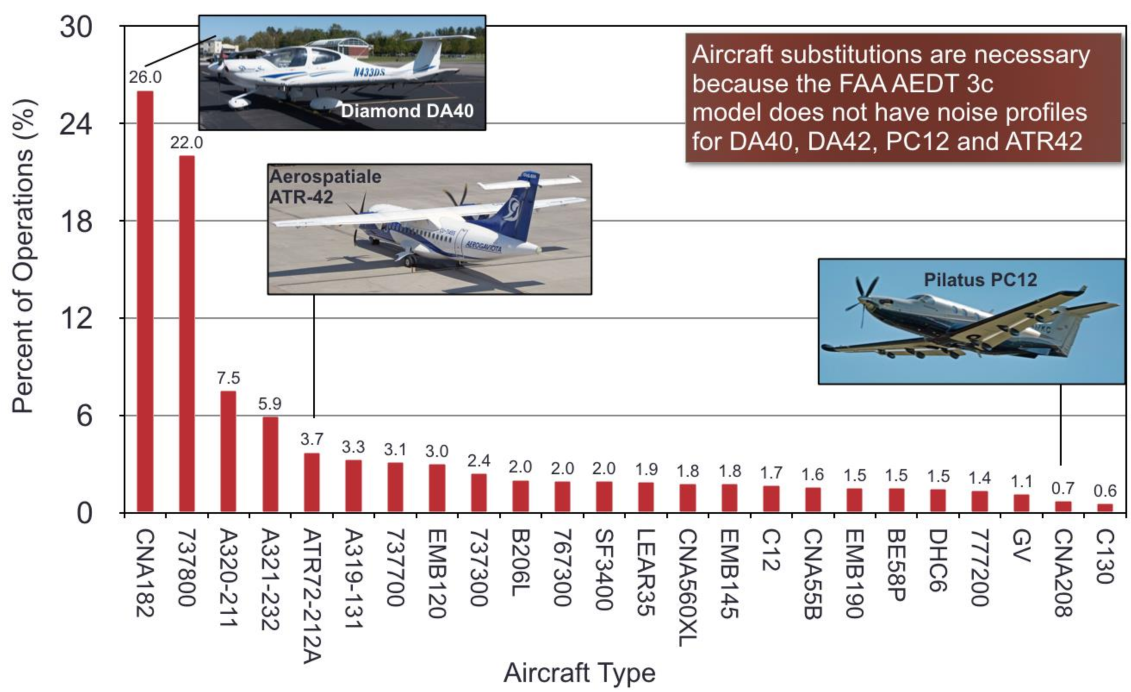

Figure 3.15: Aircraft Fleet Mix at Normal Manley International Airport. Source: Data Provided by NMIA ATC Control Tower.

After a careful analysis of the complete tower activity records, we model NMIA operations using 24 representative aircraft available in the FAA AEDT 3c model. These aircraft represent 96% of the total operations at the airport. The representative demand was scaled up to produce an equivalent of 82.4 daily flights consistent with the number of operations recorded in 2019 (30,068 operations). Table 3.5 contains the consolidated aircraft fleet mix operating at NMIA using 24 representative aircraft used in the noise model. In the computer model, aircraft operations fly core flight tracks derived from the detailed analysis of commercial flight tracks collected in the study. Core tracks are dispersed in the noise model to reproduce realistic flight patterns with similar dispersion as the actual data.

Table 3.5: NMIA Aircraft Fleet Mix Used for Noise Model. Number in Cells are Annual Operations Estimated from NMIA Tower Records.

Time Period	Day		Night		
Aircraft	Runway 12	Runway 30	Runway 12	Runway 30	All Runways
CNA182	6014	83	1716	18	7831
737800	4658	233	1621	113	6625
A320-211	1270	109	838	48	2265
A321-232	1019	117	605	42	1783
ATR72-212A	773	15	315	18	1121
A319-131	880	12	86	8	986
737700	659	35	232	16	942
EMB120	567	9	310	19	905
737300	580	24	115	10	729
B206L	465	3	139	2	609
767300	363	9	201	15	588
SF3400	342	8	224	12	586
LEAR35	426	20	115	4	565
CNA560XL	377	17	140	5	539
EMB145	343	3	177	8	531
C12	260	4	221	14	499
CNA55B	311	19	141	3	474
EMB190	420	7	29		456
BE58P	328	12	107	6	453
DHC6	286	12	135	10	443
777200	157	1	236	15	409
GV	229	8	100	4	341
CNA208	197	13	7		217
C130	142	3	25	1	171

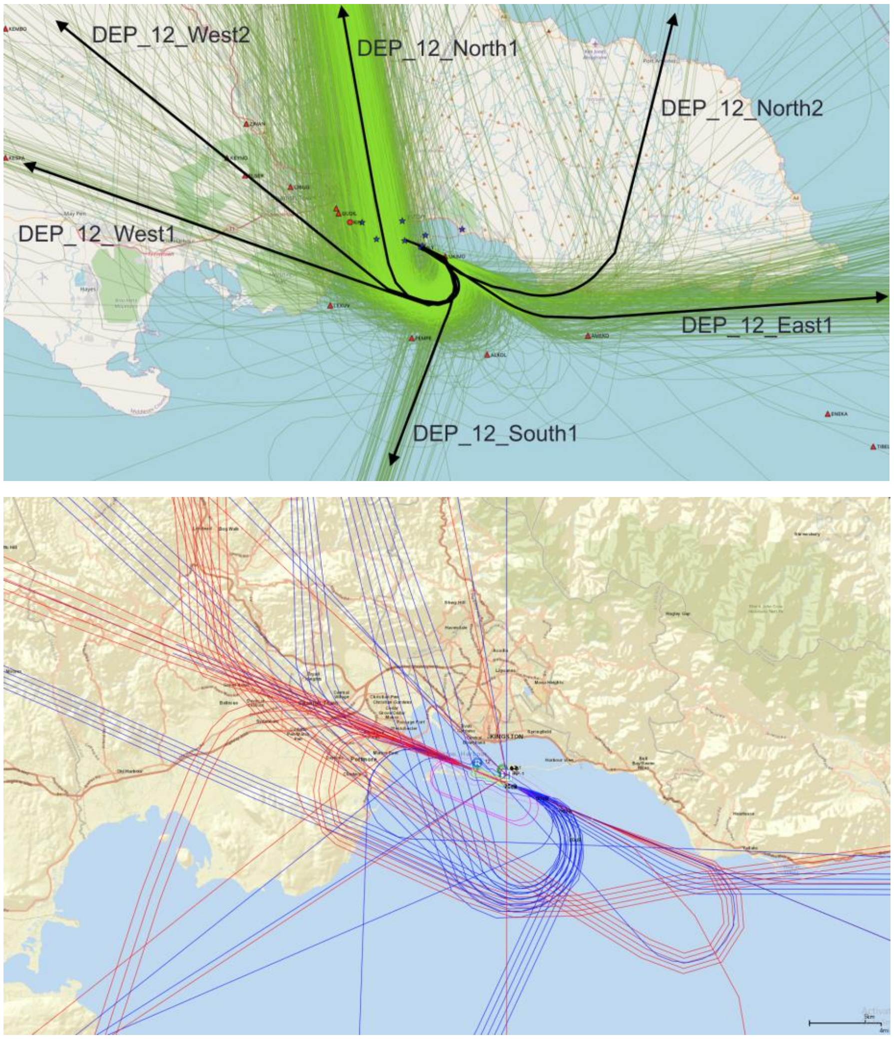

Figure 3.16: Construction of Arrival and Departure Core Tracks for Normal Manley International Airport. Top: Flight Tracks Collected using FlightAware API. Bottom: Dispersed Core Tracks Modeled in AEDT 3c.

3.3 Results

This section presents a summary of the noise scenarios modeled and the assumptions made in the analysis. We used the 2013 NMIA Airport Master Plan (May 2013) and provide additional assumptions to adjust the traffic projections based on observed traffic levels reported by the ATC tower records in years 2017-2019.

Three forecasts were developed for NMIA in the 2013 NMIA Master Plan, see Figure 3.17 which shows the total airport operations (i.e., movements in the Master Plan), including commercial, General Aviation (GA), cargo, and military operations. Two scenarios of interest in the noise analysis are the Baseline High and the Vision 2030. Both scenarios expand the number of operations at the airport and may produce higher noise impacts to the communities around the airport. The Baseline High scenario assumes a 2.2% Annual Compounded Growth Rate (CAGR) for commercial operations between 2019 and 2038. The Baseline High scenario increases the number of commercial operations by 50.3% by 2038 compared to the year 2019 operations. The Vision 2030 assumes more ambitious economic growth in Jamaica, with a 4.4% CAGR equivalent to a 128% increase in the number of commercial operations by 2038.

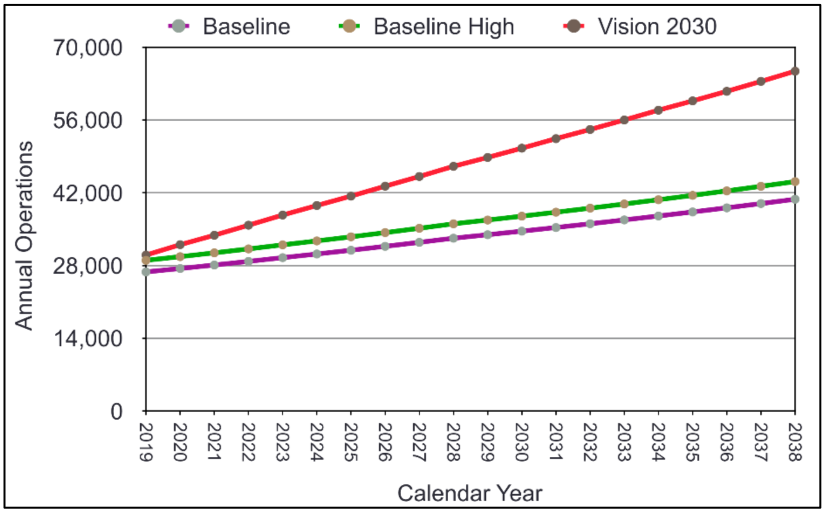

Figure 3.17 Forecasts for Normal Manley International Airport. Source: NMIA 2013 Master Plan.

Table 3.6 shows the three scenarios modeled in the project:

1. A baseline scenario with daily traffic levels equivalent to the average daily traffic observed in 2019
2. A future scenario similar to the Baseline High forecast
3. A Vision 2030 forecast with traffic levels predicted for the airport in 2038 according to the 2013 NMIA Master Plan

The numbers presented in Table 3.6 correspond to values forecast in the 2013 NMIA Airport Master Plan. Converting the annual values in reported to daily planning schedules contained in Figure 6.7 and Figure 6.8 of the Master Plan Projections in Figure 6.7 and Figure 6.8 of the Master Plan Projections in the Appendices (Nominal Planning Day Schedules). Several assumptions were made to reconcile the numbers projected in the 2013 Master Plan document with the numbers reported by the airport in 2019.

1. The projected number of commercial operations forecast in 2013 for the airport under Base, and Base High scenarios are below the numbers reported in 2019. For this reason, we use the CAGR growth rates predicted in the 2013 Master Plan from 2019-2038 to normalize the forecast.
2. The 2013 Master could not anticipate the high number of JDF operations at the airport in 2019. The number of JDF operations using single and twin-engine Diamond aircraft are included in the military category. This reclassification does not affect the noise contours because aircraft noise contributions for all aircraft are independent of their operational classification. The master plan projections assumed a constant value of 2,676 military operations annually.
3. Large capacity, four-engine aircraft using the Airbus A380 are eliminated from the noise analysis in 2038 because these aircraft will no longer be in the fleet given the new realities in the aviation industry. Instead, we model large capacity aircraft using more efficient twin-engine aircraft using the Boeing 787-9 that is likely to be in service in 2038 with British Airways and Air Canada. Given the taxiway "Alpha" and runway centerline configuration at NMIA, Airbus A380 operations would have placed a difficult burden in the airside capacity as recognized in the Mater Plan even with the proposed re-alignment of taxiway "Alpha".
4. The daily schedules reported in Table 3.6 and Figure 3.17 of the Master Plan Projections in the Appendices, projects 88 commercial operations as design day for year 2038 in the Vision 2030 scenario. Eighty-eight daily commercial operations are inconsistent with the forecast movements in 2038 (38,533 commercial operations). For this reason, we assume the forecast of the annual number operations in the Master Plan Projections in the Appendices to be correct and produce a corrected equivalent of 105 commercial operations in 2038 under the Vision 2038 scenario.

The baseline design day considered the year 2019 traffic levels because there have been significant variations in the airport traffic in the last three years. Between 2017 and 2019, the traffic levels at NMIA increased by 26%. According to the 2013

NMIA Master Plan, the growth of traffic at NMIA is likely to be dominated by changes in traffic levels to and from North America and other Caribbean countries. We assign future flights to North America and the Caribbean to narrow-body aircraft such as the Boeing 737-800 and Airbus A320/A321 family of aircraft, including new versions of the Boeing 737-8 Max and Airbus A321neo. We consider a hybrid fleet mix in 2038, assuming that not all Boeing 737-800 and Airbus A320 will be replaced by their new generation aircraft. The Vision 2030 scenario assumes a higher number of wide-body aircraft operations at NMIA in 2038. It is important to recognize that today wide-body aircraft operations at the airport constitute 2.9% of the total operations at NMIA. In 2038, the Master Plan forecast expects up to 27% of the commercial flights to be wide-body aircraft according to the daily schedule included in the Master Plan Projections in the Appendices.

Table 3.6: Noise Scenarios Modeled for the NMIA Airport. Numbers in Cells are Annual Operations except the Last Row.

	Year 2019 Current Runway Configuration	Baseline High 300-meter Extension to the West and 90-meter RESA areas	Vision 2030 300-meter Extension to the West and 90-meter RESA areas
Commercial	15,631	25,124	38,533
Cargo	2,295	2,227	5,898
GA Private	3,568	14,132	18,303
Military	8,002	2,676	2,676
Helicopter	609	610	610
Total	30,104	44,769	66,020
Daily Operations	**82**	**123**	**180**

The noise metric used in this analysis is the Day-Night Average Sound Level (L_{DN}). L_{DN} is a metric accepted in many ICAO contracting states (ICAO, 2008) included the United States of America. The formula to estimate Day-Night Average Sound Level (L_{DN}) is:

Equation 3.1. Day-Night Average Sound Level (LDN)

$$L_{DN} = 10\log(1/24)\times\left[15\times10^{L_D/10} + 9\times10^{(L_N+10)/10}\right]$$

Where L_D and L_N are the equivalent continuous A-weighted sound pressure levels over, respectively, the 15-hour daytime period 07:00 to 22:00 hours and the 9-hour night period 22:00 to 07:00 hours (ICAO, 2008).

Table 3.7 illustrates compatible land uses associated with values of (LDN). Note that there are no restrictions related to noise compatibility for (LDN) values below 55 (measured in dBA). The results presented in the following section illustrate the extent of the NMIA noise contours down to 50 LDN dBA. It is important to remember that values of (LDN) below 55 are associated with minimal or no noise impacts (FAA, 2010).

Table 3.7: Land Use Compatibility Table for Day-Night Average Sound Level (L_{DN}). Source: FAA Part 150 Airport Noise Compatibility Studies.

Noise Exposure	L_{DN} Range (dBA)	Noise Controls	Land Uses Allowed
Minimal	0-55	Not needed	Residential, Public use (schools, hospitals, etc.), Commercial Use (offices, business and professional).
Moderate	55-65	Land use controls considered	Residential and public use are allowed but with restrictions. Commercial use allowed.
Significant	65-75	Noise controls and easement	No residential, public or commercial use.
Severe	75 and higher	Containment within airport boundary	None.

3.3.1 Current Conditions

Figure 3.18 shows the predicted noise contours for the Normal Manley International Airport under current conditions with average daily traffic of 82 operations. The 50 L_{DN} noise contours extend past the Portmore area. However, values of **50 L_{DN} do not represent a noise problem** according to existing international codes. The Caribbean Maritime University (CMU) is located just outside the 50 L_{DN} noise contour. According to Table 3.4 the average L_{DN} noise level recorded at CMU is 50.8 dBA.

Further examination of the noise events logged by the survey at CMU shows that days with high L_{DN} noise levels (days 2,3,4,6, 8 in Table 3.4) had numerous noise events compared to the aeronautical operations of the airport. We conclude that higher L_{DN} noise levels recorded at CMU are influenced by external events such as construction equipment or highway traffic. Figure 3.19 shows a detailed view of the baseline noise contours. A small island contour on the ENE side of the airport is associated with helicopter operations (i.e., military and civilian operations). Figure 3.21 shows the LAeq noise contours for NMIA airport under current traffic conditions. The noise model shows that CMU is located just outside the 45 LAeq noise level. According to Table 3.4, the average LAeq noise level recorded at CMU is 46.4 dBA.

Further examination of the noise events logged by the noise meter at CMU shows that days with high LAeq noise levels (days 2,3,4,6, 8 in Table 3.4) had more than twice the number of noise events compared to the aeronautical operations of the airport. LAeq values recorded at CMU and other sites far from the airport may be influenced by external noise events unrelated to aviation operations. At current airport traffic levels, we observe no moderate or significant effects of noise on the population. The 55 L_{DN} noise contour does not affect population centers. The 75 L_{DN} contour is 95% contained within airport property.

3.3.2 Master Plan Baseline High

Figure 3.22 to Figure 3.25 illustrates the noise contours for a future demand scenario (**Baseline High** in the 2013 Master Plan) with a total of 123 total daily operations (69 commercial operations). The Baseline High scenario assumes 26 additional narrow-body commercial flights (Boeing 737-8Max and Airbus A321neo aircraft) and three wide-body commercial flights using a new generation Boeing 787-9 aircraft. Figure 3.24 shows the 55 L_{DN} noise contour extending past the Royal View Hotel in Port Henderson. The population impact of this future scenario is estimated to affect 560 people living under the 55 L_{DN} noise contour – a minimal impact. Figure 3.25 shows more detail of the L_{DN} noise contours under the future scenario.

3.3.3 Vision 2030

Figure 3.26 to Figure 3.30 illustrates the noise contours for the Vision 2030 scenario. Vision 2030 assumes a 4.4% CAGR growth with 105 commercial flights in 2038 (180 total daily flights at the airport). In the future, we expect many Boeing 737-8Max and Airbus A321neo to operate at NMIA Airport. Wide-body commercial flights use the new generation Boeing 787-9 aircraft. Figure 3.29 shows the 55 L_{DN} noise contour extending past the Royal View Hotel in Port Henderson. The population impact of the Vision 2030 scenario is estimated to affect 8,474 people living under the 55 L_{DN} noise contour – a modest impact considering that 55 L_{DN}. Figure 3.30 shows more detail of the L_{DN} noise contours under the future scenario.

Summary

Table 3.8 shows a summary of NMIA noise contour analysis and results.

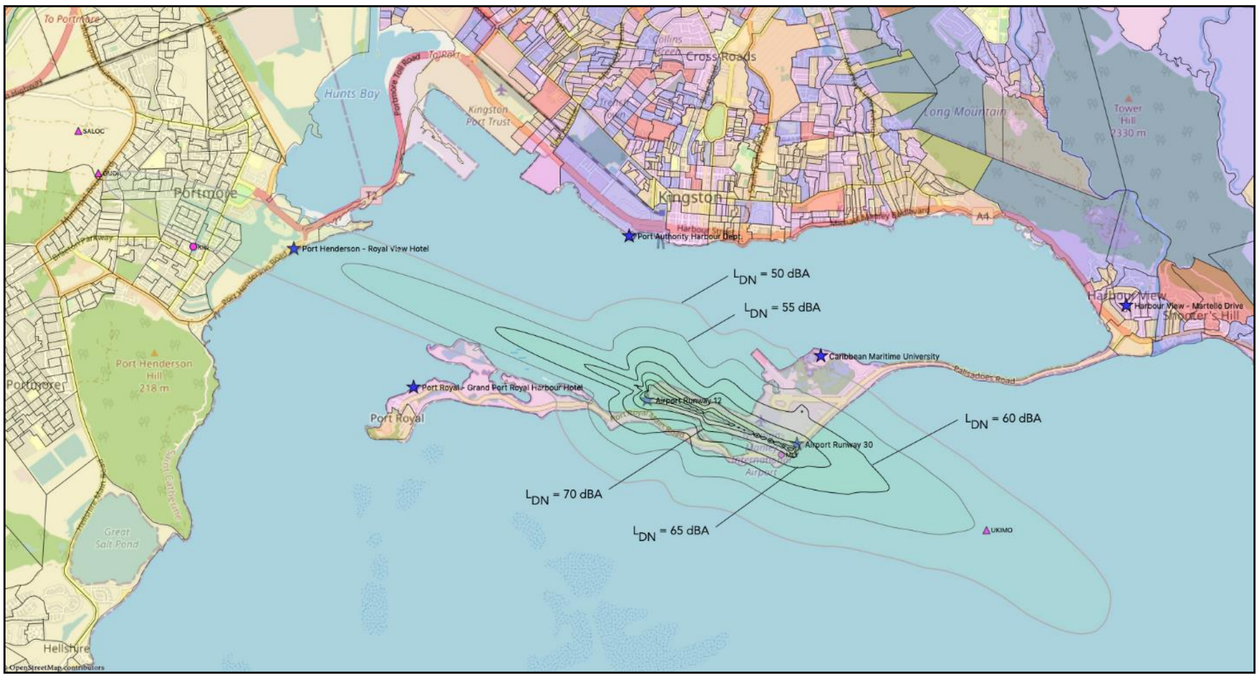

Figure 3.18: Baseline L_{DN} Noise Contours for the Normal Manley International Airport. 82 Daily Flight Operations. Source of Map: OpenStreet.

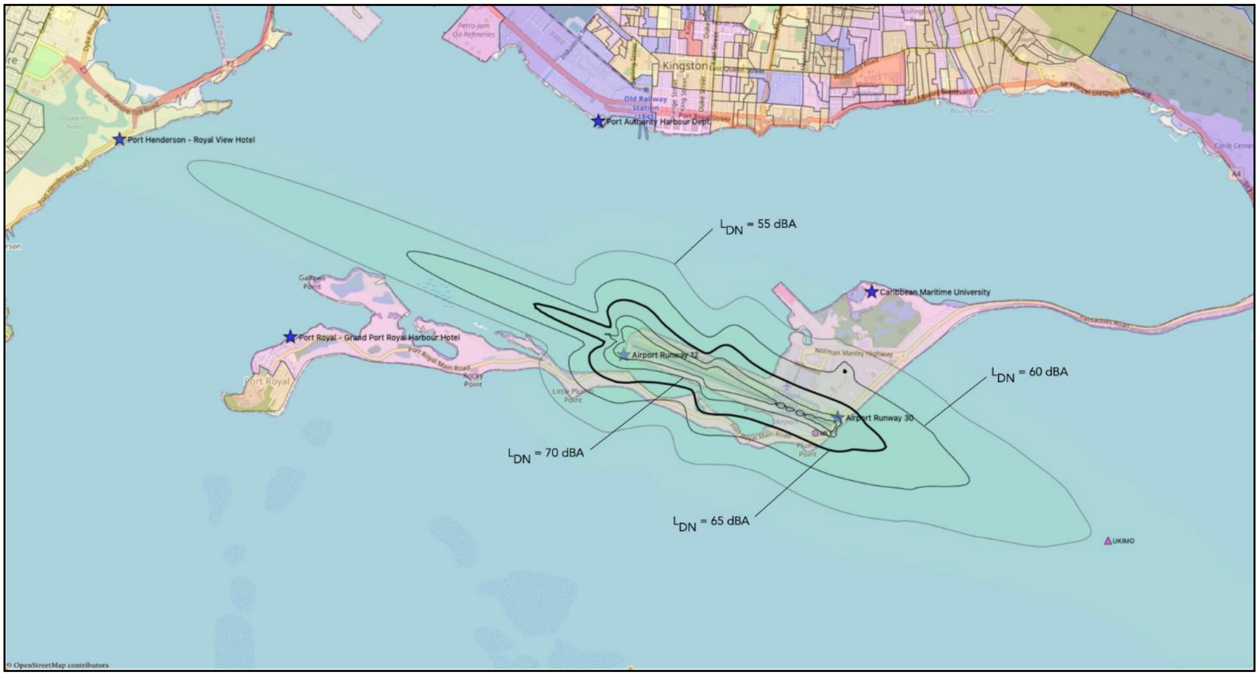

Figure 3.19: Detailed Baseline L_{DN} Noise Contours for the Normal Manley International Airport. Highlighted Contour is at 65 L_{DN}. 82 Daily Flight Operations. Source of Map: OpenStreet.

