2015 AERONAUTICAL NOISE MANAGEMENT REPORT

-VANCOUVER AIRPORT AUTHORITY-

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INTRODUCTION

Vancouver Airport Authority ("Airport Authority") took over management of the Vancouver International Airport ("YVR") from Transport Canada in 1992. The Airport Authority is a not-for-profit organization, governed by a community-based Board of Directors, and oversees the daily operations of YVR to ensure the airport runs safely and efficiently.

As a community based organization, the Airport Authority is committed to a positive long-term relationship with our surrounding communities and is dedicated to operating YVR in a manner that minimizes negative impacts on the environment, while providing 24-hour airport services.

Managing noise from aircraft operations has been a priority for the Airport Authority since assuming responsibility of YVR. As with our other work, we approach noise management using a sustainability framework, which integrates the economic, environmental, social and governance aspects of our business. This framework is essential to our success and provides a responsible approach for our business objectives and our commitment to the local community.

In 2015, YVR served a record of 20.3 million passengers and accommodated approximately 318,000 aircraft landings and take-offs, making YVR the second busiest and one of the fastest growing airports in Canada.

The objective of this report is to share information with the community about activities of the YVR Aeronautical Noise Management Program, and to facilitate informed dialogue between stakeholders involved in managing aircraft noise. Data and information compiled for this report also helps to support discussions with members of the YVR Aeronautical Noise Management Committee ("ANMC"), a consultative forum for independently appointed community and industry representatives to share information and provide advice and input on the development of initiatives to the Airport Authority through a collaborative process.

2015 HIGHLIGHTS

The Airport Authority has a comprehensive program to manage noise from aircraft and airport operations. The YVR Aeronautical Noise Management Program has many elements, and the 5-year YVR Noise Management Plan is an integral part of advancing the goals of the program. The Noise Management Plan is a requirement under the Airport Authority's ground lease with Transport Canada, and the current Plan (2014-2018) can be found at www.yvr.ca.

The 2014-2018 YVR Noise Management Plan contains ten areas of focus along with supporting initiatives. Work in 2015 helped support many of the initiatives and a summary of work is provided below.

AIRSPACE CHANGE COMMUNICATION & CONSULTATION PROTOCOL

The Airspace Change Communication & Consultation Protocol ("ACCCP"), which was developed jointly by a number of Canadian airports and NAV CANADA[1] to address communication and consultation requirements for changes to airspace procedures, was approved by the Minister of Transport in June 2015. The Airport Authority contributed to the development of the ACCCP by working with other airports and providing input through the Canadian Airports Council.

The objective of the ACCCP is to outline when and how the aviation industry communicates and consults during airspace or procedural changes and clarifies the roles and responsibilities of the parties involved. The ACCCP can be found on the Canadian Airports Council website (www.cacairports.ca).

PERFORMANCE BASED NAVIGATION (PBN) AT YVR

Performance Based Navigation ("PBN") is an air navigation system based on Global Positioning System ("GPS") satellite technology. With the use of GPS and sophisticated aircraft avionics, PBN offers benefits of enhanced safety, efficiency, precision and reduced environmental impacts.

Under PBN, there are two types of specifications: Area Navigation ("RNAV"); and Required Navigation Performance ("RNP"). RNP requires performance monitoring and alerting capability on board the aircraft that RNAV does not demand. As a result, RNP is more precise than RNAV and is recognized as the worldwide standard under International Civil Aviation Organization ("ICAO") to support improvements in safety, efficiency and reduced environmental impacts.