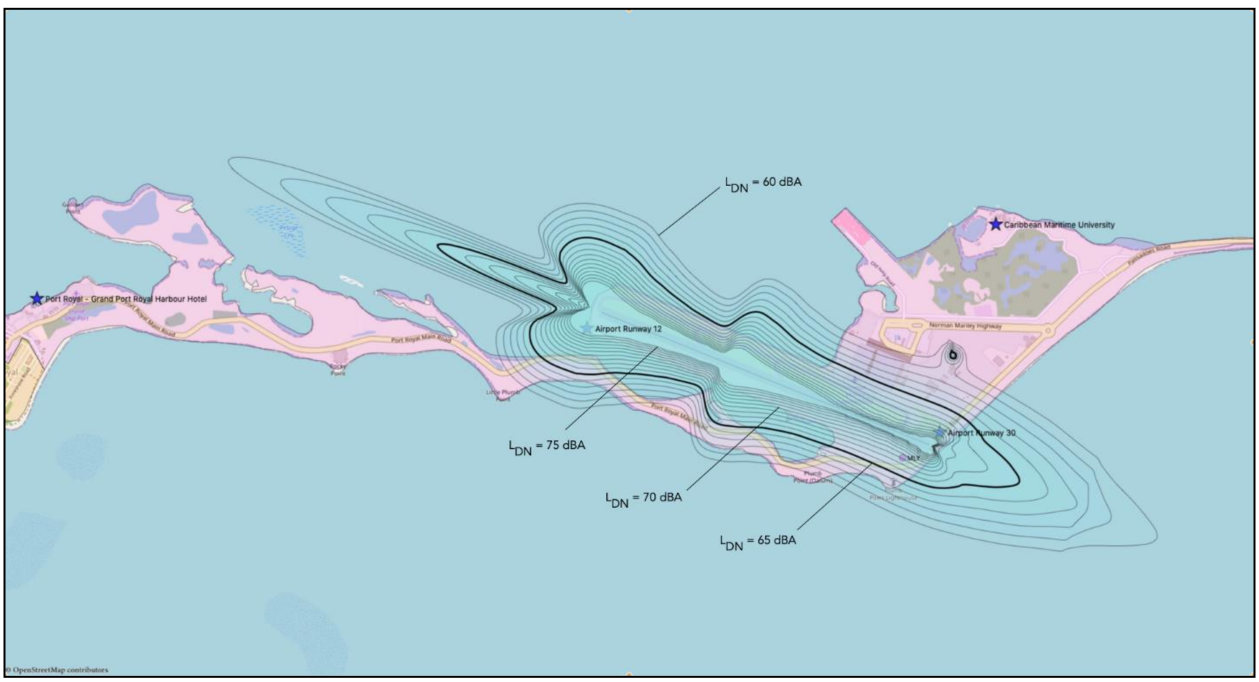

Figure 3.20: Baseline One-dBA Spacing L_{DN} Noise Contours for the Normal Manley International Airport. Highlighted Contour is at 65 L_{DN}. 82 Daily Flight Operations. Source of Map: OpenStreet.

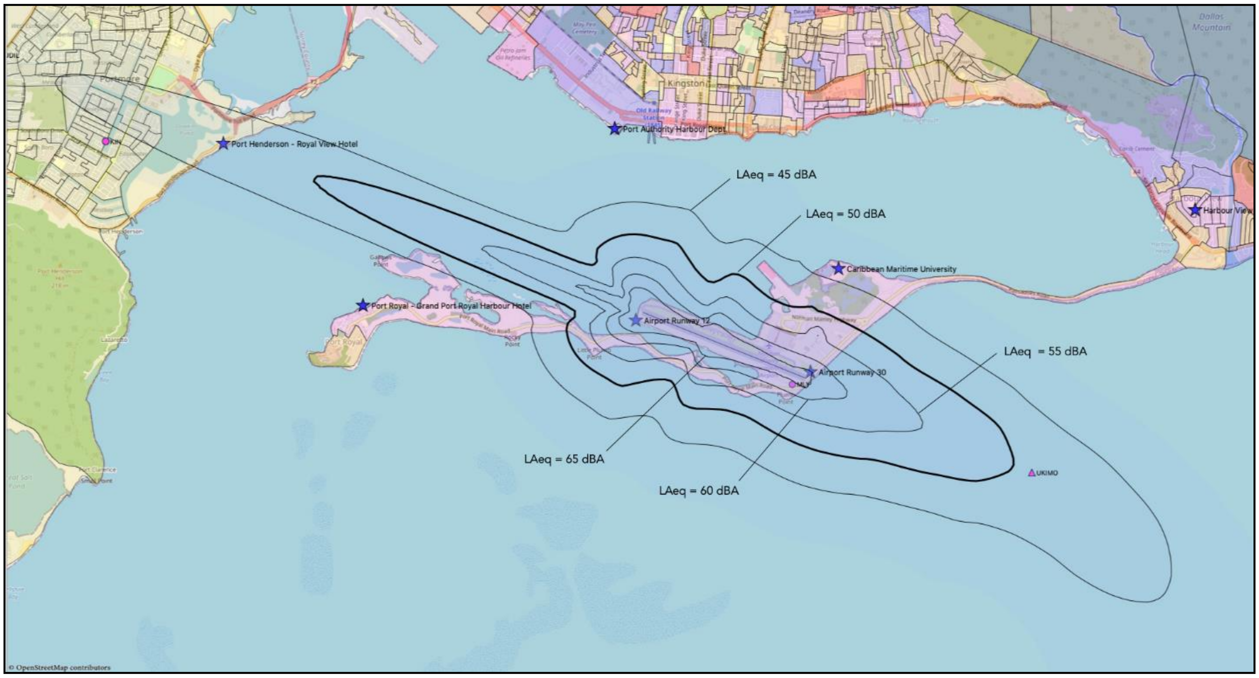

Figure 3.21: Baseline LA_{eq} Noise Contours for the Normal Manley International Airport. Highlighted Contour is at 50 L_{DN}. 82 Daily Flight Operations. Source of Map: OpenStreet.

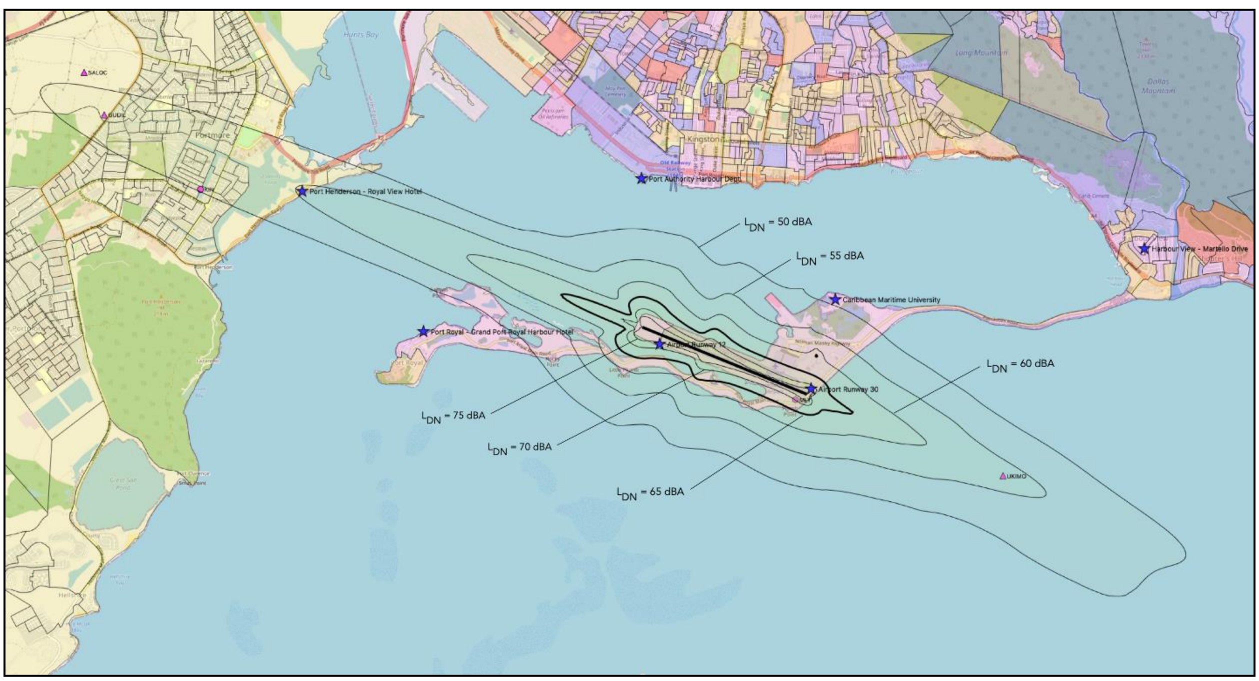

Figure 3.22: Baseline High Scenario L_{DN} Noise Contours for the Normal Manley International Airport. 123 Daily Flight Operations. Source of Map: OpenStreet.

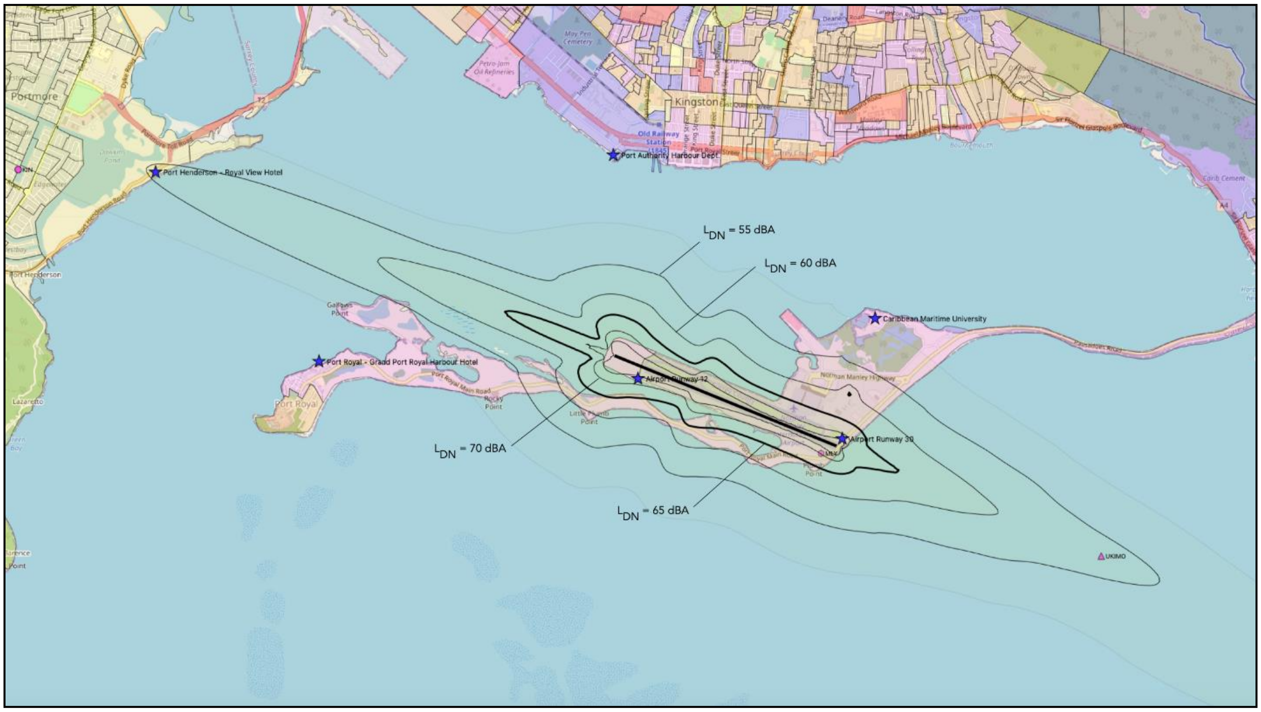

Figure 3.23: Detail of Baseline High Scenario L_{DN} Noise Contours for the Normal Manley International Airport. 123 Daily Flight Operations. Source of Map: OpenStreet.

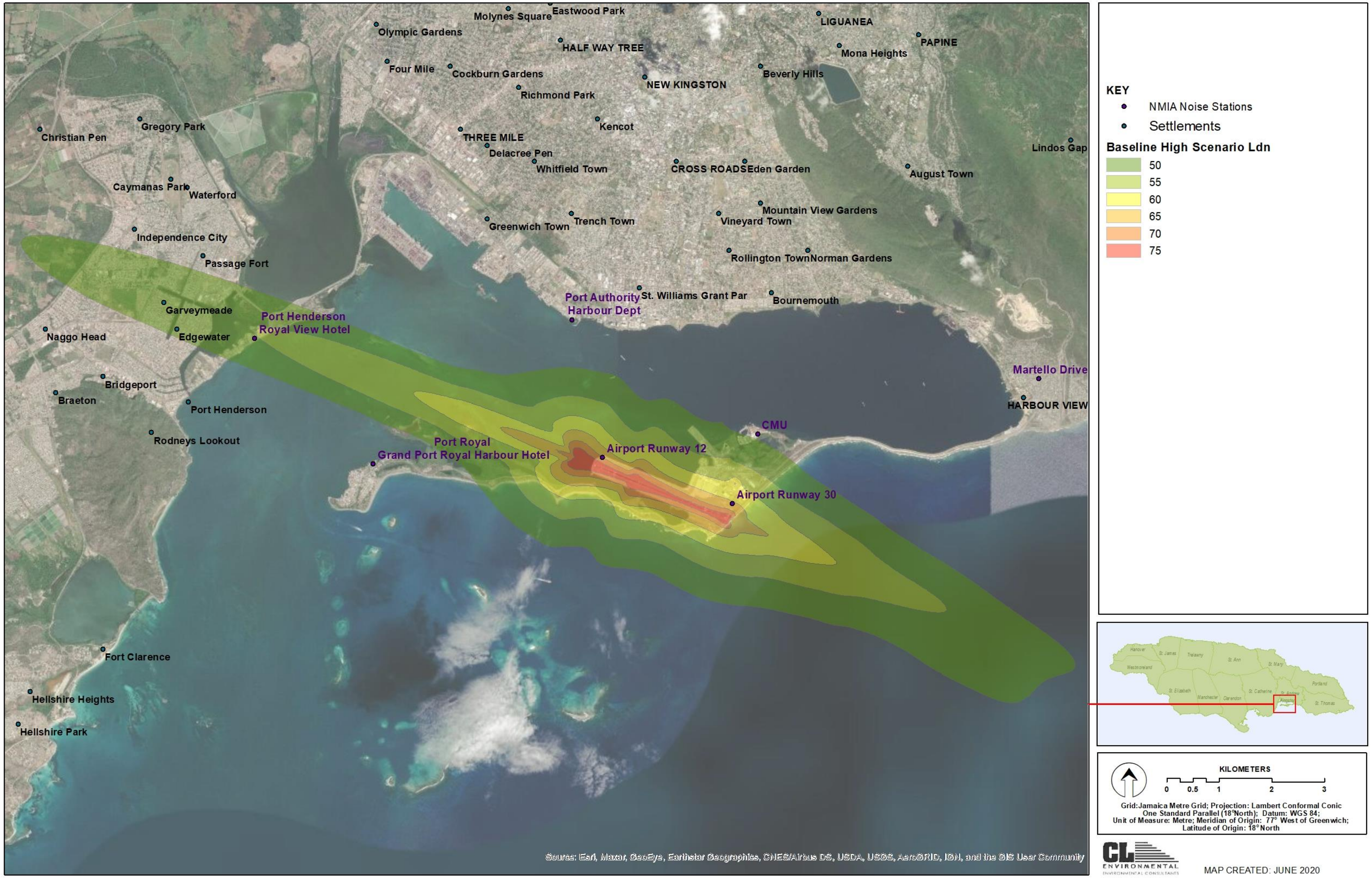

Figure 3.24 Baseline High Scenario L_{DN} Noise Contours for the Normal Manley International Airport. 123 Daily Flight Operations (satellite imagery)

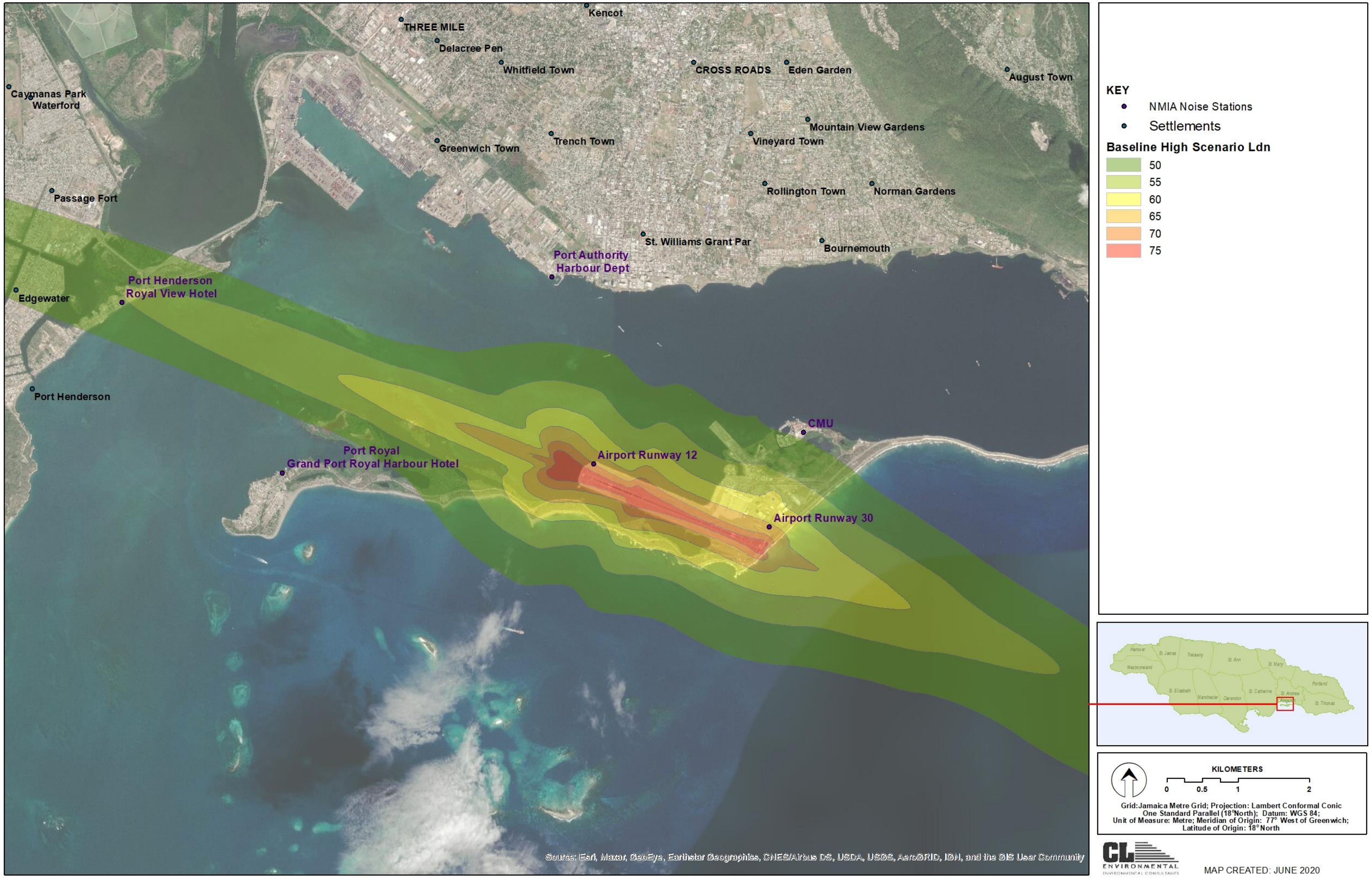

Figure 3.25 Detail of Baseline High Scenario L_{DN} Noise Contours for the Normal Manley International Airport. 123 Daily Flight Operations (satellite imagery)

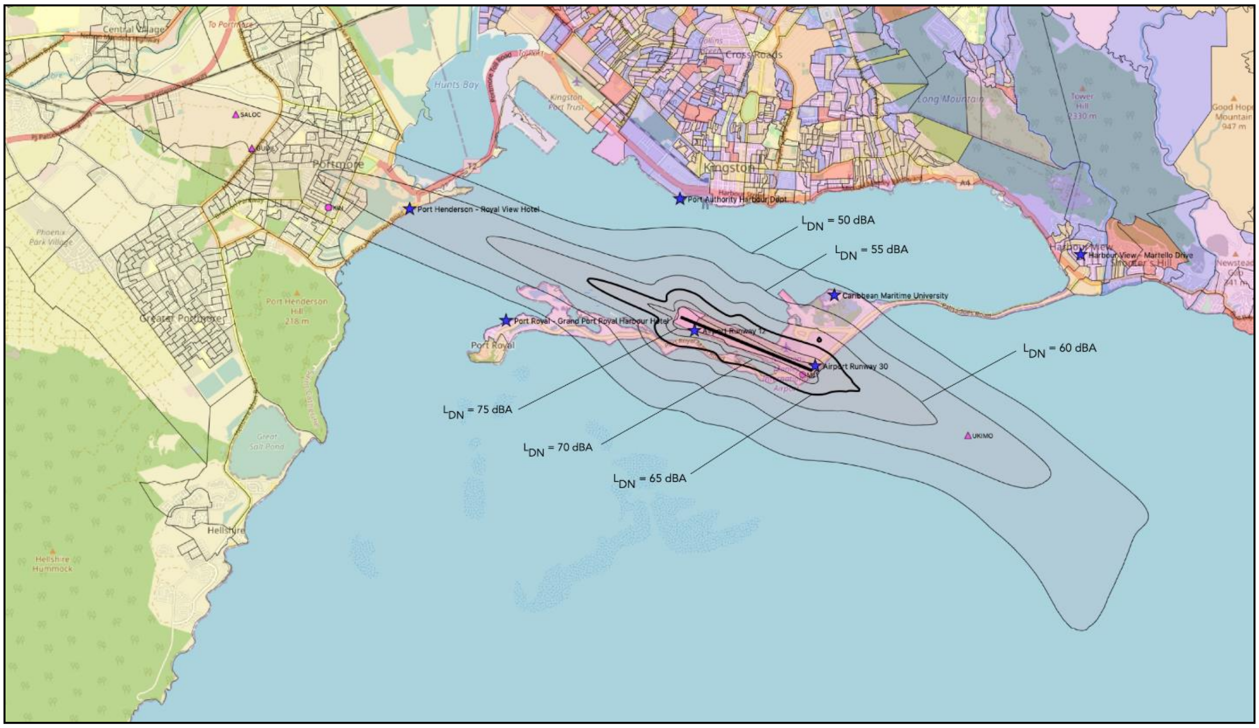

Figure 3.26: Vision 2030 Scenario L_{DN} Noise Contours for the Normal Manley International Airport. 180 Daily Flight Operations. Source of Map: OpenStreet.

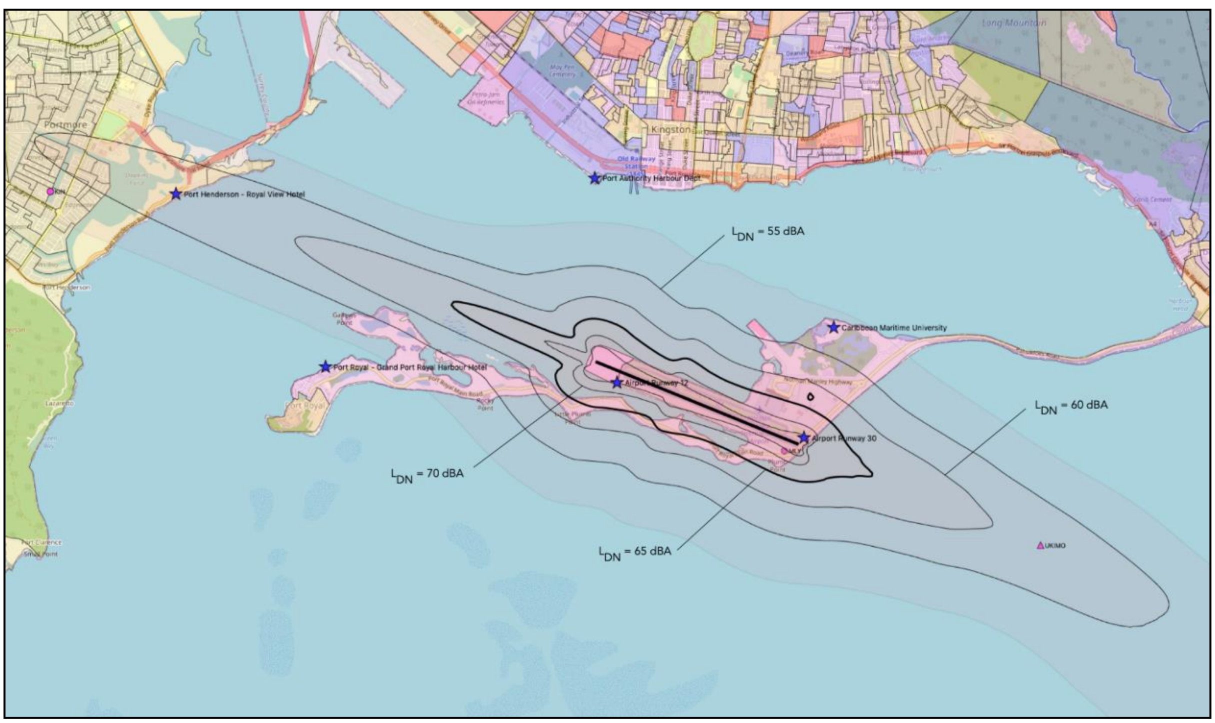

Figure 3.27: Detail of Vision 2030 Scenario L_{DN} Noise Contours for the Normal Manley International Airport. 180 Daily Flight Operations. Source of Map: OpenStreet.

Figure 3.28: Vision 2030 Scenario 55 L_{DN} Noise Contour for the Normal Manley International Airport. 180 Daily Flight Operations. Source of Map: OpenStreet.

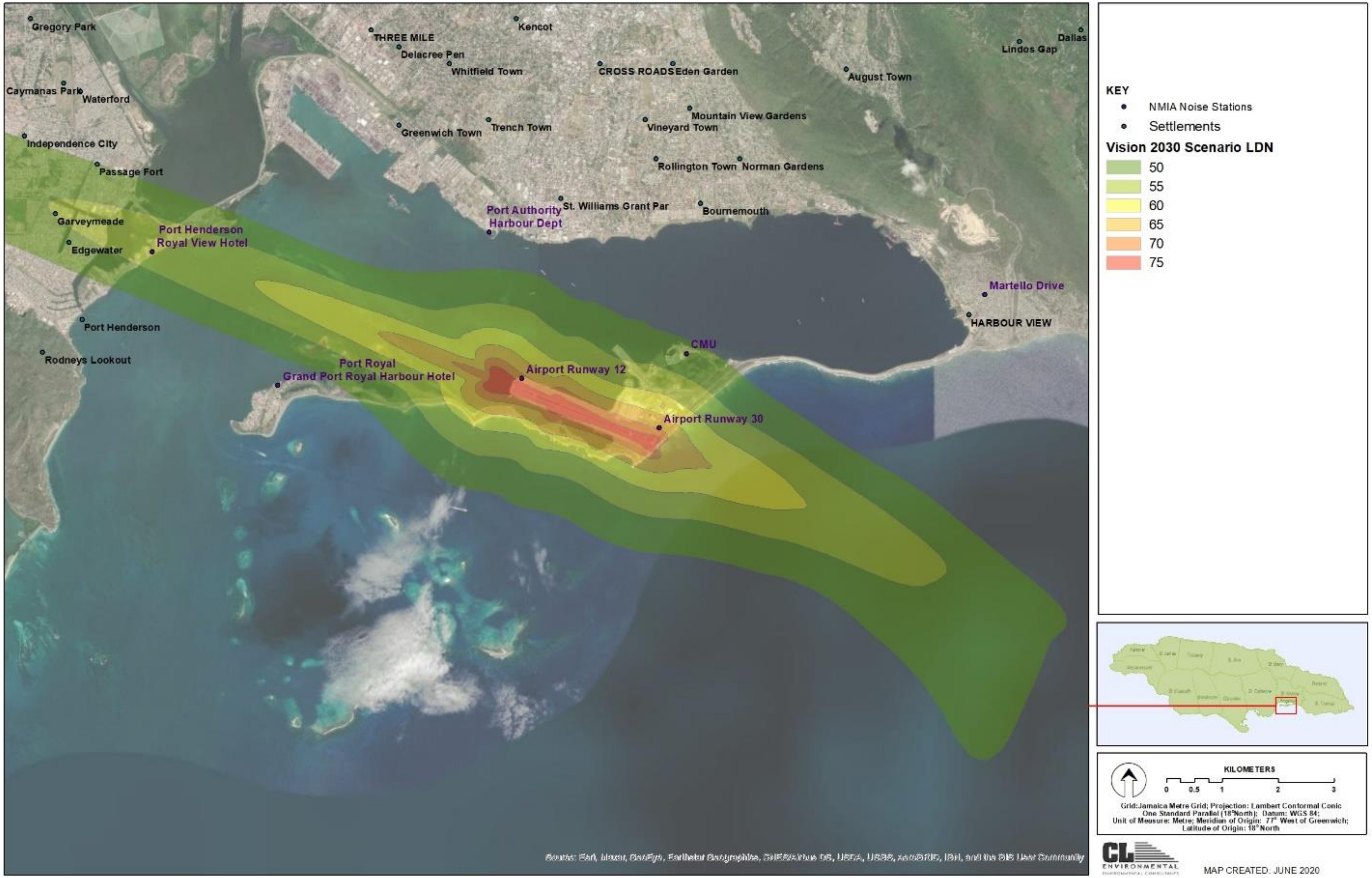

Figure 3.29 Detail of Vision 2030 Scenario L_{DN} Noise Contours for the Normal Manley International Airport. 180 Daily Flight Operations (satellite imagery)

Figure 3.30 Vision 2030 Scenario 55 L_{DN} Noise Contour for the Normal Manley International Airport. 180 Daily Flight Operations (satellite imagery)

3.3.4 Summary

Table 3.8: Summary of NMIA Airport Noise Contour Analysis and Results.

	Baseline Case Year 2019 Traffic Demand	Future Scenario Baseline High Year 2038	Future Scenario Vision 2030 Year 2038
Daily Operations	82	123	180
L_{DN}	**Area (square km)**	**Area (square km)**	**Area (square km)**
55	13.53	17.90	27.16
60	6.27	7.58	11.37
65	2.55	3.11	4.69
70	1.06	1.34	1.99
75	0.45	0.60	0.87
Impacts	No effect	Minor effect on population.	Modest effect on population
55 L_{DN}	No effect on population	55 L_{DN} contour may affect 560 people.	55 L_{DN} contour may affect 8,478 people
60 L_{DN}	No effect on population	60 L_{DN} contour has no impact on population	60 L_{DN} contour has no impact on population
65 L_{DN}	No effect on populations	65 L_{DN} contour has no impact on population	65 L_{DN} contour has no impact on population
75 L_{DN}	Contour nearly fully contained within airport property (except for a small portion extending to Port Royal Main Road)	75 L_{DN} contour nearly fully contained within airport property (except for a small portion extending to Port Royal Main Road)	75 L_{DN} contour nearly fully contained within airport property (except for a small portion extending to Port Royal Main Road)

3.4 Emissions Inventory

An emissions report is generated using the AEDT 3c model and presented in Table 3.9 and Table 3.10. Numerous assumptions are needed to model the Ground Support Equipment (GSE) used at the NMIA airport. For example, aircraft gate operations assume 13 minutes of Auxiliary Power Unit (APU) use on the ground per flight. We assign GSE vehicles to each aircraft operation from a long list of GSE equipment available in the AEDT 3c model. The emissions analysis assumes a threshold altitude of 10,000 feet for fuel and emission computations. The height of the mixing layer is assumed to be 3,000 feet. Figure 3.31 shows a summary of selected emissions estimated for all daily NMIA operations. The results are expressed in grams and include all GSE associated with ramp operations. Figure 3.32 shows the fuel and CO2 emissions for daily operations at NMIA. Figure 3.32 shows that the combination of new, more fuel-efficient aircraft in the future (2038) and consideration of GSE equipment, produces some savings in the future as the number of operations increases.

Table 3.9: Emissions Report for Flight Operations and Ground Support Equipment. Year 2019 Traffic.

Mode	Fuel (g)	Distance (km)	Duration (hr)	CO (g)	HC (g)	TOG (g)	VOC (g)
Startup	-	-	-	-	6,087	7,038	7,001
Taxi Out	4,102,101	-	0	96,491	9,032	10,366	10,251
Climb Ground	6,201,055	36	0	99,934	15,315	17,628	17,472

Climb Below 1000	7,269,710	287	0	167,612	15,971	18,289	18,052
Climb Below Mixing Height	10,246,225	505	0	192,851	16,421	18,773	18,507
Climb Below 10000	16,642,504	1,363	0	297,691	17,885	20,316	19,923
Above 10000	-	-	-	-	-	-	-
Descend Below 10000	7,428,515	1,576	0	203,947	8,217	9,279	9,055
Descend Below Mixing Height	6,561,398	931	0	148,328	6,754	7,651	7,485
Descend Below 1000	3,002,602	203	0	94,826	5,303	6,029	5,915
Descend Ground	2,561,265	29	0	51,748	4,802	5,511	5,450
Taxi In	2,082,938	-	0	49,419	4,727	5,426	5,367
Full Flight	24,071,019	2,939	0	501,637	26,102	29,595	28,978
GSE LTO	-	-	0	35,386	-	1,475	1,360
APU	-	-	0	7,459	380	440	438

Table 3.10: Emissions Report for Flight Operations and Ground Support Equipment (Particulate, NOx, SOx and CO2).

Mode	NMHC (g)	Nox (g)	nvPM Mass (g)	PMSO (g)	PMFO (g)	CO2 (g)	SOx (g)	PM 2.5 (g)	PM 10 (g)
Startup	7,038	-	-	-	-	-	-	-	-
Taxi Out	10,319	15,012	265	177	62	12,942,129	4,804	504	504
Climb Ground	17,579	56,466	500	268	81	19,564,329	7,263	848	848
Climb Below 1000	18,180	76,498	609	313	129	22,935,936	8,514	1,051	1,051
Climb Below Mixing Height	18,644	135,108	1,007	441	161	32,326,840	12,000	1,609	1,609
Climb Below 10000	20,096	263,498	1,821	715	210	52,507,099	19,492	2,746	2,746
Above 10000	-	-	-	-	-	-	-	-	-
Descend Below 10000	9,144	49,205	671	319	119	23,436,966	8,700	1,108	1,108
Descend Below Mixing Height	7,555	45,199	602	283	109	20,701,210	7,685	994	994
Descend Below 1000	5,966	16,196	211	129	65	9,473,209	3,517	405	405
Descend Ground	5,486	12,677	185	111	36	8,080,790	3,000	332	332
Taxi In	5,403	7,612	132	90	32	6,571,669	2,440	255	255
Full Flight	29,240	312,703	2,492	1,034	329	75,944,065	28,192	3,854	3,854
GSE LTO	1,298	4,133	-	-	-	-	25	208	221
APU	440	8,661	-	-	-	-	1,140	874	874

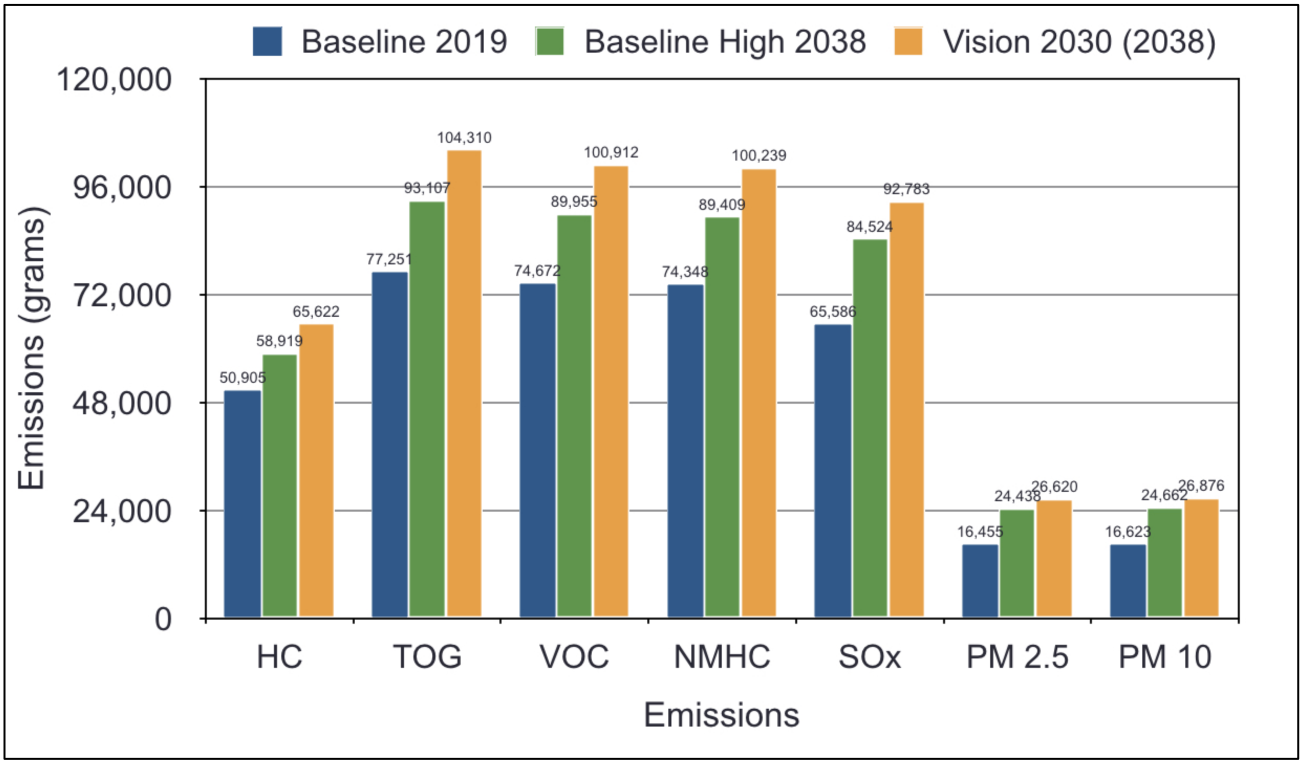

Figure 3.31: Comparison of Various Emissions at NMIA for Three Scenarios.

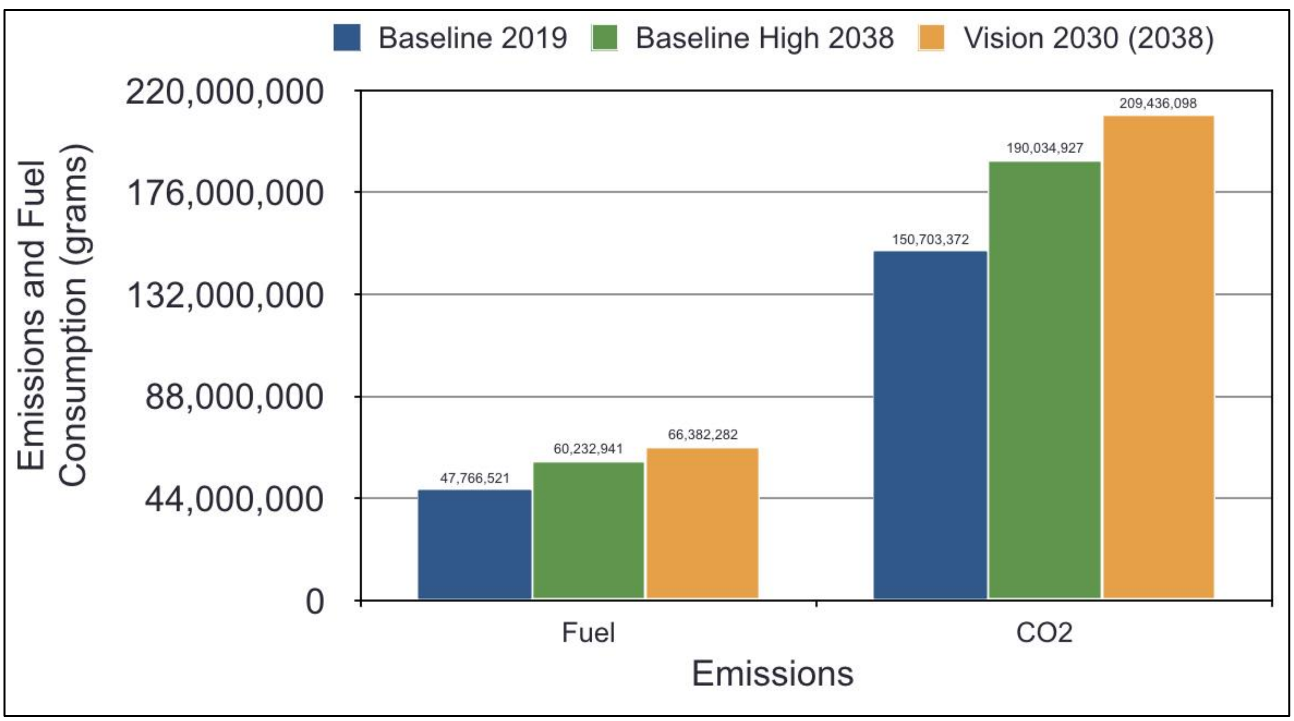

Figure 3.32: Comparison of Fuel and CO2 Emissions at NMIA for Three Scenarios.

4 Conclusions and Recommendations

4.1 Conclusions

The Norman Manley International Airport has a unique location in the Palisadoes tombolo. The airport location provides a natural way to mitigate community noise impacts of the airport. The analysis shows that under current conditions (i.e., defined as the average day of 2019), the airport noise contours below the 55 L_{DN} level do not affect any population centers around the airport. The baseline noise analysis also shows that the 75 L_{DN} level contour is nearly contained within the airport boundary as recommended by ICAO and FAA criteria. A small portion of the 75 L_{DN} contour extends to Port Royal Main Road. Two future scenarios were modeled using the FAA AEDT 3c model: a) a Baseline High and b) Vision 2030 scenario with 180 daily operations.

The team's noise data provided sufficient evidence to validate the noise modeling analysis using the FAA AEDT 3c model. The actual noise measurements recorded in the field, are expected to be higher than those predicted by the computer model because the field data includes other noise events (or sources) besides aircraft flyovers.

According to the Base High scenario, the 55 LDN noise contour extends to Port Henderson, affecting at most 560 people, which is a minor impact. Given the history of operations at NMIA and the airport's limited gate capacity, 123 daily operations, including 69 commercial operations, maybe a reasonable forecast for the airport in the 2035-2038 time period.

A previous noise study modeled 130 daily operations and arrived at similar conclusions. We do not anticipate significant changes to the noise contours for the current traffic conditions if the runway is extended to the West. A runway extension will extend runway 12 threshold further West and allow the airport to meet Runway End Safety Areas (RESA). The airport noise model parameters used nominal glide-paths followed by commercial and cargo airlines operating at NMIA. The Flightaware data justified for such assumptions. A previous noise study had limited video data of landings on runways 12 and 30 revealed that pilots operating at NMIA follow standard glide-path guidance that produces average touchdown locations consistent with the runway length at the airport. Table 3.8 summarizes the results of the noise study. The table also includes the contour areas associated with different L_{DN} levels for three scenarios investigated.

Table 3.7 in the report the guideline for population noise impacts is a subjective assessment because not all people react to noise in the same way. In the U.S. and Europe, there are communities that complain about noise at or slightly below the 55 L_{DN} level. The airport today has 82 daily operations and the 55 L_{DN} contours do not affect any populated area. The airport operates favorably using runway 12 for 96% of its arrivals and departures. This is a very important noise mitigation technique because it sends departures (the operation that produces the highest noise footprint) to the ocean before turning North or going East. An important operational question is if there are some operations that perform takeoffs and landings with a tailwind (not desirable) induced by the precision criteria of runway 12. Airlines and pilots follow strict protocols to land with tailwind (typically no more than 8 knots of tailwind). In the noise study we do not challenge that assumption and take the current operations as safe. The accident of an American Airlines Boeing 737-800 in 2009 at NMIA is a reminder what can happen if pilots land on a wet runway with tailwind.

Based on wind data provided by the Jamaica Meteorology office, if wind conditions are the only operational criteria considered at the airport, the airport will probably operate 85% of the time using runway 12 and 15% using runway 30. According to the Flight Safety Foundation, flying a precision approach reduces the risk of an accident by a factor of five compared to a non-precision runway approach. It is clear that airlines and pilots are trading these two criteria at NMIA in favor of using ILS guidance on runway 12 at the expense of some operations having small to moderate tailwind components. If the airport upgrades the precision approach capabilities for runway 30 in the near future, we could expect more operations on runway 30. This will result in lengthening of the L_{DN} contours to the Northwest. With the current level of operations, even an 85/15% split in runway operations, we do not anticipate population noise impacts to Northwest communities.

4.2 Recommendations and Strategies

Considering future scenarios (Base High and Vision 2030), the population impact using the current split of operations between runways 12/30 at 96/4% is likely to be small. Nevertheless, the airport, ATC, and airline operators may want to consider two noise mitigation strategies for departures from runway 30 when traffic and aircraft operational conditions permit: i) reduced thrust settings and ii) noise abatement departures to the West. These are discussed further:

1. Reduced thrust settings for runway 30 departures. Engage the airlines to use reduced thrust takeoffs for night departures from runway 30 when wind conditions do not allow departures to the East (runway 12). Reduced thrust takeoffs common technique that airlines use because it increases engine life reducing maintenance cost. Reduced thrust setting departures are aircraft specific but many of the routes flown from Kingston to North America (e.g., Miami and Fort Lauderdale) using Boeing 737-800 and Airbus A320 aircraft permit the use of reduced thrust settings especially at night when temperatures are milder. The extension of the runway will help promote reduced thrust takeoffs because pilots will have longer Accelerate-Stop Distance Available (ASDA) in the future. This will decrease the noise over Port Henderson and areas to the Northwest.
2. A noise abatement departure may also be possible because aircraft departing West would reduce thrust (and flatten their climb profile) as they overfly populated areas to the West at night. Based on the Flightaware data, narrow-body aircraft reach 1500-2000 feet after departure from runway 30 when overflying Port Henderson. This provides enough altitude to execute a noise abatement procedure and fly a quiet profile in a safe manner.
3. Land use planning for the potentially affected areas might consider restrictions on additional development, requiring noise abatement measures. This might include noise attenuation building materials (walls and glazing) and other measures. Further zoning measures are discussed in the Airport Zoning Analysis Report (Deliverable 6)

Vision 2030 scenario assumes many more operations at night at the airport. The two operational and noise abatement techniques and land use planning measures described above should be considered if the traffic grows as predicted in Vision 2030.

5 References

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6 Appendices

6.1 Noise Calibration

Brüel & Kjær
North America Inc.