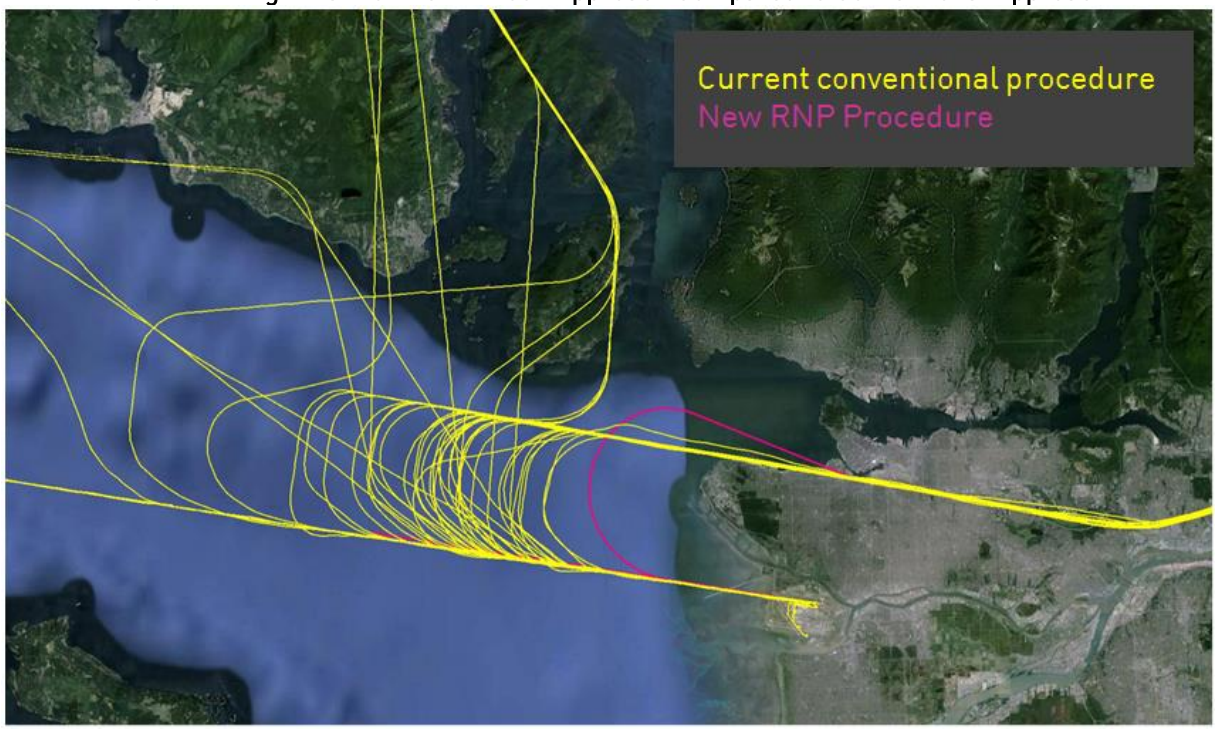
While a number of RNP approach procedures have been in use since 2004 in Canada, these procedures were restricted and only available for use by a few operators. In October 2015, NAV CANADA published the first public RNP approach procedure in Canada for YVR. As this procedure is public, it can be used by any aircraft that meets RNP equipment requirements and has aircrew that are certified.

The RNP approach procedure published for YVR is for aircraft arriving from the east and northeast and landing on Runway 08L. The flight path for this approach follows the existing conventional arrival route until the final segments of the approach, which then has the aircraft track over the water. Figure 1 illustrates the flight path of the RNP approach (shown in magenta) compared to aircraft following conventional approaches (shown in yellow).

The new RNP approach procedure does not replace the conventional approach procedure as the conventional procedure will remain in use. At present the use of the RNP approach procedure is not expected to be high at YVR due to the relatively small number of aircraft and aircrews that are certified to fly this procedure and the challenge of fitting aircraft using this procedure into the mix of other aircraft using the conventional procedure.

[1] NAV CANADA is the not-for-profit company that provides civil air navigation services in Canada. NAV CANADA provides air traffic control, flight information, weather briefings, aeronautical information services, airport advisory services and maintains the electronic aids to navigation.

FIGURE 1: Flight Path of the RNP 08L Approach Compared to Conventional Approach



As recommended in the ACCCP, a communications plan was developed for the introduction for the RNP procedure based on the nature of change and associated impacts to help engage the community. The communications plan included the preparation of web-based materials for the public (available at www.yvr.ca), and briefing sessions for the ANMC and Transport Canada.

It is anticipated that additional RNP procedures will be developed and introduced for other runways at YVR as more aircraft become eligible to fly RNP. The Airport Authority and NAV CANADA are committed to engaging with the community on flight path designs and changes associated with these future procedures.

ENGINE RUN-UP STUDY

The Airport Authority built a Ground Run-up Enclosure (GRE) in 2012 to mitigate noise from engine run up operations. In 2015, we completed a review of the run-up operations occurring outside the GRE facility to identify potential procedural or operational controls to further mitigate noise. This review was completed by Harris Miller Miller & Hanson ("HMMH") and focused on run-ups performed at four key locations on the airfield: 1) Jazz Hangar; 2) Apron III; 3) Apron II; and 4) Air Canada South Hangar. These locations were identified through an analysis of records for historical run-ups performed in the years 2013 and 2014.

Operational data and current run-up procedures were provided to HMMH for their review. Key findings were presented by HMMH to the ANMC, and the final report was delivered in December 2015.

The study concluded that the existing procedures used by the Airport Authority provide the best possible noise reduction based on current run-up operations at the airport. HMMH did recommend that the Airport Authority continue to monitor run-ups and consider additional remedies if the operations and trends change in the future.