The Bruel and Kjaer Calibration Laboratory
3079 Premiere Parkway Suite 120
Duluth, GA 30097
Telephone: 770-209-6907
Fax: 770-447-4033
Web site address: http://www.bksv.com

ACCREDITED

Calibration Certificate # 1568.01

CERTIFICATE OF CALIBRATION No.: CAS-416103-L3Y8P3-403 Page 1 of 2

CALIBRATION OF:

Calibrator:	Brüel & Kjær	Type 4231 IEC Class: 1	Serial No.:	3018640

CUSTOMER:

CL Environmental
20 Windsor Avenue
5 Kingston Jamaica

CALIBRATION CONDITIONS:

Environment conditions:	Air temperature:	23.4	°C
	Air pressure:	98.698	kPa
	Relative Humidity:	32	%RH

SPECIFICATIONS:

This document certifies that the acoustic calibrator as listed under "Type" has been calibrated and unless otherwise indicated under "Final Data", meets acceptance criteria as prescribed by the referenced Procedure. Statements of compliance, where applicable, are based on calibration results falling within specified criteria with no reduction by the uncertainty of the measurements. The calibration of the listed transducer was accomplished using a test system which conforms to the requirements of ISO/IEC 17025, ANSI/NCSL Z540-1, and guidelines of ISO 10012-1. For "as received" and "final" data, see the attached page(s). Items marked with one asterisk (*) are not covered by the scope of the current A2LA accreditation. This Certificate and attached data pages shall not be reproduced, except in full, without written approval of the Bruel and Kjaer Calibration Laboratory-Duluth, GA. Results relate only to the items tested. The transducer has been calibrated using Measurement Standards with values traceable to the National Institute of Standards and Technology, National Measurement Institutes or derived from natural physical constants. The acoustic calibrator has been calibrated in accordance with the requirements as specified in IEC60942.

PROCEDURE:

The measurements have been performed with the assistance of Brüel & Kjær acoustic calibrator calibration application Software version 2.3.4 Type 7794 using calibration procedure 4231 Complete

RESULTS:

[X] "As Received" Data: Within Acceptance Criteria [ ] "As Received" Data: Outside Acceptance Criteria
[X] "Final" Data : Within Acceptance Criteria [ ] "Final" Data : Outside Acceptance Criteria

The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with EA-4/02from elements originating from the standards, calibration method, effect of environmental conditions and any short time contribution from the calibrator under calibration.

Date of Calibration: November 4, 2019 Certificate issued: November 4, 2019

Meshaun Hobbs
Calibration Technician

Quality Representative

Figure 6.1 Bruel & Kjaer 4231 Noise Calibration Certificate

Brüel & Kjær
North America Inc.

CERTIFICATE OF CALIBRATION

No.: CAS-416103-L3Y8P3-403

Type: 4231 Serial No.: 3018640 Page 2 of 2

Sound Pressure Levels

All stated values are valid at environmental reference conditions

Nominal Level [dB]	Accept Limit Lower [dB]	Accept Limit Upper [dB]	Measured Level [dB]	Measurement Uncertainty [dB]
94	93.80	94.20	93.98	0.12
114	113.80	114.20	113.97	0.12

Frequency

Nominal Frequency [Hz]	Accept Limit Lower [Hz]	Accept Limit Upper [Hz]	Measured Frequency [Hz]	Measurement Uncertainty [Hz]
1000	999.00	1001.00	999.97	0.10

Total Distortion*

Distortion mode: [X] TD* [ ] THD*

Calibration Level [dB]*	Accept Limit [%]*	Measured Distortion [%]*	Measurement Uncertainty [%]*
94	1.00	0.55	0.13
114	1.00	0.33	0.13

Environmental Reference Conditions:

Pressure: 101.3 kPa, Temperature: 23 °C, Relative Humidity: 50%

Instrument List

Type	Description	Serial no	Cal. date	Due date	Calibrated by	Trace number
3560	PULSE Analyzer	2723320	2019-10-17	2020-10-31	JCA	CAS-413598-Q8W9Z2-101
9545	Transfer Microphone	3	2019-10-16	2020-10-31	MH	CAS-413598-Q8W9Z2-401
4228	Reference Sound Source	1610502	2019-04-05	2021-04-30	W.Shipman	CAS-375162-C8J4Z3-705

During the calibration the calibrator has been loaded by the load volume of the Transfer Microphone. The load volumes for a number of different types of Transfer Microphones are listed in the table below.
For Brüel & Kjær Pistonphones types 4220 and 4228 the result of the SPL calibration has been corrected to be valid for a load volume of 1333 mm^3 . For all other types the result is valid with the actual load volume.

Transfer Microphone Type	Fulfils standard IEC 61094-1 LS	Fulfils standard IEC 61094-4 WS	Load Volume 1" (1/2" mic including DP-0776)	Load Volume 1/2"
4180	yes	yes	1126 mm^3	43 mm^3
4192	-	yes	1273 mm^3	190 mm^3
9545	-	-	1333 mm^3	-

Condition "As Received":

Good

Comments

Figure 6.2 Bruel & Kjaer 4231 Noise Calibration Certificate

6.2 NMIA Aircraft Movement Data

Table 6.1 NMIA Aircraft arrival and departure dates and times during noise assessment

Direction	Airline_Code	Date	Flight_Number	Actual_Time	Equipment	Departure To	Runway
DEPARTING	NORTHERN AIR CARGO	03/13/2020	8039	0:20	B763	KMIA	12
ARRIVING	AMERICAN AIRLINES	03/13/2020	1082	0:21	B738		12
ARRIVING	AMERIJET	03/13/2020	849	0:29	B763		12
ARRIVING	DELTA AIRLINES	03/13/2020	383	0:34	B738		12
DEPARTING	PRIVATE	03/13/2020	BILL	0:49	C25B	MDJB	12
DEPARTING	AMERIJET	03/13/2020	848	1:23	B763	MNMG	12
DEPARTING	CARIBBEAN AIRLINES	03/13/2020	017	1:28	B738	KJFK	12
DEPARTING	JAMAICA DEFENCE FORCE	03/13/2020	FREE	2:20	HELI	UPC	12
ARRIVING	JET BLUE	03/13/2020	2959	5:16	A320		12
ARRIVING	JET BLUE	03/13/2020	659	6:28	A321		12
DEPARTING	JET BLUE	03/13/2020	2860	6:34	A320	KJFK	12
DEPARTING	JET BLUE	03/13/2020	960	8:04	A321	KJFK	12
ARRIVING	CARIBBEAN AIRLINES	03/13/2020	016	10:35	B738		12
DEPARTING	AMERICAN AIRLINES	03/13/2020	2370	11:01	B738	KMIA	12
DEPARTING	DELTA AIRLINES	03/13/2020	2843	12:29	B738	KJFK	12
ARRIVING	JET BLUE	03/13/2020	1675	12:35	A320		12
ARRIVING	JET BLUE	03/13/2020	559	12:38	A321		12
ARRIVING	WORLD ATLANTIC AIRLINES	03/13/2020	620	12:58	MD83		12
DEPARTING	JAMAICA DEFENCE FORCE	03/13/2020	FREE	13:24	DA40	ZZZZ	12

DEPARTING	WORLD ATLANTIC AIRLINES	03/13/2020	620	13:58	MD83	MKJS	12
DEPARTING	JET BLUE	03/13/2020	1676	14:01	A320	KFLL	12
ARRIVING	JAMAICA DEFENCE FORCE	03/13/2020	FREE	14:07	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/13/2020	FREE	14:07	DA40	CCTS	12
DEPARTING	AIR TURKS AND CAICUS	03/13/2020	613	14:10	E120	MUCU	12
DEPARTING	INTERISLAND AIRWAYS	03/13/2020	251	14:13	E145	MBPV	12
ARRIVING	JAMAICA DEFENCE FORCE	03/13/2020	FREE	14:14	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/13/2020	FREE	14:15	DA40	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/13/2020	FREE	14:21	DA40		12
DEPARTING	JET BLUE	03/13/2020	560	14:25	A321	KJFK	12
ARRIVING	JAMAICA DEFENCE FORCE	03/13/2020	FREE	14:36	DA40		12
ARRIVING	JAMAICA DEFENCE FORCE	03/13/2020	FREE	14:39	HELI		12
ARRIVING	DELTA	03/13/2020	2841	14:41	B738		12
DEPARTING	PRIVATE	03/13/2020	BILL	14:48	PRM1	KTMB	12
DEPARTING	JDF	03/13/2020	free	14:52	DA40	CCTS	12
ARRIVING	JDF	03/13/2020	free	14:58	DA40		12
DEPARTING	JDF	03/13/2020	free	14:59	DA40	CCTS	12
DEPARTING	JDF	03/13/2020	free	15:06	DA40	CCTS	12
ARRIVING	JDF	03/13/2020	free	15:07	DA40		12
DEPARTING	JDF	03/13/2020	free	15:13	DA40	CCTS	12

ARRIVING	JDF	03/13/2020	free	15:14	DA40		12
DEPARTING	JDF	03/13/2020	free	15:21	DA40	CCTS	12
ARRIVING	JDF	03/13/2020	free	15:22	DA40		12
DEPARTING	JDF	03/13/2020	free	15:27	DA40	CCTS	12
ARRIVING	JDF	03/13/2020	free	15:28	DA40		12
ARRIVING	PRIVATE	03/13/2020	BILL	15:41	C56X		12
DEPARTING	JDF	03/13/2020	free	15:43	DA40	CCTS	12
ARRIVING	JDF	03/13/2020	free	15:44	DA40		12
ARRIVING	CARIBBEAN AIRLINES	03/13/2020	414	15:46	B738		12
ARRIVING	SPIRIT AIRLINES	03/13/2020	723	15:49	A320		12
ARRIVING	JDF	03/13/2020	free	15:58	DA40		12
ARRIVING	MILITARY	03/13/2020	free	16:05	HELI		12
DEPARTING	PRIVATE	03/13/2020	BILL	16:09	C56X	MKJS	12
DEPARTING	JAMAICA DEFENCE FORCE	03/13/2020	FREE	16:12	HELI	UPC	12
ARRIVING	PRIVATE	03/13/2020	BILL	16:14	C421		12
ARRIVING	AMERICAN AIRLINES	03/13/2020	1589	16:24	B738		12
DEPARTING	DELTA	03/13/2020	321	16:38	B738	KATL	12
ARRIVING	FEDERAL EXPRESS	03/13/2020	8126	16:46	ATR42		12
DEPARTING	CARIBBEAN AIRLINES	03/13/2020	414	16:52	B738	MYNN	12
DEPARTING	SPIRIT AIRLINES	03/13/2020	702	17:05	A320	KFLL	12
ARRIVING	IBC	03/13/2020	965	17:31	SW4		12

ARRIVING	AMERICAN AIRLINES	03/13/2020	1400	17:36	B738		12
ARRIVING	CUBANA AIRLINES	03/13/2020	6084	17:39	YK42		12
ARRIVING	WESTJET AIRLINES	03/13/2020	2600	17:42	B737		12
DEPARTING	FEDERAL EXPRESS	03/13/2020	8126	17:43	ATR42	MKJS	12
DEPARTING	JAMAICA DEFENCE FORCE	03/13/2020	FREE	17:53	DA42	MKJS	12
DEPARTING	AMERICAN AIRLINES	03/13/2020	1545	17:56	B738	KMIA	12
DEPARTING	JDF	03/13/2020	free	18:22	DA40	MKJS	12
ARRIVING	PRIVATE	03/13/2020	BILL	18:24	C560		12
DEPARTING	IBC	03/13/2020	510	18:33	SW4	MKJS	12
DEPARTING	PRIVATE	03/13/2020	BILL	18:50	C421	MPMG	12
DEPARTING	CARIBBEAN AIRLINES	03/13/2020	033	18:53	B738	KFLL	12
DEPARTING	CUBANA AIRLINES	03/13/2020	6085	18:56	YK42	MUCU	12
DEPARTING	WESTJET AIRLINES	03/13/2020	2601	18:59	B737	CYYZ	12
DEPARTING	AMERICAN AIRLINES	03/13/2020	1548	19:03	B738	KMIA	12
ARRIVING	MILITARY	03/13/2020	free	19:27	DA42		12
DEPARTING	PRIVATE	03/13/2020	BILL	19:29	C560	MYNN	12
ARRIVING	JDF	03/13/2020	FREE	20:06	DA40		12
DEPARTING	CARIBBEAN AIRLINES	03/13/2020	455	20:10	B738	TBPB	12
ARRIVING	ISLAND WAYS	03/13/2020	408	20:23	E120		30
ARRIVING	JET BLUE	03/13/2020	875	21:05	A320		12
ARRIVING	IBC	03/13/2020	509	21:09	SW4		12

ARRIVING	CARIBBEAN AIRLINES	03/13/2020	415	21:12	B738		12
ARRIVING	PRIVATE	03/13/2020	BILL	21:20	GLF4		12
ARRIVING	PRIVATE	03/13/2020	BILL	21:22	PRM1		12
ARRIVING	AIR TURKS AND CAICUS	03/13/2020	250	21:28	E145		12
ARRIVING	AIR CANADA	03/13/2020	1802	21:47	A321		12
ARRIVING	BRITISH AIRWAYS	03/13/2020	2263	21:51	B772		12
ARRIVING	LYNDEN AIR CARGO	03/13/2020	2039	21:53	C130		12
ARRIVING	JDF	03/13/2020	free	21:57	DA40		12
DEPARTING	JDF	03/13/2020	FREE	21:58	DA40	CCTS	12
DEPARTING	PRIVATE	03/13/2020	BILL	22:00	PRM1	MKTP	12
ARRIVING	FEDERAL EXPRESS	03/13/2020	7126	22:06	ATR42		12
ARRIVING	JDF	03/13/2020	free	22:07	DA40		12
DEPARTING	JDF	03/13/2020	FREE	22:08	DA40	CCTS	12
ARRIVING	JDF	03/13/2020	free	22:14	DA40		12
DEPARTING	JDF	03/13/2020	FREE	22:15	DA40	CCTS	12
DEPARTING	IBC	03/13/2020	964	22:24	SW4	KMIA	12
ARRIVING	JDF	03/13/2020	free	22:26	DA40		12
DEPARTING	JDF	03/13/2020	FREE	22:27	DA40	CCTS	12
DEPARTING	JET BLUE	03/13/2020	876	22:31	A320	KFLL	30
DEPARTING	CARIBBEAN AIRLINES	03/13/2020	415	22:35	B738	TTPP	12
ARRIVING	JDF	03/13/2020	free	22:38	DA40		12

DEPARTING	FEDERAL EXPRESS	03/13/2020	7126	22:46	ATR42	KMIA	30
DEPARTING	AIR CANADA	03/13/2020	1803	23:11	A321	CYZX	12
ARRIVING	CARIBBEAN AIRLINES	03/13/2020	036	23:26	B738		12
ARRIVING	CAYMAN AIRWAYS	03/13/2020	606	23:31	B733		12
ARRIVING	AMERICAN AIRLINES	03/14/2020	1082	0:15	B738		12
ARRIVING	DELTA AIRLINES	03/14/2020	383	0:26	B737-800		12
DEPARTING	CAYMAN AIRWAYS	03/14/2020	607	0:32	B733	MWCR	30
DEPARTING	BRITISH AIRWAYS	03/14/2020	25k	0:47	B772	EGKK	12
ARRIVING	PRIVATE	03/14/2020	BILL	0:49	H25B		12
DEPARTING	CARIBBEAN AIRLINES	03/14/2020	017	1:24	B738	KJFK	12
DEPARTING	PRIVATE	03/14/2020	BILL	1:48	H25B	TNCA	12
ARRIVING	CARIBBEAN AIRLINES	03/14/2020	454	2:26	B738		30
ARRIVING	JET BLUE	03/14/2020	2959	5:19	A320		12
ARRIVING	PRIVATE	03/14/2020	BILL	5:38	B738		12
ARRIVING	JET BLUE	03/14/2020	659	6:44	A321		12
DEPARTING	JET BLUE	03/14/2020	BILL	6:47	A320	KJFK	12
DEPARTING	PRIVATE	03/14/2020	BILL	7:12	B738	SLCB	12
DEPARTING	JET BLUE	03/14/2020	960	8:20	A321	KJFK	30
ARRIVING	CARIBBEAN AIRLINES	03/14/2020	016	10:37	B738		12
DEPARTING	LYNDEN AIR CARGO	03/14/2020	2039	10:45	C130	TVSA	12
DEPARTING	AMERICAN AIRLINES	03/14/2020	2370	11:06	B738	KMIA	30

ARRIVING	PRIVATE	03/14/2020	BILL	11:17	PC12		12
ARRIVING	JET BLUE	03/14/2020	559	12:20	A321		12
ARRIVING	JET BLUE	03/14/2020	1675	12:32	A320		12
DEPARTING	DELTA AIRLINES	03/14/2020	2843	12:40	B737-800	KJFK	12
DEPARTING	PRIVATE	03/14/2020	BILL	12:43	PC12	KTMB	12
ARRIVING	CAYMAN AIRWAYS	03/14/2020	600	12:58	B738		12
DEPARTING	JET BLUE	03/14/2020	1676	13:49	A320	KFLL	30
DEPARTING	AIR TURKS AND CAICUS	03/14/2020	251	13:59	E145	MBPV	12
DEPARTING	ISLAND WAYS	03/14/2020	407	14:11	E120	MDSD	12
ARRIVING	DELTA AIRLINES	03/14/2020	2841	14:19	B738		12
DEPARTING	JET BLUE	03/14/2020	560	14:21	A321	KJFK	12
DEPARTING	CARIBBEAN AIRLINES	03/14/2020	009	14:31	B738	MWCR	30
ARRIVING	SPIRIT AIRLINES	03/14/2020	723	16:03	A320		12
DEPARTING	PRIVATE	03/14/2020	BILL	16:12	GLF4	KSLC	12
DEPARTING	DELTA AIRLINES	03/14/2020	321	16:27	B738	KATL	12
DEPARTING	MILITARY	03/14/2020	free	16:40	DA40	MKJP	12
ARRIVING	AMERICAN AIRLINES	03/14/2020	1589	16:42	B738		12
ARRIVING	MILITARY	03/14/2020	free	16:46	DA40		12
DEPARTING	SPIRIT AIRLINES	03/14/2020	702	17:06	A320	KFLL	12
ARRIVING	CARIBBEAN AIRLINES	03/14/2020	008	17:24	B738		12
ARRIVING	AMERICAN AIRLINES	03/14/2020	1400	17:31	B738		12

DEPARTING	AMERICAN AIRLINES	03/14/2020	1545	17:46	B738	KMIA	12
ARRIVING	CARIBBEAN AIRLINES	03/14/2020	456	17:56	B738		12
ARRIVING	WESTJET AIRLINES	03/14/2020	2600	18:06	B737		12
ARRIVING	PRIVATE	03/14/2020	BILL	18:11	E55P		12
ARRIVING	COPA AIRLINES	03/14/2020	418	18:29	E190		12
DEPARTING	PRIVATE	03/14/2020	BILL	18:55	E55P	KHOU	12
DEPARTING	AMERICAN AIRLINES	03/14/2020	1548	19:01	B738	KMIA	12
DEPARTING	JAMAICA DEFENCE FORCE	03/14/2020	FREE	19:04	DA42	MKJS	12
DEPARTING	WESTJET AIRLINES	03/14/2020	2601	19:07	B737	CYYZ	12
DEPARTING	CARIBBEAN AIRLINES	03/14/2020	033	19:21	B738	KFLL	12
DEPARTING	CARIBBEAN AIRLINES	03/14/2020	457	19:24	B738	TNCM	12
ARRIVING	ROYAL AIR FORCE	03/14/2020	2888	20:01	A332		12
DEPARTING	COPA AIRLINES	03/14/2020	417	20:12	E190	MPTO	12
ARRIVING	JET BLUE	03/14/2020	875	21:04	A320		12
ARRIVING	JDF	03/14/2020	FREE	21:49	DA40		12
DEPARTING	JET BLUE	03/14/2020	876	22:22	A320	KFLL	12
ARRIVING	INTERISLAND AIRWAYS	03/14/2020	250	22:55	E145		12
ARRIVING	AIR TURKS AND CAICUS	03/14/2020	617	23:00	E145		12
ARRIVING	CARIBBEAN AIRLINES	03/14/2020	36	23:56	B738		12
DEPARTING	ROYAL AIR FORCE	03/15/2020	free	0:19	A332	MZBZ	12
ARRIVING	AMERICAN AIRLINES	03/15/2020	1082	0:24	B738		12

ARRIVING	DELAT CONNECTION	03/15/2020	383	0:48	B738		12
DEPARTING	INTERISLAND AIRWAYS	03/15/2020	618	1:05	E145	MUHA	30
DEPARTING	CARIBBEAN AIRLINES	03/15/2020	017	1:30	B738	KJFK	30
ARRIVING	JET BLUE	03/15/2020	2959	5:08	A320		12
ARRIVING	JET BLUE	03/15/2020	659	6:33	A321		12
DEPARTING	JET BLUE	03/15/2020	2860	6:47	A320	KJFK	30
DEPARTING	JET BLUE	03/15/2020	960	8:28	A321	KJFK	30
ARRIVING	CARIBBEAN AIRLINES	03/15/2020	016	10:16	B737		12
DEPARTING	AMERICAN AIRLINES	03/15/2020	2370	11:14	B738	KMIA	30
ARRIVING	JET BLUE	03/15/2020	559	12:32	A321		12
ARRIVING	JET BLUE	03/15/2020	1675	12:40	A320		12
DEPARTING	DELAT CONNECTION	03/15/2020	2843	12:42	B738	KJFK	30
DEPARTING	CARIBBEAN AIRLINES	03/15/2020	079	13:52	B737	CYYZ	30
DEPARTING	JET BLUE	03/15/2020	1676	13:54	A320	KFLL	30
DEPARTING	AIR TURKS AND CAICUS	03/15/2020	251	14:04	E145	MBPV	12
DEPARTING	JET BLUE	03/15/2020	560	14:19	A321	KJFK	30
ARRIVING	PRIVATE	03/15/2020	BILL	14:40	C25B		12
ARRIVING	DELTA	03/15/2020	2841	14:43	B738		12
ARRIVING	CARIBBEAN AIRLINES	03/15/2020	414	14:46	B738		12
DEPARTING	PRIVATE	03/15/2020	BILL	14:53	C525	KFLL	12
ARRIVING	SPIRIT AIRLINES	03/15/2020	723	16:03	A320		12

DEPARTING	CARIBBEAN AIRLINES	03/15/2020	414	16:11	B738	MYNN	12
ARRIVING	PRIVATE	03/15/2020	BILL	16:23	PC12		12
DEPARTING	DELTA	03/15/2020	321	16:35	B738	KATL	12
ARRIVING	AMERICAN AIRLINES	03/15/2020	1589	16:36	B738		12
DEPARTING	PRIVATE	03/15/2020	BILL	16:59	C25B	MDJB	12
DEPARTING	PRIVATE	03/15/2020	BILL	17:00	PC12	MKTP	12
DEPARTING	SPIRIT AIRLINES	03/15/2020	702	17:06	A320	KFLL	30
ARRIVING	AMERICAN AIRLINES	03/15/2020	1400	17:44	B738		12
ARRIVING	JET BLUE	03/15/2020	2600	17:46	B737		12
DEPARTING	CARIBBEAN AIRLINES	03/15/2020	033	18:46	B738	KFLL	30
DEPARTING	AMERICAN AIRLINES	03/15/2020	1548	19:06	B738	KMIA	30
DEPARTING	JET BLUE	03/15/2020	2601	19:12	B737	CYYZ	12
DEPARTING	AMERICAN AIRLINES	03/15/2020	1545	19:29	B738	KMIA	30
ARRIVING	CARIBBEAN AIRLINES	03/15/2020	415	20:12	B738		12
DEPARTING	CARIBBEAN AIRLINES	03/15/2020	415	21:13	B738	TTPP	12
ARRIVING	PRIVATE	03/15/2020	BILL	21:37	C56X		12
ARRIVING	AIR TURKS AND CAICUS	03/15/2020	250	21:41	E145		12
DEPARTING	PRIVATE	03/15/2020	BILL	22:17	C56X	MKTP	30
ARRIVING	PRIVATE	03/15/2020	BILL	22:37	C525		12
ARRIVING	JET BLUE	03/15/2020	875	22:47	A320		12
ARRIVING	CAYMAN AIRWAYS	03/15/2020	606	23:26	B738		12

ARRIVING	CARIBBEAN AIRLINES	03/15/2020	036	23:33	B738		12
ARRIVING	CARIBBEAN AIRLINES	03/15/2020	078	23:48	B737		12
DEPARTING	JET BLUE	03/16/2020	876	0:01	A320	KFLL	12
ARRIVING	AMERICAN AIRLINES	03/16/2020	1082	0:26	B738		30
ARRIVING	DELTA AIRLINES	03/16/2020	383	0:45	B738		30
DEPARTING	CAYMAN AIRWAYS	03/16/2020	607	0:48	B738	MWCR	30
DEPARTING	CARIBBEAN AIRLINES	03/16/2020	017	1:30	B738	KJFK	30
ARRIVING	JET BLUE	03/16/2020	2959	5:02	A320		12
DEPARTING	JET BLUE	03/16/2020	2860	6:37	A320	KJFK	12
ARRIVING	CARIBBEAN AIRLINES	03/16/2020	016	10:23	B738		12
DEPARTING	AMERICAN AIRLINES	03/16/2020	2370	11:03	B738	KMIA	30
ARRIVING	PRIVATE	03/16/2020	BILL	11:09	PC12		12
DEPARTING	PRIVATE	03/16/2020	BILL	12:05	PC12	KTMB	30
ARRIVING	JET BLUE	03/16/2020	559	12:20	A321		12
DEPARTING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	12:28	DA40	S/W	30
DEPARTING	DELTA AIRLINES	03/16/2020	2843	12:36	B738	KJFK	12
ARRIVING	JET BLUE	03/16/2020	1675	12:40	A320		12
ARRIVING	CAYMAN AIRWAYS	03/16/2020	620	13:07	B738		12
DEPARTING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	13:27	DA40	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	13:27	DA40		12

DEPARTING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	13:33	DA40	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	13:33	DA40		12
ARRIVING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	13:40	DA40		12
ARRIVING	NORTHERN AIR CARGO	03/16/2020	8040	13:43	B763		12
DEPARTING	AIR TURKS AND CAICUS	03/16/2020	251	13:50	E145	MBPV	12
DEPARTING	JET BLUE	03/16/2020	1676	13:53	A320	KFLL	30
DEPARTING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	13:56	DA42	S/W	30
DEPARTING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	14:03	DA40	S/W	30
DEPARTING	CAYMAN AIRWAYS	03/16/2020	621	14:06	B733	MKJS	30
DEPARTING	JET BLUE	03/16/2020	560	14:29	A321	KJFK	30
ARRIVING	DELTA AIRLINES	03/16/2020	2841	14:36	B738		12
DEPARTING	MILITARY	03/16/2020	free	14:39	DA40	ZZZZ	12
ARRIVING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	14:56	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	14:57	DA40	CCTS	12
DEPARTING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	15:00	DA42	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	15:00	DA42		12
ARRIVING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	15:03	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	15:04	DA40	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	15:05	DA42		12

DEPARTING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	15:06	DA42	CCTS	12
DEPARTING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	15:11	DA40	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	15:11	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	15:12	DA42	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	15:12	DA42		12
ARRIVING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	15:15	DA40		12
ARRIVING	FEDERAL EXPRESS	03/16/2020	8126	15:22	ATR42		12
DEPARTING	NORTHERN AIR CARGO	03/16/2020	8040	15:28	B763	MKJS	30
ARRIVING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	15:31	DA42		12
DEPARTING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	15:58	DA42	S/W	12
ARRIVING	SPIRIT AIRLINES	03/16/2020	723	16:05	A320		12
ARRIVING	AMERICAN AIRLINES	03/16/2020	1589	16:27	B738		12
ARRIVING	IBC	03/16/2020	965	16:28	SW4		12
ARRIVING	PRIVATE	03/16/2020	BILL	16:30	C500		12
DEPARTING	DELTA AIRLINES	03/16/2020	321	16:32	B738	KATL	12
ARRIVING	CARIBBEAN AIRLINES	03/16/2020	458	16:41	B737		12
ARRIVING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	16:46	DA42		12
DEPARTING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	16:47	DA42	CCTS	12
DEPARTING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	16:51	DA42	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	16:51	DA42		12

DEPARTING	FEDERAL EXPRESS	03/16/2020	8126	16:56	ATR42	MKJS	12
ARRIVING	PRIVATE	03/16/2020	BILL	17:04	PC12		12
DEPARTING	SPIRIT AIRLINES	03/16/2020	702	17:06	A320	KFLL	12
ARRIVING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	17:08	DA42		12
ARRIVING	WESTJET AIRLINES	03/16/2020	2600	17:21	B737		12
DEPARTING	PRIVATE	03/16/2020	BILL	17:35	PC12	MKTP	30
ARRIVING	AMERICAN AIRLINES	03/16/2020	1400	17:48	B738		12
DEPARTING	IBC	03/16/2020	510	18:02	SW4	MKJS	12
DEPARTING	AMERICAN AIRLINES	03/16/2020	1545	18:07	B738	KMIA	12
ARRIVING	PRIVATE	03/16/2020	6084	18:16	AT45		12
ARRIVING	MILITARY	03/16/2020	free	18:22	DA40		12
ARRIVING	COPA AIRLINES	03/16/2020	418	18:37	E190		12
ARRIVING	PRIVATE	03/16/2020	BILL	18:48	ASTR		12
DEPARTING	WESTJET AIRLINES	03/16/2020	2601	18:57	B737	CYYZ	30
DEPARTING	AMERICAN AIRLINES	03/16/2020	1548	19:05	B738	KMIA	30
DEPARTING	CARIBBEAN AIRLINES	03/16/2020	459	19:24	B737	TAPA	12
DEPARTING	CARIBBEAN AIRLINES	03/16/2020	456	19:43	B737	TBPB	12
DEPARTING	CUBANA AIRLINES	03/16/2020	6085	19:53	YK42	MUCU	12
ARRIVING	AMERIJET	03/16/2020	816	20:01	B763		12
DEPARTING	PRIVATE	03/16/2020	BILL	20:07	C500	SVBM	12
DEPARTING	PRIVATE	03/16/2020	BILL	20:19	ASTR	KOPF	12

DEPARTING	COPA AIRLINES	03/16/2020	417	20:23	E190	MPTO	12
ARRIVING	IBC	03/16/2020	509	20:48	SW4		12
DEPARTING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	20:54	DA40	CCTS	30
DEPARTING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	21:10	DA40	CCTS	12
ARRIVING	JET BLUE	03/16/2020	875	21:11	A320		12
DEPARTING	AMERIJET	03/16/2020	816	21:20	B763	TNCC	30
ARRIVING	AIR CANADA	03/16/2020	1802	21:22	A321		12
ARRIVING	FEDERAL EXPRESS	03/16/2020	7126	21:34	ATR42		12
ARRIVING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	21:51	DA40		30
DEPARTING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	21:52	DA40	CCTS	30
DEPARTING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	21:54	DA40	CCTS	30
ARRIVING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	21:54	DA40		30
DEPARTING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	21:59	DA40	CCTS	30
ARRIVING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	21:59	DA40		30
ARRIVING	BRITISH AIRWAYS	03/16/2020	2263	22:05	B772		30
DEPARTING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	22:08	DA40	CCTS	30
ARRIVING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	22:08	DA40		30
DEPARTING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	22:11	DA42	CCTS	30
ARRIVING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	22:15	DA40		30
DEPARTING	IBC	03/16/2020	964	22:20	SW4	KMIA	30

DEPARTING	JET BLUE	03/16/2020	876	22:26	A320	KFLL	30
DEPARTING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	22:28	DA40	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	22:28	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	22:31	DA40	CCTS	30
DEPARTING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	22:35	DA40	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	22:35	DA40		12
DEPARTING	AIR CANADA	03/16/2020	1803	22:38	A321	CYYZ	30
DEPARTING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	22:42	DA40	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	22:42	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	22:45	DA40	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	22:45	DA40		12
ARRIVING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	22:49	DA42		30
DEPARTING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	22:49	DA42	CCTS	30
ARRIVING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	22:52	DA40		12
ARRIVING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	22:56	DA42		30
DEPARTING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	22:56	DA42	CCTS	30
DEPARTING	FEDERAL EXPRESS	03/16/2020	7126	23:00	ATR42	KMIA	30
ARRIVING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	23:03	DA42		30
DEPARTING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	23:03	DA42	CCTS	30

ARRIVING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	23:10	DA42		30
DEPARTING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	23:10	DA42	CCTS	30
ARRIVING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	23:22	DA40		30
ARRIVING	JAMAICA DEFENCE FORCE	03/16/2020	FREE	23:25	DA42		30
DEPARTING	JDF	03/17/2020	free	0:19	DA40	ZZZZ	12
ARRIVING	AMERICAN AIRLINES	03/17/2020	1082	0:26	B738		12
ARRIVING	INTERISLAND AIRWAYS	03/17/2020	250	0:38	E120		12
ARRIVING	DELTA	03/17/2020	383	1:28	B738		12
DEPARTING	CARIBBEAN AIRLINES	03/17/2020	017	1:44	B738	KJFK	12
DEPARTING	INTERISLAND AIRWAYS	03/17/2020	604	1:44	E120	MKJS	12
ARRIVING	JDF	03/17/2020	free	1:49	DA40		12
DEPARTING	JDF	03/17/2020	free	1:49	DA40	CCTS	12
DEPARTING	BRITISH AIRWAYS	03/17/2020	25k	1:53	B772	EGKK	12
ARRIVING	JDF	03/17/2020	free	1:56	DA40		12
DEPARTING	JDF	03/17/2020	free	1:56	DA40	CCTS	12
ARRIVING	CARIBBEAN AIRLINES	03/17/2020	454	2:07	B737		12
ARRIVING	JDF	03/17/2020	free	2:09	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	4:00	B350	ZZZZ	12
ARRIVING	JET BLUE	03/17/2020	2959	6:02	A320		12
ARRIVING	JET BLUE	03/17/2020	659	6:29	A321		12

DEPARTING	JET BLUE	03/17/2020	2860	7:16	A320	KJFK	12
ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	7:29	B350		12
DEPARTING	JET BLUE	03/17/2020	960	8:03	A321	KJFK	12
ARRIVING	CARIBBEAN AIRLINES	03/17/2020	016	10:59	B738		12
DEPARTING	AMERICAN AIRLINES	03/17/2020	2370	11:08	B738	KMIA	12
ARRIVING	JET BLUE	03/17/2020	559	12:36	A321		12
ARRIVING	JET BLUE	03/17/2020	1675	12:39	A320		12
DEPARTING	DELTA	03/17/2020	2843	12:41	B738	KJFK	12
DEPARTING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	12:52	DA40	S/W	12
ARRIVING	CAYMAN AIRWAYS	03/17/2020	600	12:53	B733		12
ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	13:32	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	13:32	DA40	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	13:38	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	13:38	DA40	CCTS	12
DEPARTING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	13:42	DA42	S/W	12
ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	13:44	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	13:44	DA40	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	13:50	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	13:51	DA40	CCTS	12
DEPARTING	JET BLUE	03/17/2020	1676	13:55	A320	KFLL	12

ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	13:57	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	13:58	DA40	CCTS	12
DEPARTING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	14:04	DA40	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	14:05	DA40		12
DEPARTING	JET BLUE	03/17/2020	560	14:18	A321	KJFK	12
ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	14:19	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	14:19	DA40	S/W	12
DEPARTING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	14:20	DA40	CCTS	12
DEPARTING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	14:24	DA42	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	14:26	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	14:26	DA40	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	14:30	DA42		12
DEPARTING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	14:30	DA42	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	14:32	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	14:32	DA40	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	14:37	DA42		12
DEPARTING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	14:37	DA42	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	14:39	DA40		12
ARRIVING	CARIBBEAN AIRLINES	03/17/2020	414	14:43	B737		12

ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	`	14:44	DA42		12
DEPARTING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	14:45	DA42	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	14:52	DA42		12
DEPARTING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	14:53	DA42	CCTS	12
ARRIVING	AIR TURKS AND CAICUS	03/17/2020	601	14:55	E120		12
ARRIVING	PRIVATE	03/17/2020	BILL	15:01	PRM1		12
DEPARTING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	15:04	B350	L/C	12
ARRIVING	PRIVATE	03/17/2020	BILL	15:13	C25B		12
ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	15:16	DA40		12
ARRIVING	DELTA AIRLINES	03/17/2020	2841	15:24	B738		12
ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	15:26	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	15:26	DA42	S/W	12
ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	15:35	DA40		12
ARRIVING	JDF	03/17/2020	free	15:36	HELI		12
DEPARTING	AIR TURKS AND CAICUS	03/17/2020	251	15:37	E120	MBPV	12
DEPARTING	CAYMAN AIRWAYS	03/17/2020	601	15:42	B733	MWCR	12
ARRIVING	FEDERAL EXPRESS	03/17/2020	8126	15:44	ATR42		12
DEPARTING	PRIVATE	03/17/2020	BILL	15:48	PRM1	MYNN	12
DEPARTING	CARIBBEAN AIRLINES	03/17/2020	414	15:56	B737	TTPP	12
ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	15:59	DA42		12

ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	16:15	DA42		12
DEPARTING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	16:16	DA42	CCTS	12
ARRIVING	AMERICAN AIRLINES	03/17/2020	1589	16:20	B738		12
ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	16:22	DA42		12
DEPARTING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	16:22	DA42	CCTS	12
ARRIVING	PRIVATE	03/17/2020	BILL	16:25	LJ35		12
ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	16:27	DA42		12
DEPARTING	FEDERAL EXPRESS	03/17/2020	8126	16:28	ATR42	MKJS	12
DEPARTING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	16:28	DA42	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	16:35	DA42		12
DEPARTING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	16:35	DA42	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	16:38	DA42		12
DEPARTING	DELTA AIRLINES	03/17/2020	321	16:42	B738	KATL	12
DEPARTING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	16:47	DA40	L/C	12
DEPARTING	PRIVATE	03/17/2020	BILL	17:08	C25B	MDJB	12
DEPARTING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	17:25	DA42	L/C	12
ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	17:25	DA40		12
DEPARTING	JDF	03/17/2020	FREE	17:27	DA40	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	17:35	DA40		12

DEPARTING	JDF	03/17/2020	FREE	17:35	DA40	CCTS	12
ARRIVING	AMERICAN AIRLINES	03/17/2020	1400	17:42	B738		12
ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	17:44	DA40		12
DEPARTING	JDF	03/17/2020	FREE	17:45	DA40	CCTS	12
ARRIVING	MERLIN EXPRESS	03/17/2020	505	17:46	SF340		12
ARRIVING	IBC	03/17/2020	965	17:49	SW4		12
ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	17:52	DA40		12
DEPARTING	AMERICAN AIRLINES	03/17/2020	1545	17:52	B738	KMIA	12
DEPARTING	JDF	03/17/2020	FREE	17:53	DA40	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	18:08	DA40		12
ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	18:13	DA42		12
DEPARTING	JDF	03/17/2020	FREE	18:14	DA40	CCTS	12
DEPARTING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	18:24	DA40	S/W	12
ARRIVING	JDF	03/17/2020	FREE	18:27	DA40		12
DEPARTING	JDF	03/17/2020	FREE	18:31	DA40	CCTS	12
ARRIVING	JDF	03/17/2020	FREE	18:31	DA40		12
ARRIVING	JDF	03/17/2020	FREE	18:40	DA40		12
DEPARTING	IBC	03/17/2020	510	18:44	SW4	MKJS	12
DEPARTING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	18:50	DA42	S/W	12
DEPARTING	CARIBBEAN AIRLINES	03/17/2020	033	18:51	B737	KFLL	12

ARRIVING	PRIVATE	03/17/2020	BILL	18:56	PRM1		12
ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	18:58	B350		12
DEPARTING	AMERICAN AIRLINES	03/17/2020	1548	19:00	B738	KMIA	12
ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	19:04	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	19:05	DA40	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	19:12	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	19:13	DA40	CCTS	12
DEPARTING	PRIVATE	03/17/2020	BILL	19:16	PRM1	MKTP	12
ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	19:20	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	19:21	DA40	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	19:28	DA40		12
ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	19:29	DA42		12
DEPARTING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	19:30	DA42	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	19:34	DA42		12
DEPARTING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	19:35	DA42	CCTS	12
ARRIVING	CARIBBEAN AIRLINES	03/17/2020	415	19:43	B737		12
ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	19:45	DA42		12
DEPARTING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	19:46	DA42	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	19:51	DA42		12

DEPARTING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	19:51	DA42	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	19:59	DA42		12
DEPARTING	JAMAICA DEFENCE FORCE	03/17/2020	FREE	20:23	HELI	UPC	12
ARRIVING	JET BLUE	03/17/2020	875	21:03	A320		12
DEPARTING	CARIBBEAN AIRLINES	03/17/2020	415	21:13	B737	TTPP	12
ARRIVING	AIR CANADA	03/17/2020	1802	21:58	A321		12
ARRIVING	FEDERAL EXPRESS	03/17/2020	7126	22:20	ATR42		12
DEPARTING	JET BLUE	03/17/2020	876	22:22	A320	KFLL	30
DEPARTING	MERLIN EXPRESS	03/17/2020	964	22:37	SF340	KMIA	30
DEPARTING	FEDERAL EXPRESS	03/17/2020	7126	22:55	ATR42	KMIA	12
ARRIVING	ISLAND WAYS	03/17/2020	250	23:00	E120		30
DEPARTING	AIR CANADA	03/17/2020	1803	23:04	A321	CYYZ	30
ARRIVING	CARIBBEAN AIRLINES	03/17/2020	036	23:44	B737		12
ARRIVING	AMERICAN AIRLINES	03/18/2020	1082	0:17	B738		12
ARRIVING	DELTA AIRLINES	03/18/2020	383	0:39	B738		12
DEPARTING	PRIVATE	03/18/2020	BILL	1:09	LJ35	KFXE	12
DEPARTING	CARIBBEAN AIRLINES	03/18/2020	017	1:34	B737	KJFK	12
ARRIVING	JET BLUE	03/18/2020	2959	4:54	A320		12
DEPARTING	JET BLUE	03/18/2020	2860	6:38	A320	KJFK	12
ARRIVING	JET BLUE	03/18/2020	659	6:39	A321		12

DEPARTING	JET BLUE	03/18/2020	960	8:06	A321	KJFK	12
ARRIVING	CARIBBEAN AIRLINES	03/18/2020	016	10:39	B738		12
DEPARTING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	12:13	DA40	S/W	12
DEPARTING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	12:17	DA42	S/W	12
ARRIVING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	12:21	DA42		12
ARRIVING	JET BLUE	03/18/2020	559	12:33	A321		12
DEPARTING	DELTA AIRLINES	03/18/2020	2843	12:36	B738	KJFK	12
ARRIVING	JET BLUE	03/18/2020	1675	12:44	A320		12
ARRIVING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	12:56	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	12:57	DA40	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	12:57	DA42		12
DEPARTING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	13:03	DA40	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	13:03	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	13:05	DA42	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	13:05	DA42		12
ARRIVING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	13:10	DA40		12
ARRIVING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	13:12	DA42		12
DEPARTING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	13:13	DA42	CCTS	12
ARRIVING	JDF	03/18/2020	free	13:16	HELI		12

DEPARTING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	13:30	DA40	CCTS	12
DEPARTING	AIR TURKS AND CAICUS	03/18/2020	251	13:44	E120	MBPV	12
DEPARTING	JET BLUE	03/18/2020	1676	13:49	A320	KFLL	12
DEPARTING	JET BLUE	03/18/2020	560	14:08	A321	KJFK	12
ARRIVING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	14:15	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	14:16	DA40	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	14:21	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	14:21	DA40	CCTS	12
ARRIVING	DELTA	03/18/2020	2841	14:34	B738		12
ARRIVING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	14:38	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	15:21	DA42	S/W	12
ARRIVING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	16:00	DA42		12
DEPARTING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	16:00	DA40	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	16:05	DA42		12
DEPARTING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	16:05	DA42	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	16:09	DA42		12
DEPARTING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	16:09	DA42	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	16:13	DA42		12
DEPARTING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	16:13	DA42	CCTS	12

ARRIVING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	16:18	DA42		12
DEPARTING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	16:18	DA42	CCTS	12
DEPARTING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	16:21	DA40	S/W	12
ARRIVING	AMERICAN AIRLINES	03/18/2020	1589	16:28	B738		12
ARRIVING	CARIBBEAN AIRLINES	03/18/2020	456	16:30	B738		12
ARRIVING	MILITARY	03/18/2020	bill	16:32	C130		12
ARRIVING	FEDERAL EXPRESS	03/18/2020	8126	16:37	ATR42		12
ARRIVING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	16:40	DA42		12
DEPARTING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	16:40	DA42	CCTS	12
DEPARTING	DELTA	03/18/2020	321	16:43	B738	KATL	12
ARRIVING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	16:46	DA42		12
DEPARTING	MILITARY	03/18/2020	20	16:53	DA40	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	17:05	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	17:05	DA40	CCTS	12
DEPARTING	FEDERAL EXPRESS	03/18/2020	8126	17:28	ATR42	MKJS	12
ARRIVING	IBC	03/18/2020	965	17:28	SW4		12
ARRIVING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	17:40	DA40		12
DEPARTING	JDF	03/18/2020	free	17:42	HELI	UPC	12
DEPARTING	AMERICAN AIRLINES	03/18/2020	1545	17:52	B738	KMIA	12
ARRIVING	MILITARY	03/18/2020	20	17:56	DA40		12

DEPARTING	MILITARY	03/18/2020	20	17:56	DA40	CCTS	12
ARRIVING	MILITARY	03/18/2020	20	18:03	DA40		12
ARRIVING	AIR CANADA	03/18/2020	1802	18:04	A321		12
DEPARTING	MILITARY	03/18/2020	67	18:07	C130	MUGM	12
DEPARTING	MILITARY	03/18/2020	21	18:33	DA42	CCTS	12
DEPARTING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	18:53	DA40	MKTP	12
DEPARTING	AMERICAN AIRLINES	03/18/2020	1548	19:01	B738	KMIA	12
DEPARTING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	19:02	DA40	S/W	12
ARRIVING	MILITARY	03/18/2020	21	19:02	DA42		12
DEPARTING	AIR CANADA	03/18/2020	1803	19:07	A321	CYYZ	12
DEPARTING	CARIBBEAN AIRLINES	03/18/2020	457	19:11	B738	TNCM	12
ARRIVING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	19:24	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	19:24	DA40	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	19:25	HELI		12
ARRIVING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	19:29	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	19:29	DA40	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	19:36	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	19:36	DA40	CCTS	12
DEPARTING	IBC	03/18/2020	510	19:38	SW4	MKJS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	19:42	DA40		12

DEPARTING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	19:42	DA40	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	19:44	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	19:45	DA40	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	19:48	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	19:48	DA40	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	19:51	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	19:51	DA40	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	19:52	DA40		12
ARRIVING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	19:57	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	19:57	DA40	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	20:05	DA40		12
ARRIVING	JET BLUE	03/18/2020	875	21:07	A320		12
ARRIVING	IBC	03/18/2020	504	21:29	SW4		12
ARRIVING	FEDERAL EXPRESS	03/18/2020	7126	21:48	ATR42		12
DEPARTING	IBC	03/18/2020	964	22:07	SW4	KMIA	12
DEPARTING	JET BLUE	03/18/2020	876	22:17	A320	KFLL	12
ARRIVING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	22:23	HELI		12
DEPARTING	FEDERAL EXPRESS	03/18/2020	7126	22:27	ATR42	KMIA	12
DEPARTING	JAMAICA DEFENCE FORCE	03/18/2020	FREE	22:28	HELI	UPC	12