SUMMER 2015 RUNWAY OPERATIONS

In the Summer of 2015, Airport Authority advanced multiple airside projects including starting the multi-year project to construct Runway End Safety Areas on the south airfield and completing emergency repairs to Taxiway Delta. This work required nightly closure of the south runway for extended periods of time, during which air traffic was diverted to the north runway. The Airport Authority posted community advisories informing of changes to runway operations and provided updates as needed. A summary of RESA construction and Taxiway Delta repair work is provided below.

Runway End Safety Area ("RESA") Construction Project

In 2015, the Airport Authority commenced a three-year project of constructing RESAs for the south runway and the crosswind runway. RESAs are specialized areas at the end of a runway that protect and reduce the severity of damage to an aircraft in the unlikely event of an overrun or undershoot. The Airport Authority is proactively building RESAs to meet international recommendations and the anticipated Canadian standard currently being assessed by Transport Canada.

Nightly RESA construction began on May 19 continuously to June 30 and then shifted to 5-nights a week from July 1 to August 31. During those periods, the south runway was closed from 9 PM to 7 AM, and all operations were moved to the north runway. On the nights with no construction work, the north runway remained open to accommodate landings as the approach lights on the south runway were not in service.

The first year of RESA construction was completed successfully, as scheduled, with the last day of closure taking place on the night of August 31; however, extended nightly closures of the south runway continued past August 31 to accommodate emergency repair work on Taxiway Delta (see description below). Extended south runway closures will be required for RESA work in 2016 and 2017. In 2016, the construction is scheduled to commence on May 8.

Emergency Repairs to Taxiway Delta

In addition to the RESA construction summarized above, urgent repair work on Taxiway Delta was required due to rapidly deteriorating conditions of the pavement. Taxiway Delta is a main taxiway that connects the east end of the south runway to the main apron at YVR. While this taxiway was scheduled for rehabilitation in 2017, the high temperatures during the summer and the presence of large heavily loaded aircraft caused the pavement conditions to deteriorate at a much faster rate.

This repair work commenced in late July and took place concurrently with the RESA construction in order to minimize impacts on the community by taking advantage of runway closures. While the Airport Authority endeavored to complete the repairs within the timeframe of the RESA project, work continued past August 31 due to the amount of effort involved and was completed on the morning of September 19.

NOISE MONITORING TERMINAL (NMT #1) INSTALLATION

The Airport Authority installed a noise monitoring terminal (NMT #1) at the Richmond Olympic Oval in August 2015. This equipment had previously been installed at the Richmond General Hospital but was removed in 2010 at the request of the property owner. Several locations in the area were evaluated before the decision was made to install equipment for NMT#1 at the Richmond Olympic Oval, which was selected due to its proximity to the float plane routes operating from YVR and the maintenance bases located on the south side of the airport. The noise data collected from all NMT sites are presented in this report.

YVR FLY QUIET AWARDS

The YVR Fly Quiet Awards were presented at the YVR Airline Operators Committee meeting in October 2015. The goal of these awards is to raise awareness of noise issues within the aviation community. Eligibility criteria include:

1. The airline must not be in suspected violation of any of the published Noise Abatement Procedures.
2. The airline must have the lowest average annual noise level for their aircraft category (as measured by the Aircraft Noise & Operations Monitoring System).
3. The airline must fly regular services at YVR.

The winners of the awards included: Central Mountain Air (propeller category); Jazz (narrow-body jets); and Japan Airlines (wide-body jets). Award winners for past years are presented in Table 1.

TABLE 1: YVR Fly Quiet Award Winners, 2012-2014

YEAR	Propeller	Narrow Body Jets	Wide Body Jets
2014	Central Mountain Air	Jazz	JAL JAPAN AIRLINES
2013	Jazz	U·S AIRWAYS	中国南方航空 CHINA SOUTHERN AIRLINES
2012	Jazz	WESTJET	JAL JAPAN AIRLINES