ARRIVING	BRITISH AIRWAYS	03/18/2020	2263	22:36	B772		12
ARRIVING	AIR TURKS AND CAICUS	03/18/2020	250	23:05	E145		30
ARRIVING	AMERIJET	03/18/2020	839	23:25	B763		30
ARRIVING	INTERISLAND AIRWAYS	03/19/2020	617	0:08	E145		12
ARRIVING	DELTA AIRLINES	03/19/2020	383	0:42	B738		12
DEPARTING	AMERIJET	03/19/2020	383	0:49	B763	MNMG	12
DEPARTING	BRITISH AIRWAYS	03/19/2020	25k	1:09	B772	EGKK	12
DEPARTING	CARIBBEAN AIRLINES	03/19/2020	017	1:40	B738	KJFK	12
ARRIVING	JDF	03/19/2020	free	3:46	B350		12
ARRIVING	JET BLUE	03/19/2020	2959	5:02	A320		12
DEPARTING	JET BLUE	03/19/2020	2860	6:38	A320	KJFK	12
ARRIVING	JET BLUE	03/19/2020	659	6:39	A321		12
DEPARTING	JET BLUE	03/19/2020	960	8:15	A321	KJFK	12
ARRIVING	CARIBBEAN AIRLINES	03/19/2020	016	10:30	B738		12
DEPARTING	MILITARY	03/19/2020	free	12:26	DA40	ZZZZ	12
ARRIVING	JET BLUE	03/19/2020	1675	12:31	A320		12
DEPARTING	JAMAICA DEFENCE FORCE	03/19/2020	FREE	12:34	DA40	ZZZZ	12
ARRIVING	JET BLUE	03/19/2020	559	12:41	A321		12
ARRIVING	MILITARY	03/19/2020	free	13:03	DA40		12
DEPARTING	MILITARY	03/19/2020	free	13:09	DA40	ZZZZ	12
ARRIVING	WORLD ATLANTIC AIRLINES	03/19/2020	600	13:12	MD83		12

ARRIVING	MILITARY	03/19/2020	free	13:15	DA40		12
DEPARTING	MILITARY	03/19/2020	free	13:16	DA40	ZZZZ	12
ARRIVING	JAMAICA DEFENCE FORCE	03/19/2020	FREE	13:18	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/19/2020	FREE	13:19	DA40	ZZZZ	12
DEPARTING	MILITARY	03/19/2020	free	13:23	DA40	ZZZZ	12
ARRIVING	JAMAICA DEFENCE FORCE	03/19/2020	FREE	13:25	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/19/2020	FREE	13:26	DA40	ZZZZ	12
ARRIVING	JAMAICA DEFENCE FORCE	03/19/2020	FREE	13:30	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/19/2020	FREE	13:31	DA40	ZZZZ	12
DEPARTING	MILITARY	03/19/2020	free	13:32	DA40	ZZZZ	12
ARRIVING	MILITARY	03/19/2020	free	13:37	DA40		12
DEPARTING	MILITARY	03/19/2020	free	13:38	DA40	ZZZZ	12
ARRIVING	JAMAICA DEFENCE FORCE	03/19/2020	FREE	13:40	DA40		12
ARRIVING	MILITARY	03/19/2020	free	13:43	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/19/2020	FREE	13:56	HELI	ZZZZ	12
DEPARTING	JET BLUE	03/19/2020	1676	13:59	A320	KFLL	12
DEPARTING	AIR TURKS AND CAICUS	03/19/2020	251	14:01	E145	MBPV	12
DEPARTING	JET BLUE	03/19/2020	560	14:16	A321	KJFK	12
DEPARTING	WORLD ATLANTIC AIRLINES	03/19/2020	601	14:27	MD83	MWCR	12
DEPARTING	JAMAICA DEFENCE FORCE	03/19/2020	FREE	15:14	DA40	S/W	12

ARRIVING	PRIVATE	03/19/2020	BILL	15:30	BE19		12
ARRIVING	FEDERAL EXPRESS	03/19/2020	8126	15:59	ATR42		12
ARRIVING	SPIRIT AIRLINES	03/19/2020	723	16:02	A320		12
ARRIVING	CARIBBEAN AIRLINES	03/19/2020	723	16:02	B738		12
ARRIVING	JAMAICA DEFENCE FORCE	03/19/2020	FREE	16:03	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/19/2020	FREE	16:09	DA40	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/19/2020	FREE	16:15	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/19/2020	FREE	16:15	DA40	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/19/2020	FREE	16:22	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/19/2020	FREE	16:22	DA40	CCTS	12
ARRIVING	AMERICAN AIRLINES	03/19/2020	1589	16:25	B737-800		12
ARRIVING	JAMAICA DEFENCE FORCE	03/19/2020	FREE	16:27	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/19/2020	FREE	16:27	DA40	CCTS	12
DEPARTING	DELTA AIRLINES	03/19/2020	321	16:31	B738	KATL	12
ARRIVING	JAMAICA DEFENCE FORCE	03/19/2020	FREE	16:34	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/19/2020	FREE	16:34	DA40	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/19/2020	FREE	16:41	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/19/2020	FREE	16:41	DA40	CCTS	12
DEPARTING	FEDERAL EXPRESS	03/19/2020	8126	16:45	ATR42	MKJS	12

ARRIVING	JAMAICA DEFENCE FORCE	03/19/2020	FREE	16:48	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/19/2020	FREE	16:48	DA40	CCTS	12
DEPARTING	PRIVATE	03/19/2020	BILL	17:13	BE19	MBPV	12
ARRIVING	IBC	03/19/2020	965	17:14	SW4		12
DEPARTING	SPIRIT AIRLINES	03/19/2020	702	17:20	A320	KFLL	12
ARRIVING	AMERICAN AIRLINES	03/19/2020	1400	17:35	B738		12
DEPARTING	AMERICAN AIRLINES	03/19/2020	1545	17:52	B737-800	KMIA	12
ARRIVING	CUBANA AIRLINES	03/19/2020	6050	18:00	YK42		12
ARRIVING	COPA AIRLINES	03/19/2020	418	18:32	B738		12
DEPARTING	AMERICAN AIRLINES	03/19/2020	1548	18:47	B738	KMIA	12
DEPARTING	CARIBBEAN AIRLINES	03/19/2020	033	18:53	B738	KFLL	12
ARRIVING	CARIBBEAN AIRLINES	03/19/2020	459	19:06	B738		12
DEPARTING	CUBANA AIRLINES	03/19/2020	6051	19:09	YK42	MUCM	12
DEPARTING	IBC	03/19/2020	510	19:38	SW4	MKJS	12
DEPARTING	COPA AIRLINES	03/19/2020	417	20:26	B738	MPTO	12
ARRIVING	JET BLUE	03/19/2020	875	21:01	A320		12
ARRIVING	AIR CANADA	03/19/2020	14802	21:09	A321		12
ARRIVING	JAMAICA DEFENCE FORCE	03/19/2020	FREE	21:23	HELI		12
DEPARTING	JAMAICA DEFENCE FORCE	03/19/2020	FREE	21:23	HELI	UPC	12
ARRIVING	FEDERAL EXPRESS	03/19/2020	7126	21:34	ATR42		12

ARRIVING	INTERISLAND AIRWAYS	03/19/2020	250	21:36	E120		12
ARRIVING	IBC	03/19/2020	509	21:37	SW4		12
DEPARTING	IBC	03/19/2020	964	22:12	SW4	KMIA	12
DEPARTING	JET BLUE	03/19/2020	876	22:18	A320	KFLL	12
DEPARTING	AIR CANADA	03/19/2020	1803	22:39	A321	CYYZ	12
ARRIVING	NORTHERN AIR CARGO	03/19/2020	8038	23:03	B763		12
ARRIVING	AMERIJET	03/19/2020	849	23:13	B763		12
DEPARTING	JDF	03/19/2020	free	23:46	B350	ZZZZ	12
ARRIVING	CARIBBEAN AIRLINES	03/19/2020	036	23:46	B738		12
DEPARTING	AMERIJET	03/20/2020	848	0:04	B763	MNMG	12
DEPARTING	NORTHERN AIR CARGO	03/20/2020	8039	1:08	B763	KMIA	12
ARRIVING	DELTA	03/20/2020	383	1:24	B738		12
DEPARTING	CARIBBEAN AIRLINES	03/20/2020	017	1:28	B738	KJFK	12
ARRIVING	JET BLUE	03/20/2020	2959	5:01	A320		12
ARRIVING	JET BLUE	03/20/2020	659	6:25	A321		12
DEPARTING	JET BLUE	03/20/2020	2860	6:41	A320	KJFK	12
ARRIVING	JAMAICA DEFENCE FORCE	03/20/2020	FREE	7:22	B350		12
DEPARTING	JET BLUE	03/20/2020	960	8:16	A321	KJFK	12
ARRIVING	CARIBBEAN AIRLINES	03/20/2020	016	10:20	B738		12
DEPARTING	JDF	03/20/2020	free	12:21	DA40	ZZZZ	12
ARRIVING	JET BLUE	03/20/2020	559	12:32	A321		12

DEPARTING	JDF	03/20/2020	bill	12:36	DA40	ZZZZ	12
ARRIVING	JET BLUE	03/20/2020	1675	12:40	A320		12
DEPARTING	JDF	03/20/2020	free	12:43	DA40	ZZZZ	12
ARRIVING	JDF	03/20/2020	bill	13:20	DA40		12
ARRIVING	WORLD ATLANTIC AIRLINES	03/20/2020	620	13:32	MD83		12
ARRIVING	JDF	03/20/2020	23	13:36	DA40		12
DEPARTING	INTERISLAND AIRWAYS	03/20/2020	251	13:46	E120	MBPV	12
ARRIVING	JDF	03/20/2020	bill	13:48	DA40		12
DEPARTING	JET BLUE	03/20/2020	1676	13:51	A320	KFLL	12
DEPARTING	JET BLUE	03/20/2020	560	14:16	A321	KJFK	12
DEPARTING	WORLD ATLANTIC AIRLINES	03/20/2020	620	14:49	MD83	MKJS	12
ARRIVING	CARIBBEAN AIRLINES	03/20/2020	414	14:54	B738		12
DEPARTING	JDF	03/20/2020	free	15:05	DA40	CCTS	12
DEPARTING	JAMAICA DEFENCE FORCE	03/20/2020	FREE	15:07	DA42	MKJP	12
DEPARTING	JAMAICA DEFENCE FORCE	03/20/2020	FREE	15:13	DA42	MKJP	12
ARRIVING	SPIRIT AIRLINES	03/20/2020	723	15:30	A320		12
DEPARTING	JDF	03/20/2020	free	15:51	DA40	MKJP	12
ARRIVING	JDF	03/20/2020	free	15:52	DA40		12
ARRIVING	JDF	03/20/2020	bill	15:56	HELI		12
ARRIVING	JAMAICA DEFENCE FORCE	03/20/2020	FREE	15:57	DA42		12

ARRIVING	CARIBBEAN AIRLINES	03/20/2020	414	16:14	B738		12
ARRIVING	AMERICAN AIRLINES	03/20/2020	1589	16:32	B738		12
ARRIVING	FEDERAL EXPRESS	03/20/2020	8126	16:36	ATR42		12
DEPARTING	DELTA	03/20/2020	321	16:38	B738	KATL	12
DEPARTING	JDF	03/20/2020	free	16:40	DA40	MKJP	12
DEPARTING	MILITARY	03/20/2020	free	16:50	DA42	MKJP	12
ARRIVING	JAMAICA DEFENCE FORCE	03/20/2020	FREE	16:54	DA42		12
ARRIVING	JDF	03/20/2020	free	17:01	DA40		12
DEPARTING	SPIRIT AIRLINES	03/20/2020	702	17:03	A320	KFLL	12
ARRIVING	MILITARY	03/20/2020	free	17:03	DA42		12
DEPARTING	FEDERAL EXPRESS	03/20/2020	8126	17:23	ATR42	KMIA	12
ARRIVING	IBC	03/20/2020	965	18:00	SW4		12
ARRIVING	CUBANA AIRLINES	03/20/2020	6084	18:03	YK42		12
ARRIVING	WESTJET AIRLINES	03/20/2020	2600	18:08	B737		12
DEPARTING	JAMAICA DEFENCE FORCE	03/20/2020	FREE	18:29	DA40	MKJP	12
ARRIVING	PRIVATE	03/20/2020	BILL	18:43	LJ35		12
DEPARTING	AMERICAN AIRLINES	03/20/2020	1548	18:55	B738	KMIA	12
ARRIVING	JAMAICA DEFENCE FORCE	03/20/2020	FREE	19:09	DA40		12
DEPARTING	WESTJET AIRLINES	03/20/2020	2601	19:14	B737	CYYZ	12
DEPARTING	CUBANA AIRLINES	03/20/2020	6085	19:30	YK42	MUCU	12

ARRIVING	PRIVATE	03/20/2020	BILL	20:12	E145		12
ARRIVING	CARIBBEAN AIRLINES	03/20/2020	415	20:15	B738		12
DEPARTING	JDF	03/20/2020	free	20:22	HELI	UPC	12
DEPARTING	PRIVATE	03/20/2020	BILL	20:43	LJ35	KFXE	12
DEPARTING	PRIVATE	03/20/2020	BILL	21:07	E145	TFFF	12
ARRIVING	JET BLUE	03/20/2020	875	21:10	A320		12
ARRIVING	AIR CANADA	03/20/2020	1802	21:22	A321		12
ARRIVING	FEDERAL EXPRESS	03/20/2020	7126	21:30	ATR42		12
DEPARTING	IBC	03/20/2020	964	22:00	SW4	KMIA	12
ARRIVING	BRITISH AIRWAYS	03/20/2020	2263	22:07	B772		30
DEPARTING	FEDERAL EXPRESS	03/20/2020	7126	22:16	ATR42	KMIA	30
DEPARTING	JET BLUE	03/20/2020	876	22:26	A320	KFLL	12
DEPARTING	CARIBBEAN AIRLINES	03/20/2020	415	22:29	B738	TBPB	30
DEPARTING	AIR CANADA	03/20/2020	1803	22:45	A321	CYYZ	30
ARRIVING	CAYMAN AIRWAYS	03/20/2020	606	23:42	B738		12
DEPARTING	BRITISH AIRWAYS	03/21/2020	25K	0:45	B772	EGKK	12
ARRIVING	DELTA AIRLINES	03/21/2020	383	0:47	B738		12
DEPARTING	CAYMAN AIRWAYS	03/21/2020	607	1:05	B738	MWCR	12
DEPARTING	CARIBBEAN AIRLINES	03/21/2020	017	1:40	B738	KJFK	12
ARRIVING	PRIVATE	03/21/2020	BILL	3:33	GLEX		12
DEPARTING	JAMAICA DEFENCE FORCE	03/21/2020	FREE	4:20	B350	S/W	12

ARRIVING	JET BLUE	03/21/2020	2959	5:03	A320		12
ARRIVING	JET BLUE	03/21/2020	659	6:32	A321		12
DEPARTING	JET BLUE	03/21/2020	2860	6:35	A320	KJFK	12
ARRIVING	JAMAICA DEFENCE FORCE	03/21/2020	FREE	6:51	B350		12
DEPARTING	JET BLUE	03/21/2020	960	8:14	A321	KJFK	12
ARRIVING	CARIBBEAN AIRLINES	03/21/2020	016	10:42	B738		12
ARRIVING	JET BLUE	03/21/2020	559	12:23	A321		12
ARRIVING	JET BLUE	03/21/2020	1675	12:27	A320		12
DEPARTING	CARIBBEAN AIRLINES	03/21/2020	7033	13:09	B738	KFLL	12
ARRIVING	WORLD ATLANTIC AIRLINES	03/21/2020	600	13:32	MD83		12
DEPARTING	JET BLUE	03/21/2020	1676	13:52	A320	KFLL	12
DEPARTING	JAMAICA DEFENCE FORCE	03/21/2020	FREE	13:54	DA42	S/W	12
DEPARTING	JET BLUE	03/21/2020	560	14:19	A321	KJFK	12
DEPARTING	CARIBBEAN AIRLINES	03/21/2020	009	14:30	B738	MWCR	12
DEPARTING	WORLD ATLANTIC AIRLINES	03/21/2020	601	14:48	MD83	MWCR	12
ARRIVING	MILITARY	03/21/2020	free	15:07	DA42		12
ARRIVING	PRIVATE	03/21/2020	BILL	15:09	PRM1		12
DEPARTING	JAMAICA DEFENCE FORCE	03/21/2020	FREE	15:22	DA42	S/W	12
ARRIVING	JAMAICA DEFENCE FORCE	03/21/2020	FREE	15:28	DA42		12
ARRIVING	CARIBBEAN AIRLINES	03/21/2020	7010	15:50	B738		12

ARRIVING	SPIRIT AIRLINES	03/21/2020	723	15:53	A320		12
DEPARTING	PRIVATE	03/21/2020	BILL	15:55	PRM1	MYNN	12
DEPARTING	JAMAICA DEFENCE FORCE	03/21/2020	FREE	15:58	DA42	S/W	12
DEPARTING	DELTA AIRLINES	03/21/2020	321	16:30	B738	KATL	12
ARRIVING	AMERICAN AIRLINES	03/21/2020	1589	16:36	B738		12
ARRIVING	JAMAICA DEFENCE FORCE	03/21/2020	FREE	16:39	DA42		12
DEPARTING	JAMAICA DEFENCE FORCE	03/21/2020	FREE	16:39	DA42	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/21/2020	FREE	16:43	DA42		12
DEPARTING	JAMAICA DEFENCE FORCE	03/21/2020	FREE	16:44	DA42	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/21/2020	FREE	16:54	DA42		12
DEPARTING	JAMAICA DEFENCE FORCE	03/21/2020	FREE	16:54	DA42	CCTS	12
ARRIVING	PRIVATE	03/21/2020	BILL	16:57	E145		12
ARRIVING	JAMAICA DEFENCE FORCE	03/21/2020	FREE	17:00	DA42		12
DEPARTING	JAMAICA DEFENCE FORCE	03/21/2020	FREE	17:00	DA42	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/21/2020	FREE	17:07	DA42		12
DEPARTING	JAMAICA DEFENCE FORCE	03/21/2020	FREE	17:07	DA42	CCTS	12
DEPARTING	SPIRIT AIRLINES	03/21/2020	702	17:11	A320	KFLL	12
ARRIVING	JAMAICA DEFENCE FORCE	03/21/2020	FREE	17:21	DA42		12
ARRIVING	WESTJET AIRLINES	03/21/2020	2600	17:29	B737		12
ARRIVING	CARIBBEAN AIRLINES	03/21/2020	008	17:34	B737		12

ARRIVING	CARIBBEAN AIRLINES	03/21/2020	456	17:47	B738		12
DEPARTING	AMERICAN AIRLINES	03/21/2020	1545	17:57	B738	KMIA	12
ARRIVING	CARIBBEAN AIRLINES	03/21/2020	3036	18:02	B738		12
DEPARTING	PRIVATE	03/21/2020	BILL	18:05	E145	MGGT	12
ARRIVING	CUBANA AIRLINES	03/21/2020	9256	18:29	IL96		12
DEPARTING	WESTJET AIRLINES	03/21/2020	2601	19:04	B737	CYYZ	12
DEPARTING	CARIBBEAN AIRLINES	03/21/2020	7015	19:18	B738	TTPP	12
DEPARTING	CARIBBEAN AIRLINES	03/21/2020	7017	19:28	B738	TTPP	12
DEPARTING	CARIBBEAN AIRLINES	03/21/2020	457	19:36	B738	TNCM	12
ARRIVING	PRIVATE	03/21/2020	BILL	19:43	GLF4		12
ARRIVING	PRIVATE	03/21/2020	BILL	19:47	C56X		12
DEPARTING	CARIBBEAN AIRLINES	03/21/2020	7019	19:50	B738	TTPP	12
DEPARTING	CUBANA AIRLINES	03/21/2020	9257	20:35	IL96	MUHA	12
DEPARTING	PRIVATE	03/21/2020	BILL	20:37	GLF4	KTEB	12
ARRIVING	BAHAMAS AIR	03/21/2020	905	20:42	B737		12
DEPARTING	PRIVATE	03/21/2020	BILL	20:51	C56X	MYNN	12
ARRIVING	PRIVATE	03/21/2020	BILL	20:52	PRM1		12
ARRIVING	AIR TURKS AND CAICUS	03/21/2020	250	20:59	E145		12
ARRIVING	JET BLUE	03/21/2020	875	21:01	A320		12
DEPARTING	PRIVATE	03/21/2020	BILL	21:12	PRM1	MKTP	12
DEPARTING	AIR TURKS AND CAICUS	03/21/2020	618	22:02	E145	MUHA	12

ARRIVING	PRIVATE	03/21/2020	BILL	22:07	B407		12
DEPARTING	PRIVATE	03/21/2020	BILL	22:28	GLEX	KLAX	12
DEPARTING	JET BLUE	03/21/2020	876	22:36	A320	KFLL	12
DEPARTING	PRIVATE	03/21/2020	BILL	22:40	B407	MKTP	12
DEPARTING	BAHAMAS AIR	03/21/2020	906	22:54	B737	MYNN	12
ARRIVING	DELTA AIRLINES	03/22/2020	383	1:14	B738		12
ARRIVING	AIR TURKS AND CAICUS	03/22/2020	617	1:21	E145		12
DEPARTING	JAMAICA DEFENCE FORCE	03/22/2020	FREE	2:17	B350	MKJP	30
ARRIVING	CAYMAN AIRWAYS	03/22/2020	3606	3:13	B738		12
ARRIVING	PRIVATE	03/22/2020	BILL	3:27	LJ45		12
ARRIVING	PRIVATE	03/22/2020	BILL	3:40	GALX		12
DEPARTING	CAYMAN AIRWAYS	03/22/2020	3607	4:10	B738	MWCR	30
ARRIVING	JAMAICA DEFENCE FORCE	03/22/2020	FREE	5:22	B350		12
ARRIVING	JAMAICA DEFENCE FORCE	03/22/2020	FREE	7:15	B350		12
ARRIVING	JET BLUE	03/22/2020	6125	13:11	A321		12
DEPARTING	JET BLUE	03/22/2020	560	14:10	A321	KJFK	30
ARRIVING	SPIRIT AIRLINES	03/22/2020	723	15:43	A320		12
DEPARTING	AIR TURKS AND CAICUS	03/22/2020	251	15:46	E145	MBPV	12
ARRIVING	PRIVATE	03/22/2020	BILL	15:47	B407		12
DEPARTING	PRIVATE	03/22/2020	BILL	15:51	B407	ZZZZ	12

DEPARTING	PRIVATE	03/22/2020	BILL	15:56	LJ45	MKTP	12
DEPARTING	DELTA AIRLINES	03/22/2020	321	16:49	B738	KATL	12
ARRIVING	JDF	03/22/2020	free	16:58	DA40		12
DEPARTING	JDF	03/22/2020	FREE	16:58	DA40	CCTS	12
ARRIVING	JDF	03/22/2020	free	17:04	DA40		12
DEPARTING	JDF	03/22/2020	free	17:05	DA40	CCTS	12
DEPARTING	SPIRIT AIRLINES	03/22/2020	702	17:07	A320	KFLL	30
ARRIVING	JDF	03/22/2020	free	17:11	DA40		12
DEPARTING	JDF	03/22/2020	free	17:12	DA40	CCTS	12
ARRIVING	JDF	03/22/2020	free	17:26	DA40		12
ARRIVING	WESTJET AIRLINES	03/22/2020	2600	17:47	B737		12
ARRIVING	AMERICAN AIRLINES	03/22/2020	9686	18:04	B737-800		12
DEPARTING	AMERICAN AIRLINES	03/22/2020	1548	19:02	B737-800	KMIA	12
ARRIVING	JET BLUE	03/22/2020	6175	20:54	A320		12
ARRIVING	BRITISH AIRWAYS	03/22/2020	2263	21:52	B772		12
DEPARTING	JET BLUE	03/22/2020	876	22:19	A320	KFLL	12
DEPARTING	BRITISH AIRWAYS	03/23/2020	25k	0:52	B772	EGKK	12
DEPARTING	PRIVATE	03/23/2020	BILL	0:56	GALX	KHOU	12
ARRIVING	JET BLUE	03/23/2020	6125	12:34	A321		12
ARRIVING	JET BLUE	03/23/2020	6175	12:37	A320		12
ARRIVING	NORTHERN AIR CARGO	03/23/2020	8040	13:48	B763		12

DEPARTING	JET BLUE	03/23/2020	1676	14:00	A320	KFLL	30
DEPARTING	JAMAICA DEFENCE FORCE	03/23/2020	FREE	14:10	DA42	S/W	12
DEPARTING	JET BLUE	03/23/2020	560	14:19	A321	KJFK	12
ARRIVING	FEDERAL EXPRESS	03/23/2020	8126	14:52	ATR42		12
DEPARTING	JAMAICA DEFENCE FORCE	03/23/2020	FREE	14:57	DA42	CCTS	12
DEPARTING	JAMAICA DEFENCE FORCE	03/23/2020	FREE	14:58	DA40	S/W	12
DEPARTING	JAMAICA DEFENCE FORCE	03/23/2020	FREE	15:00	DA42	S/W	12
DEPARTING	JAMAICA DEFENCE FORCE	03/23/2020	FREE	15:22	DA42	S/W	12
ARRIVING	JAMAICA DEFENCE FORCE	03/23/2020	FREE	15:28	DA42		12
ARRIVING	IBC	03/23/2020	965	15:29	SW4		12
DEPARTING	NORTHERN AIR CARGO	03/23/2020	8040	15:34	B763	MKJS	12
ARRIVING	SPIRIT AIRLINES	03/23/2020	723	15:35	A320		12
DEPARTING	FEDERAL EXPRESS	03/23/2020	8126	16:00	ATR42	MKJS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/23/2020	FREE	16:11	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/23/2020	FREE	16:12	DA42	CCTS	12
DEPARTING	JAMAICA DEFENCE FORCE	03/23/2020	FREE	16:22	DA42	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/23/2020	FREE	16:30	DA42		12
DEPARTING	IBC	03/23/2020	510	16:36	SW4	MKJS	12
DEPARTING	SPIRIT AIRLINES	03/23/2020	702	16:59	A320	KFLL	12
ARRIVING	JAMAICA DEFENCE FORCE	03/23/2020	FREE	17:03	DA42		12

ARRIVING	WESTJET AIRLINES	03/23/2020	2600	18:14	B737		12
ARRIVING	MERLIN EXPRESS	03/23/2020	730	18:17	SF340		12
DEPARTING	JAMAICA DEFENCE FORCE	03/23/2020	FREE	18:49	DA42	S/W	12
ARRIVING	AMERIJET	03/23/2020	814	18:51	B763		12
ARRIVING	AMERICAN AIRLINES	03/23/2020	9690	18:55	B738		12
DEPARTING	WESTJET AIRLINES	03/23/2020	2601	19:04	B737	CYYZ	12
ARRIVING	JAMAICA DEFENCE FORCE	03/23/2020	FREE	19:32	DA42		12
DEPARTING	JAMAICA DEFENCE FORCE	03/23/2020	FREE	19:33	DA42	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/23/2020	FREE	19:38	DA42		12
DEPARTING	JAMAICA DEFENCE FORCE	03/23/2020	FREE	19:38	DA42	CCTS	12
DEPARTING	AMERICAN AIRLINES	03/23/2020	1548	19:46	B738	KMIA	12
ARRIVING	JAMAICA DEFENCE FORCE	03/23/2020	FREE	19:48	DA42		12
DEPARTING	JAMAICA DEFENCE FORCE	03/23/2020	FREE	19:48	DA42	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/23/2020	FREE	19:52	DA42		12
DEPARTING	JAMAICA DEFENCE FORCE	03/23/2020	FREE	19:52	DA42	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/23/2020	FREE	19:56	DA42		12
DEPARTING	AMERIJET	03/23/2020	814	20:04	B763	KMIA	12
ARRIVING	CUBANA AIRLINES	03/23/2020	6084	20:46	YK42		12
ARRIVING	AIR CANADA	03/23/2020	7105	21:20	A321		12
ARRIVING	FEDERAL EXPRESS	03/23/2020	7126	21:31	ATR42		12

DEPARTING	MERLIN EXPRESS	03/23/2020	964	21:59	SF340	KMIA	12
DEPARTING	CUBANA AIRLINES	03/23/2020	6085	22:16	YK42	MUCU	12
DEPARTING	FEDERAL EXPRESS	03/23/2020	7126	22:25	ATR42	KMIA	12
DEPARTING	AIR CANADA	03/23/2020	1803	22:45	A321	CYYZ	12
ARRIVING	BRITISH AIRWAYS	03/23/2020	2263	22:53	B772		12
DEPARTING	BRITISH AIRWAYS	03/24/2020	25k	1:07	B772	EGKK	12
ARRIVING	PRIVATE	03/24/2020	BILL	1:46	C560		12
DEPARTING	PRIVATE	03/24/2020	BILL	2:14	C560	MYNN	12
ARRIVING	JDF	03/24/2020	FREE	11:22	B350		12
DEPARTING	JDF	03/24/2020	free	11:22	B350	ZZZZ	12
ARRIVING	JET BLUE	03/24/2020	6125	12:33	A321		12
ARRIVING	JET BLUE	03/24/2020	6157	13:23	A320		12
DEPARTING	MILITARY	03/24/2020	free	14:14	DA42	CCTS	12
DEPARTING	JAMAICA DEFENCE FORCE	03/24/2020	FREE	14:16	DA40	ZZZZ	12
ARRIVING	MILITARY	03/24/2020	FREE	14:19	DA42		12
DEPARTING	MILITARY	03/24/2020	free	14:19	DA42	CCTS	12
ARRIVING	MILITARY	03/24/2020	FREE	14:24	DA42		12
DEPARTING	MILITARY	03/24/2020	free	14:25	DA42	CCTS	12
ARRIVING	MILITARY	03/24/2020	FREE	14:30	DA42		12
DEPARTING	MILITARY	03/24/2020	free	14:31	DA42	CCTS	12
DEPARTING	JET BLUE	03/24/2020	1676	14:33	A320	KFLL	12

ARRIVING	JDF	03/24/2020	FREE	14:36	B350		12
DEPARTING	JET BLUE	03/24/2020	560	14:38	A321	KJFK	12
ARRIVING	MILITARY	03/24/2020	FREE	14:41	DA42		12
DEPARTING	MILITARY	03/24/2020	free	14:41	DA42	CCTS	12
ARRIVING	MILITARY	03/24/2020	free	14:45	DA42		12
DEPARTING	MILITARY	03/24/2020	free	14:45	DA42	CCTS	12
ARRIVING	MILITARY	03/24/2020	free	14:51	DA42		12
DEPARTING	MILITARY	03/24/2020	free	14:51	DA42	CCTS	12
ARRIVING	MILITARY	03/24/2020	free	14:56	DA42		12
DEPARTING	MILITARY	03/24/2020	free	14:56	DA42	ZZZZ	12
ARRIVING	JAMAICA DEFENCE FORCE	03/24/2020	FREE	15:00	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/24/2020	FREE	15:01	DA40	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/24/2020	FREE	15:07	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/24/2020	FREE	15:07	DA40	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/24/2020	FREE	15:15	DA40		12
DEPARTING	JAMAICA DEFENCE FORCE	03/24/2020	FREE	15:16	DA40	CCTS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/24/2020	FREE	15:22	DA40		12
DEPARTING	MILITARY	03/24/2020	free	15:31	DA42	CCTS	12
ARRIVING	MILITARY	03/24/2020	FREE	15:31	DA42		12
ARRIVING	MILITARY	03/24/2020	free	15:36	DA42		12

DEPARTING	MILITARY	03/24/2020	free	15:37	DA42	CCTS	12
ARRIVING	MILITARY	03/24/2020	free	15:43	DA42		12
DEPARTING	MILITARY	03/24/2020	free	16:00	DA42	CCTS	12
ARRIVING	MILITARY	03/24/2020	FREE	16:05	DA42		12
DEPARTING	MILITARY	03/24/2020	free	16:05	DA42	CCTS	12
ARRIVING	MILITARY	03/24/2020	FREE	16:11	DA42		12
DEPARTING	MILITARY	03/24/2020	free	16:11	DA42	CCTS	12
ARRIVING	MILITARY	03/24/2020	FREE	16:17	DA42		12
DEPARTING	MILITARY	03/24/2020	free	16:18	DA42	CCTS	12
ARRIVING	FEDERAL EXPRESS	03/24/2020	8126	16:26	ATR42		12
ARRIVING	PRIVATE	03/24/2020	BILL	17:00	PA34		12
DEPARTING	FEDERAL EXPRESS	03/24/2020	8126	17:02	ATR42	MKJS	12
ARRIVING	DELTA AIRLINES	03/24/2020	8784	17:29	B739		12
ARRIVING	AMERICAN AIRLINES	03/24/2020	9685	17:37	B738		12
ARRIVING	IBC	03/24/2020	965	17:53	SW4		12
DEPARTING	JAMAICA DEFENCE FORCE	03/24/2020	FREE	18:06	DA42	S/W	12
DEPARTING	PRIVATE	03/24/2020	BILL	18:23	PA34	MTPP	12
DEPARTING	AMERICAN AIRLINES	03/24/2020	1548	18:55	B738	KMIA	12
DEPARTING	IBC	03/24/2020	510	19:29	SW4	MKJS	12
ARRIVING	JAMAICA DEFENCE FORCE	03/24/2020	FREE	19:36	HELI		12

ARRIVING	JAMAICA DEFENCE FORCE	03/24/2020	FREE	19:37	DA42		12
DEPARTING	JAMAICA DEFENCE FORCE	03/24/2020	FREE	19:42	HELI	UPC	12
ARRIVING	JAMAICA DEFENCE FORCE	03/24/2020	FREE	19:52	HELI		12
DEPARTING	JAMAICA DEFENCE FORCE	03/24/2020	FREE	19:54	HELI	ZZZZ	12
DEPARTING	DELTA AIRLINES	03/24/2020	8785	19:58	B739	KATL	12
ARRIVING	JAMAICA DEFENCE FORCE	03/24/2020	FREE	20:50	HELI		12
DEPARTING	JAMAICA DEFENCE FORCE	03/24/2020	FREE	21:00	HELI	UPC	12
ARRIVING	AIR CANADA	03/24/2020	7105	21:15	A321		12
ARRIVING	IBC	03/24/2020	504	21:29	SW4		12
ARRIVING	FEDERAL EXPRESS	03/24/2020	7126	21:33	ATR42		12
DEPARTING	JAMAICA DEFENCE FORCE	03/24/2020	FREE	22:02	B350	ZZZZ	12
DEPARTING	FEDERAL EXPRESS	03/24/2020	7126	22:08	ATR42	KMIA	12
DEPARTING	IBC	03/24/2020	964	22:15	SW4	KMIA	12
DEPARTING	AIR CANADA	03/24/2020	1803	22:40	A321	CYYZ	12
ARRIVING	JAMAICA DEFENCE FORCE	03/24/2020	FREE	23:30	B350		12

6.3 Departure and Arrival Core Tracks Modeled

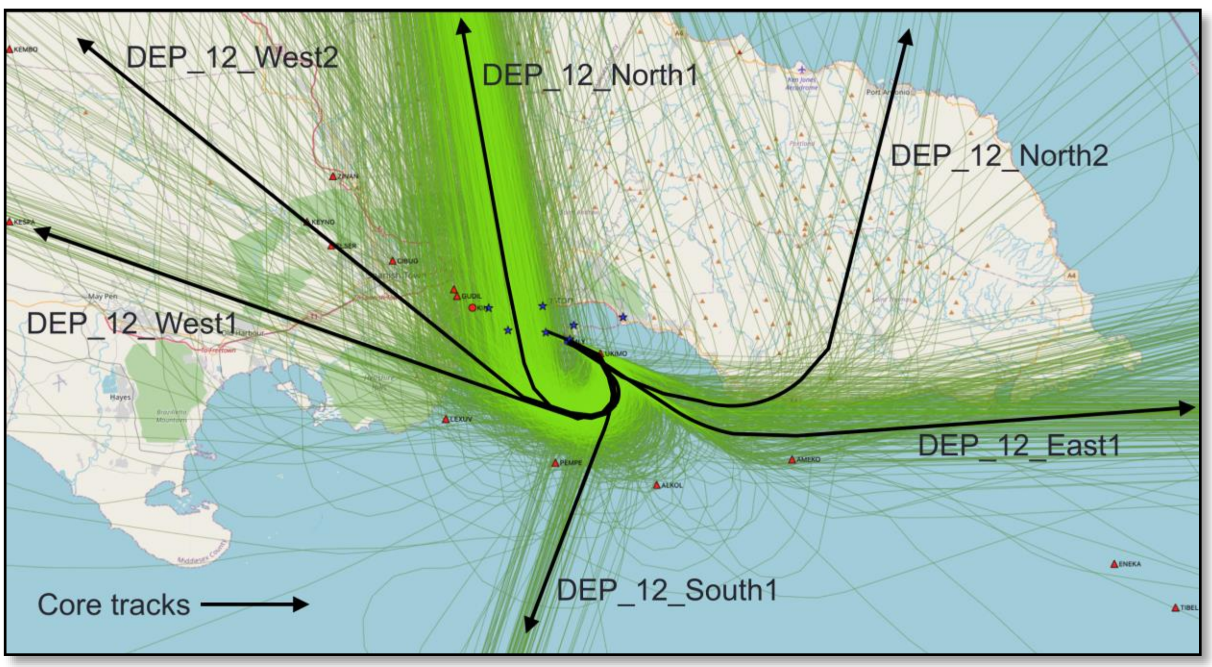

Figure 6.3Runway 12 Departure Tracks and Core Departure Tracks Modeled in AEDT 3c. Source of Map: OpenStreet. Source of Flight Track Data: FlightAware.

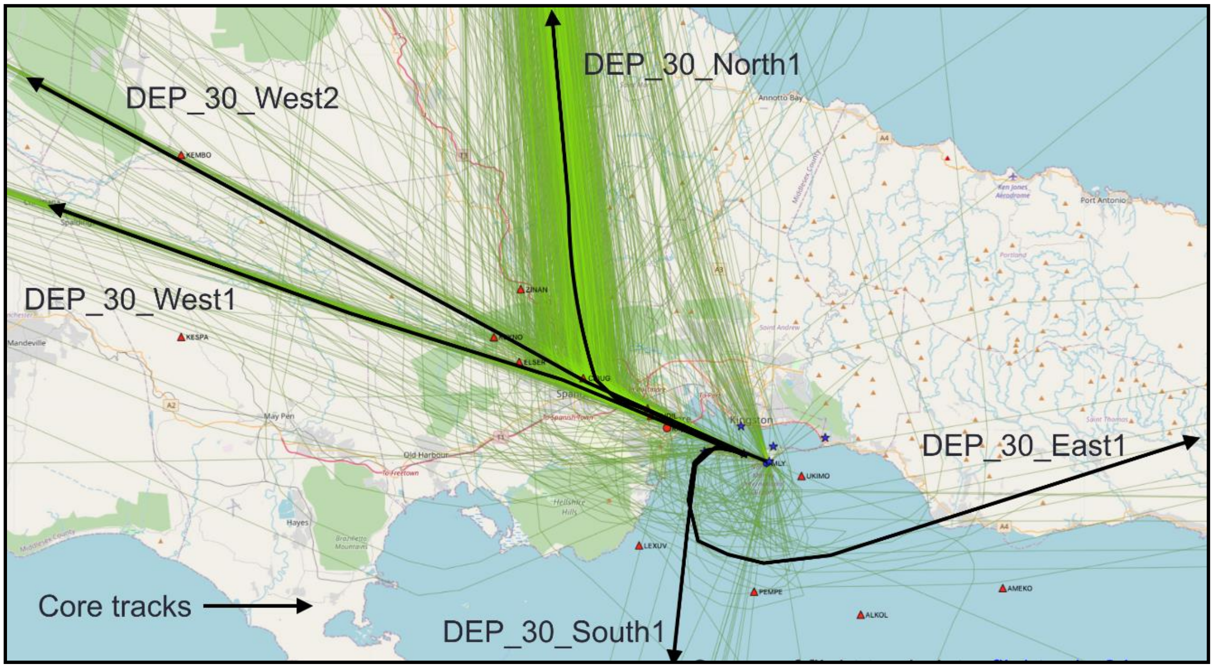

Figure 6.4Runway 30 Departure Tracks and Core Departure Tracks Modeled in AEDT 3c. Source of Map: OpenStreet. Source of Flight Track Data: FlightAware.

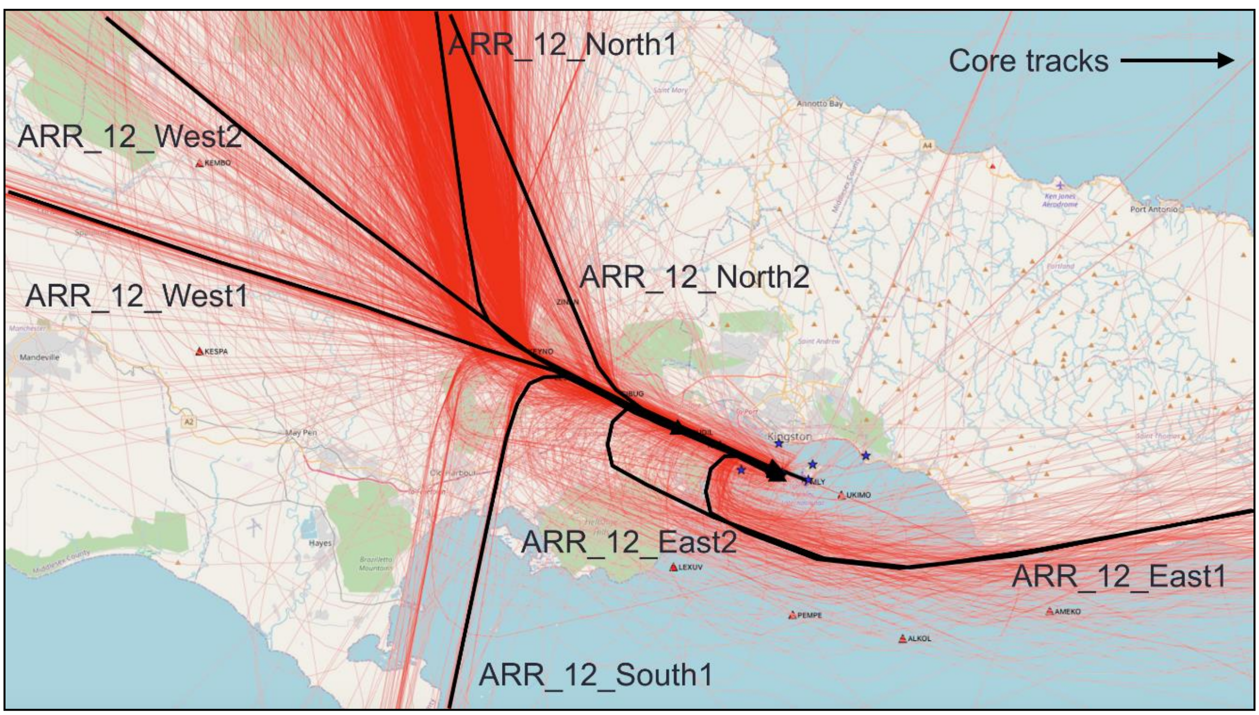

Figure 6.5Runway 12 Arrival Tracks and Core Arrival Tracks Modeled in AEDT 3c. Source of Map: OpenStreet. Source of Flight Track Data: FlightAware.

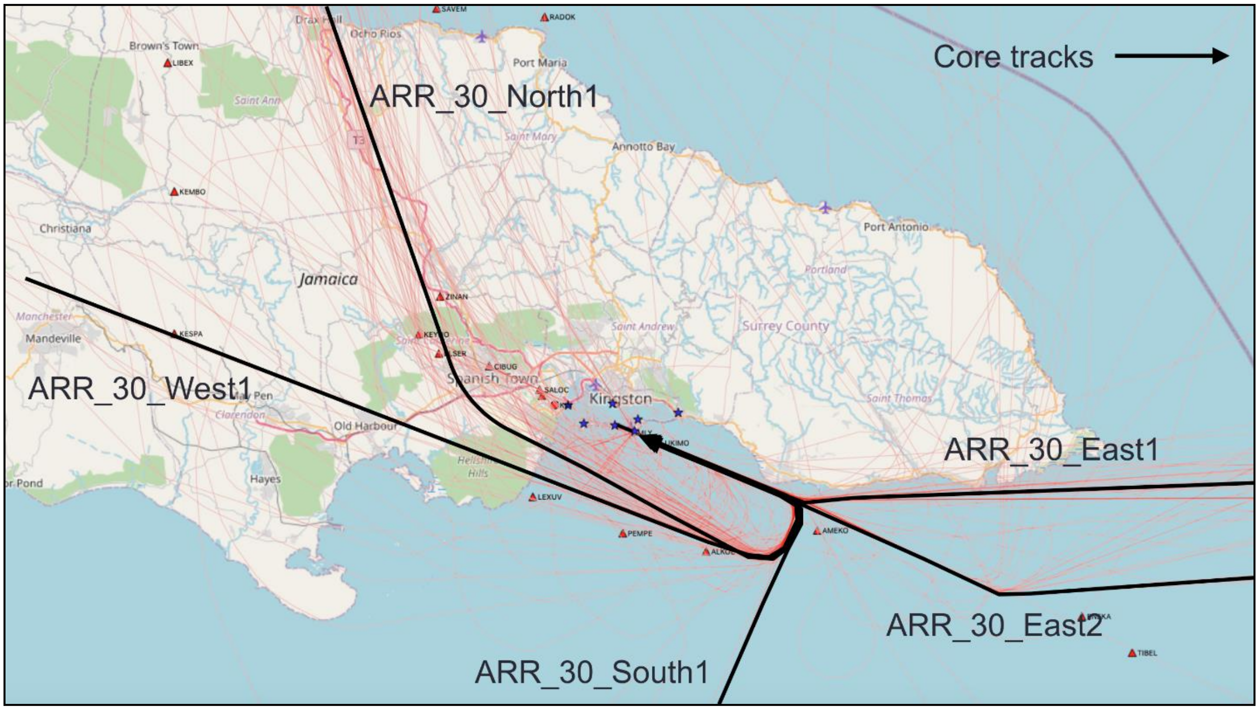

Figure 6.6Runway 30 Arrival Tracks and Core Arrival Tracks Modeled in AEDT 3c. Source of Map: OpenStreet. Source of Flight Track Data: FlightAware.

6.4 NMIA Master Plan Projections

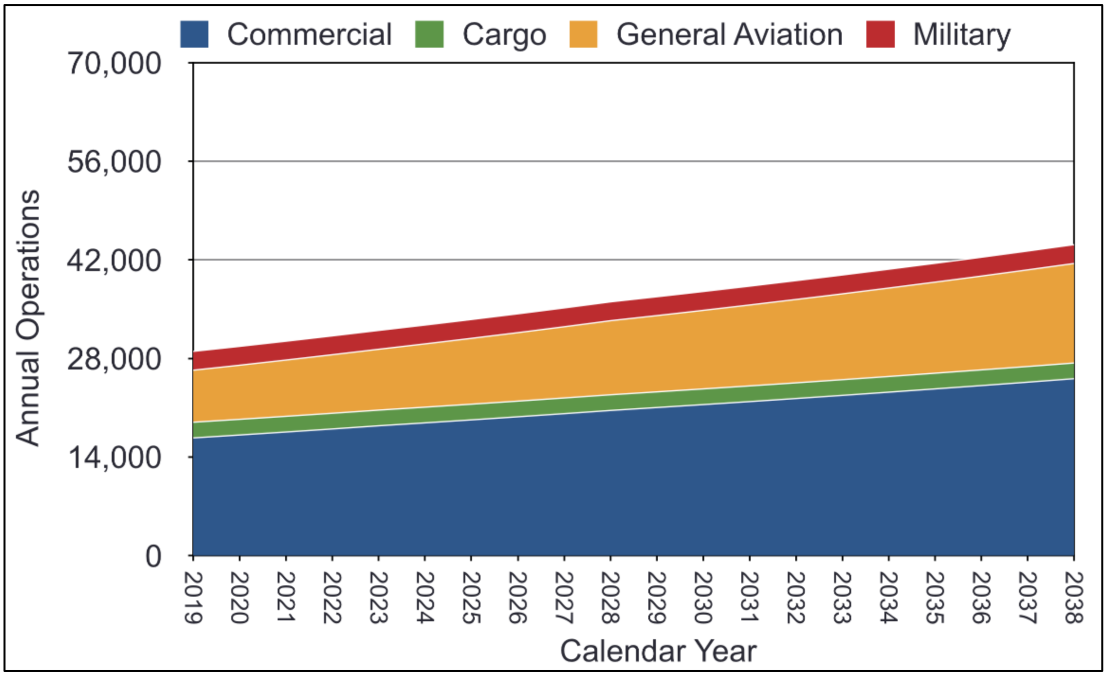

Figure 6.7Norman Manley International Airport Aviation Forecast: Base High Scenario. Source of Data: NMIA 2013 Master Plan.