YVR OPERATIONS IN REVIEW

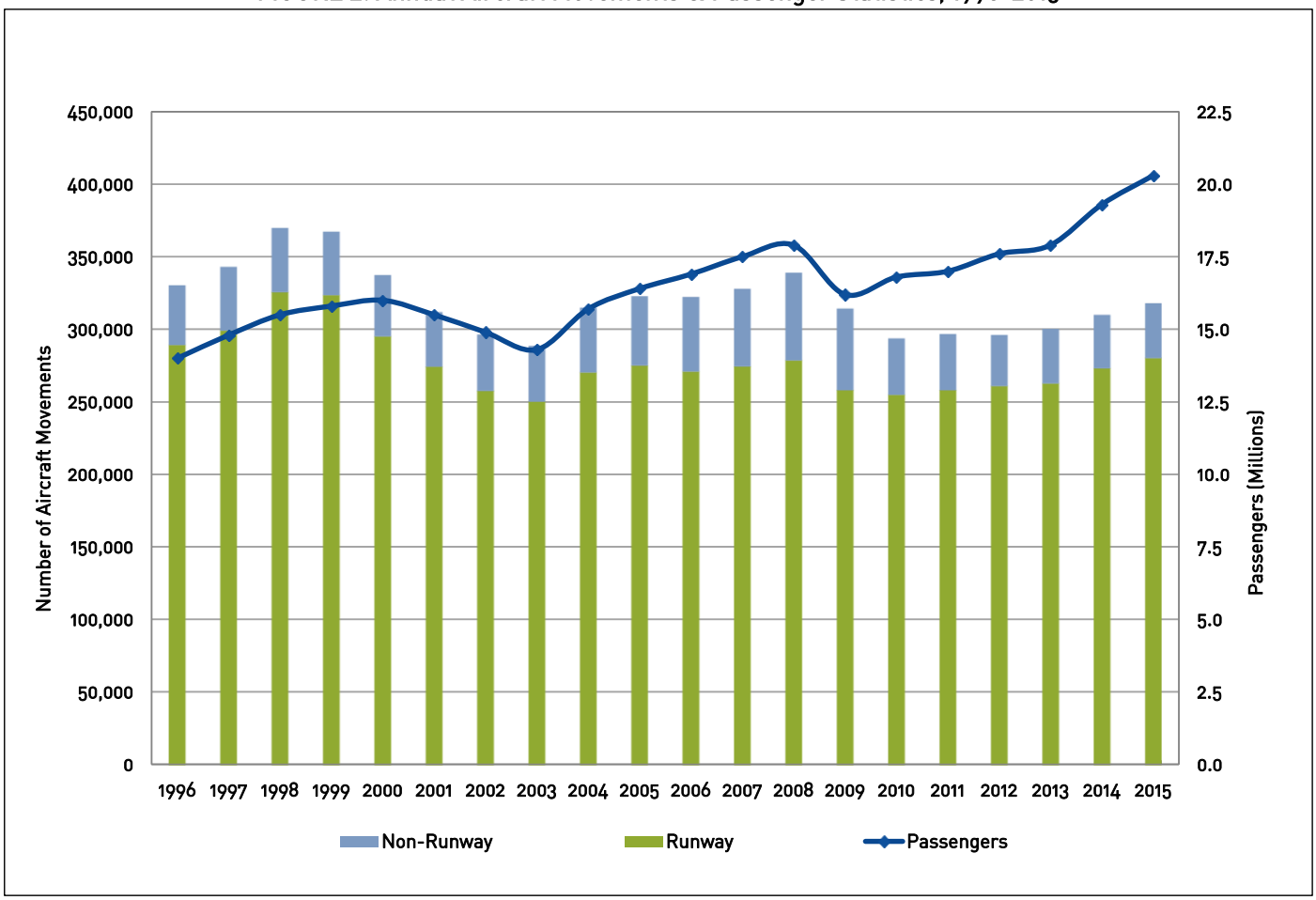
In 2015, Aircraft movements, cargo tonnage and total passengers all experienced growth compared to 2014 (see Table 2) and it proved to be a record breaking year at YVR with the airport passing the 20 million passenger mark for the first time.

Figure 2 illustrates the historical trend of aircraft movements and passengers at YVR for the time period of 1996-2015. In 2015, the number of aircraft operations was less than what occurred in the peak years (1998 and 1999) while the number of passengers continues to grow. This indicates that aircraft are now carrying more passengers per aircraft, which is a benefit with respect to noise and emissions.