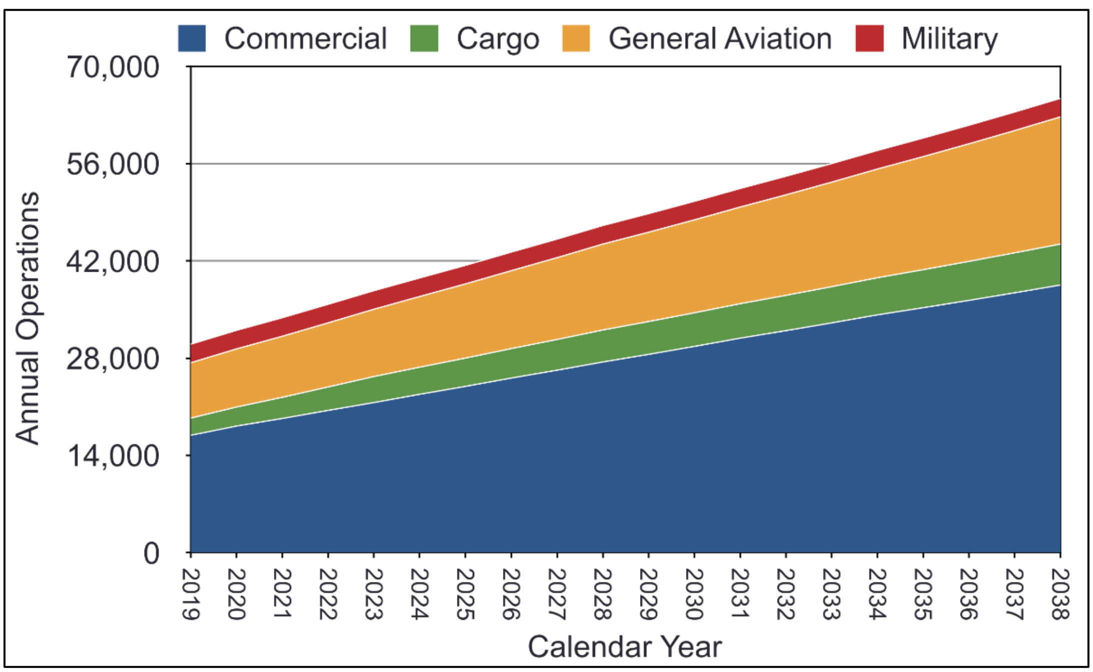

Figure 6.8Norman Manley International Airport Aviation Forecast: Vision 2030 Scenario. Source of Data: NMIA 2013 Master Plan.

6.5 Summary of Noise Meter Events Duration and Number of Events Daily

Table 6.2 Summary of Noise Meter Events at Runway 12.

Date	Number of Noise Events	Average Duration of Noise Events (s)	LAeq (dBA)	L_{DN} (dBA)
'12-Mar-2020'	73	20.44	76.74	66.97
'13-Mar-2020'	67	23.27	76.85	70.31
'14-Mar-2020'	44	20.91	77.47	64.57
'15-Mar-2020'	36	18.69	77.83	62.81
'16-Mar-2020'	66	19.00	75.98	66.33
'17-Mar-2020'	40	19.28	75.95	62.45
'18-Mar-2020'	51	19.37	75.90	63.60
'19-Mar-2020'	46	19.07	76.72	64.01
'20-Mar-2020'	48	18.90	76.23	63.93
'21-Mar-2020'	50	18.88	76.27	61.72
'22-Mar-2020'	16	18.94	77.94	57.59
'23-Mar-2020'	37	18.97	75.80	59.84
'24-Mar-2020'	27	18.04	74.60	58.17

Table 6.3 Summary of Noise Meter Events at Runway 30 Threshold.

Date	Number of Noise Events	Average Duration of Noise Events (s)	LAeq (dBA)	L_{DN} (dBA)
'12-Mar-2020'	45	20.82	90.15	63.14
'13-Mar-2020'	66	23.02	88.37	67.08
'14-Mar-2020'	31	20.77	91.05	62.96
'15-Mar-2020'	29	20.24	90.29	61.80
'16-Mar-2020'	47	19.62	88.92	63.59
'17-Mar-2020'	39	19.03	90.22	63.75
'18-Mar-2020'	39	19.69	88.67	63.39
'19-Mar-2020'	41	19.68	90.24	64.48
'20-Mar-2020'	45	20.18	87.54	63.75
'21-Mar-2020'	32	19.84	89.98	63.62
'22-Mar-2020'	8	18.88	90.55	61.86
'23-Mar-2020'	15	18.40	92.26	61.46
'24-Mar-2020'	6	19.00	95.00	60.55

Table 6.4 Summary of Noise Meter Events at Morgans Harbour.

Date	Number of Noise Events	Average Duration of Noise Events (s)	LAeq (dBA)	L_{DN} (dBA)
'14-Mar-2020'	14	24.57	62.17	54.4
'16-Mar-2020'	44	26.50	64.35	56.43
'17-Mar-2020'	12	18.75	59.42	55.21
'18-Mar-2020'	11	24.00	62.39	54.96
'19-Mar-2020'	16	22.63	63.27	55.73
'20-Mar-2020'	20	19.80	62.50	53.84
'21-Mar-2020'	15	16.87	61.42	53.97
'22-Mar-2020'	39	15.36	63.27	55.41

Table 6.5 Summary of Noise Meter Events at Newport East.

Date	Number of Noise Events	Average Duration of Noise Events (s)	LAeq (dBA)	L_{DN} (dBA)
'12-Mar-2020'	122	26.93	63.12	60.82
'13-Mar-2020'	84	19.90	62.45	59.93
'14-Mar-2020'	64	29.47	64.52	57.37
'15-Mar-2020'	115	24.62	61.69	59.02
'16-Mar-2020'	141	29.87	63.84	60.55
'17-Mar-2020'	119	47.59	63.49	60.69
'18-Mar-2020'	66	18.30	62.53	59.85
'19-Mar-2020'	166	16.29	63.80	57.66
'20-Mar-2020'	19	18.11	61.97	57.81
'21-Mar-2020'	44	18.41	62.93	56.68
'22-Mar-2020'	29	22.24	60.40	56.1
'23-Mar-2020'	91	17.04	61.91	59.45
'24-Mar-2020'	64	44.75	61.86	58.71
'25-Mar-2020'	15	21.60	64.31	59.47

Table 6.6 Summary of Noise Meter Events at Port Henderson.

Date	Number of Noise Events	Average Duration of Noise Events (s)	LAeq (dBA)	L_{DN} (dBA)
'12-Mar-2020'	129	19.29	63.23	60.24
'13-Mar-2020'	114	20.82	64.23	60.10
'14-Mar-2020'	104	19.68	63.99	60.29
'15-Mar-2020'	99	19.92	62.44	59.89
'16-Mar-2020'	117	20.03	63.01	59.70
'20-Mar-2020'	97	20.70	64.30	59.94

Table 6.7 Summary of Noise Meter Events at Caribbean Maritime University (CMU).

Date	Number of Noise Events	Average Duration of Noise Events (s)	LAeq (dBA)	L_{DN} (dBA)
'12-Mar-2020'	396	163.88	45.33	55.43
'13-Mar-2020'	723	60.06	46.33	53.33
'14-Mar-2020'	643	28.75	45.26	54.58

'15-Mar-2020'	565	30.43	45.76	48.89
'16-Mar-2020'	359	56.50	46.07	51.21
'17-Mar-2020'	38	26.16	45.84	48.75
'17-Mar-2020'	386	56.39	43.52	52.80
'18-Mar-2020'	537	43.63	44.76	51.60
'19-Mar-2020'	887	48.28	44.65	49.46
'20-Mar-2020'	889	40.91	45.12	48.48
'21-Mar-2020'	897	44.16	45.80	52.08
'22-Mar-2020'	1364	29.34	44.59	49.81
'23-Mar-2020'	746	74.58	44.70	49.51
'24-Mar-2020'	785	45.23	44.44	48.95
'25-Mar-2020'	520	32.85	45.10	46.11

Table 6.8 Summary of Noise Meter Events at Martello Harbour View.

Date	Number of Noise Events	Average Duration of Noise Events (s)	LAeq (dBA)	L_{DN} (dBA)
'12-Mar-2020'	1073	17.83	54.74	55.76
'13-Mar-2020'	882	17.08	54.32	54.86
'14-Mar-2020'	768	17.21	54.66	54.02
'15-Mar-2020'	488	16.16	53.18	52.93
'16-Mar-2020'	792	16.16	53.52	53.97
'17-Mar-2020'	754	16.29	53.95	54.82
'18-Mar-2020'	624	16.19	53.85	52.98
'19-Mar-2020'	465	33.58	53.69	57.76

'20-Mar-2020'	625	19.10	53.95	54.53
'21-Mar-2020'	544	16.19	53.59	52.91
'22-Mar-2020'	512	16.87	53.13	53.36
'23-Mar-2020'	713	17.64	53.89	54.17
'24-Mar-2020'	499	16.20	54.14	52.79

6.6 Supporting Plots to Verify Engine Runups and Duration of Noise Events Near Runway Thresholds

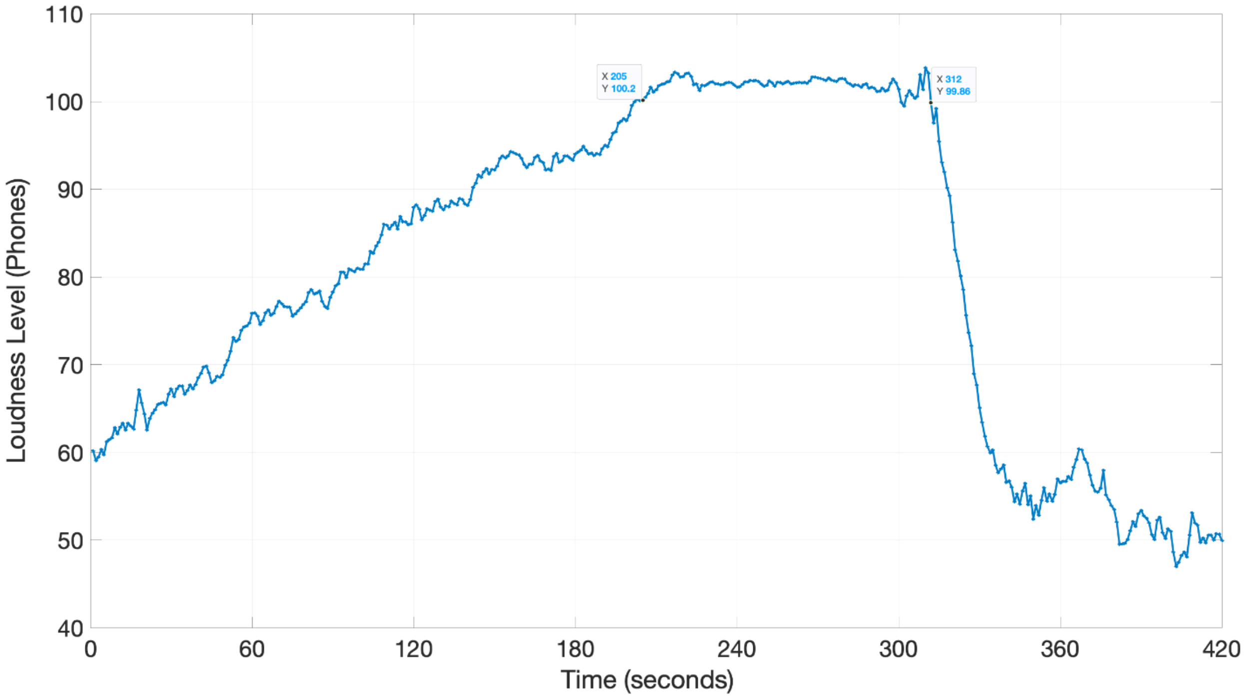

Figure 6.9Loudness Level for an Aircraft Engine Run Operation.

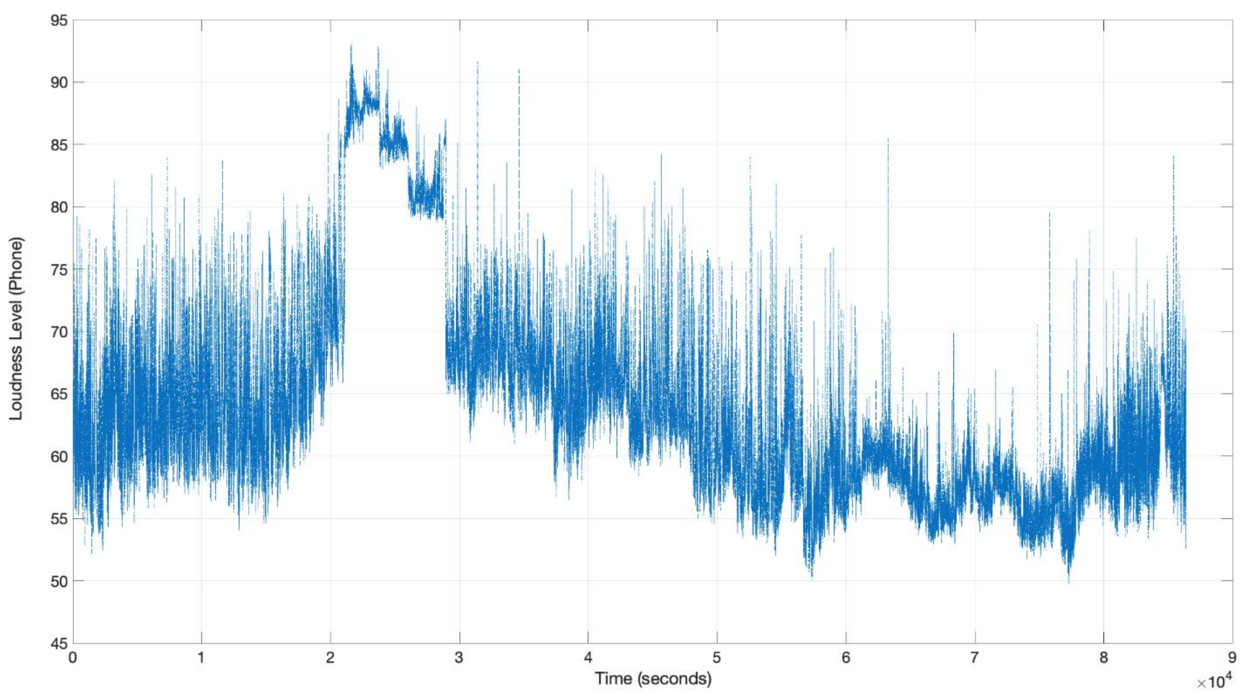

Figure 6.10 Loudness Level at Martello Harbour View.

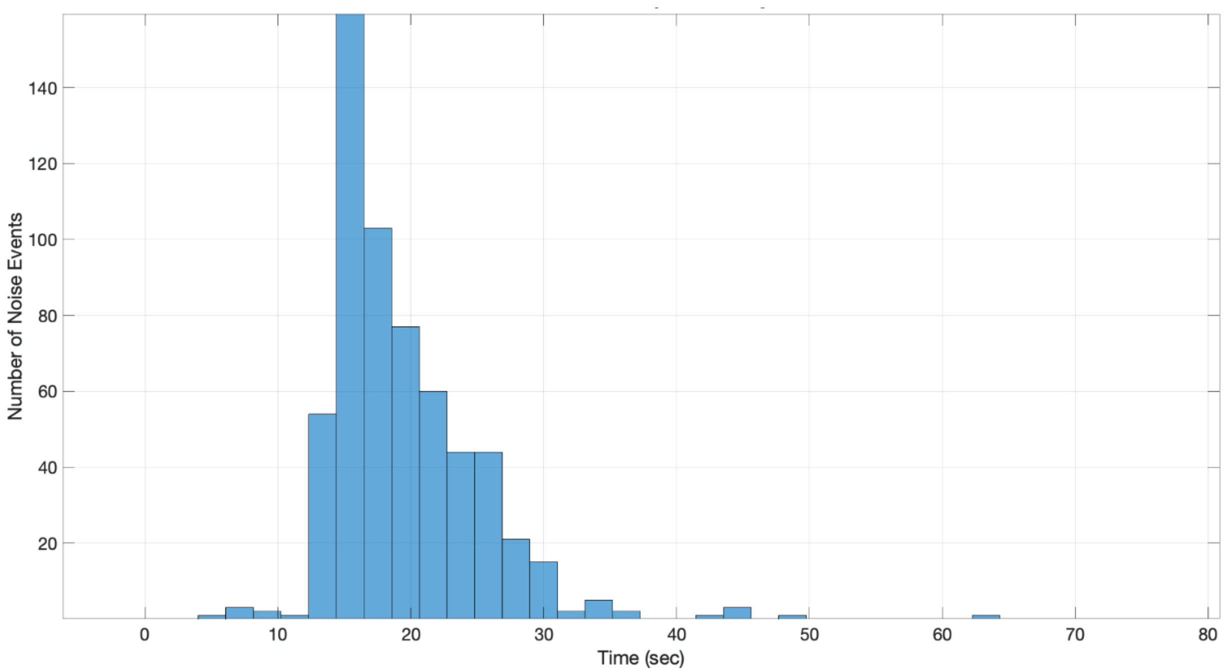

Figure 6.11 Distribution of Duration of Noise Events at Runway 12.

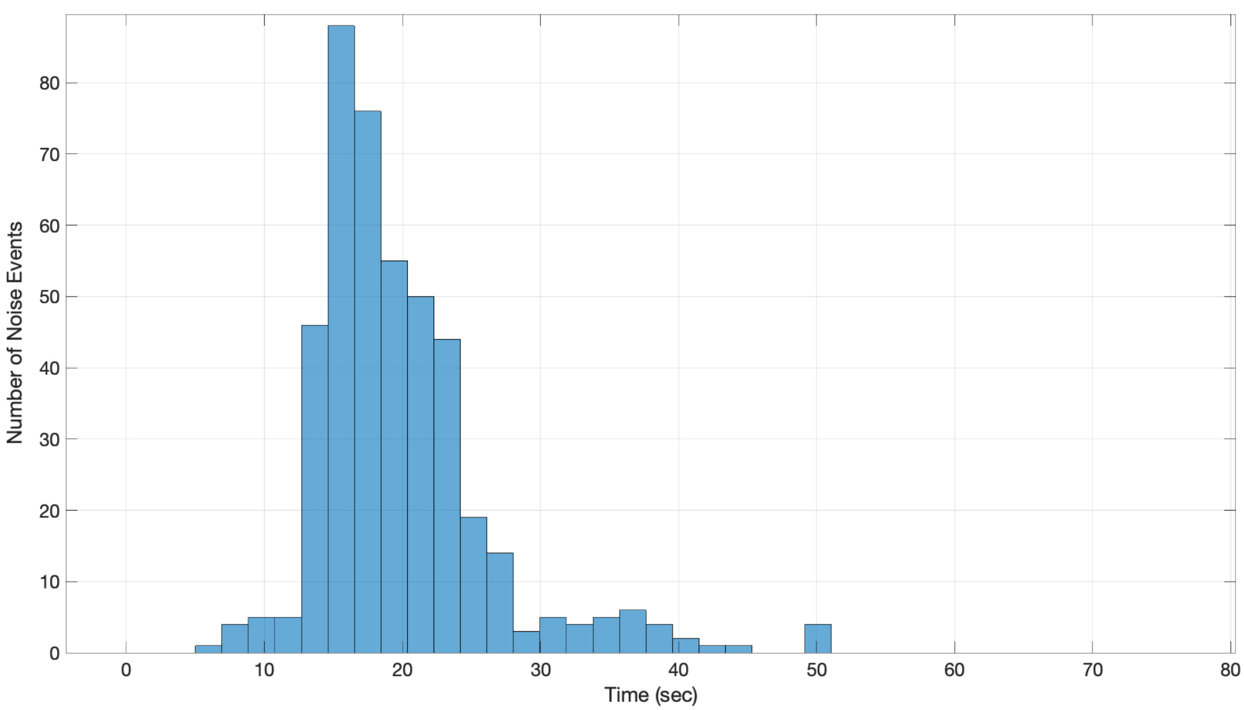

Figure 6.12 Distribution of Duration of Noise Events at Runway 30.

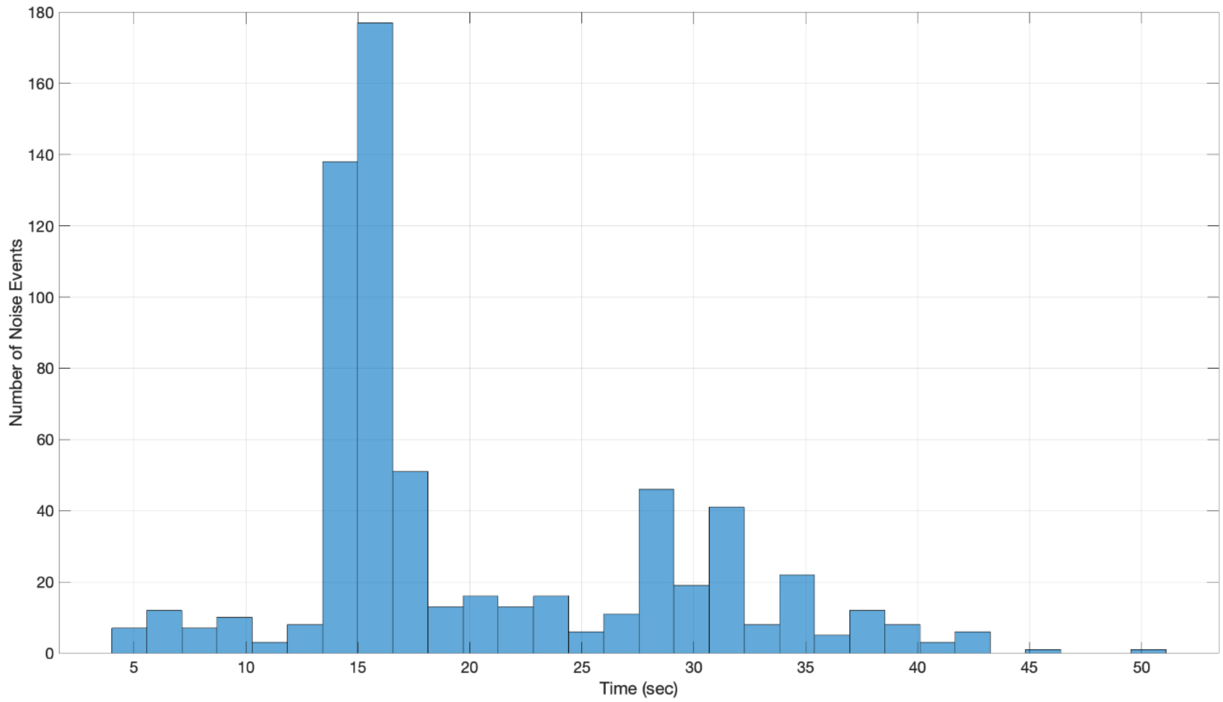

Figure 6.13 Distribution of Duration of Noise Events at Port Henderson.