TABLE 2: Operational Statistics for YVR, 2015

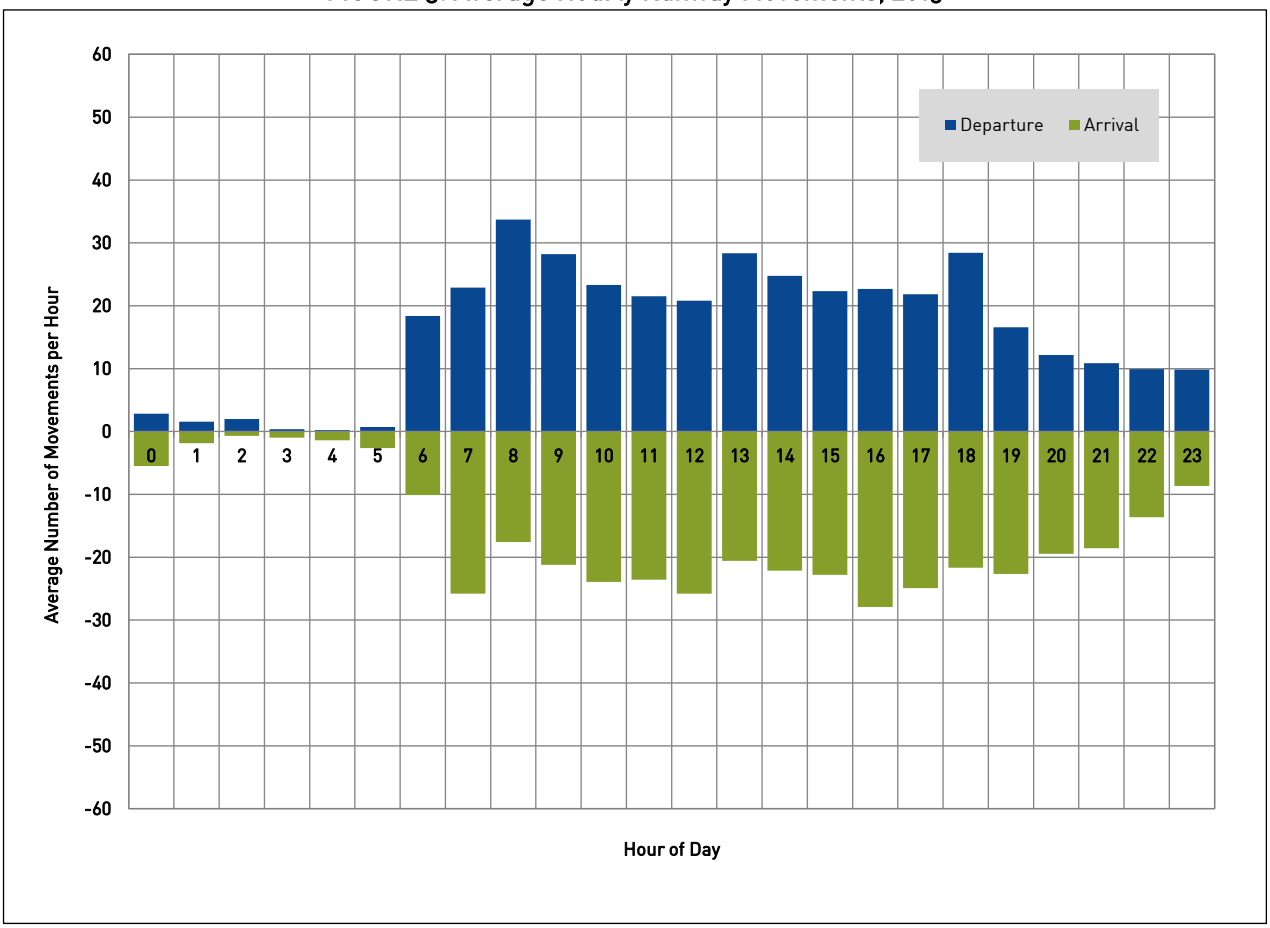
Total Movements	318,096	2.6% increase from 2014
Total Cargo (Tonnes)	271,774	5.8% increase from 2014
Total Passengers	20,315,978	4.9% increase from 2014

FIGURE 2: Annual Aircraft Movements & Passenger Statistics, 1996-2015



In 2015, approximately 97% of all aircraft activities at YVR occurred during the day-time hours[2]. Figure 3 illustrates the average hourly runway movements by arrival and departure. As illustrated, the aircraft movements start to increase at 6:00 AM and continue with peaks experienced throughout the day. The number of aircraft that operated during the night-time hours[3] in 2015 accounted for approximately 3% of total aircraft movements at YVR.

FIGURE 3: Average Hourly Runway Movements, 2015



OPERATIONAL SNAPSHOT – NIGHT OPERATIONS

Like most international airports around the world and all international airports in Canada, YVR operates 24-hours a day. While the majority of aircraft movements occur during the day-time hours, some operations occur during the night-time hours. Night-time operations are primarily associated with the cargo and courier industry with some scheduled passenger flights to Asia-Pacific.

In 2015, there were approximately 7,540 aircraft movements during night-time hours. On average, this equates to approximately 21 movements per night over the six-hour period from midnight to 6:00 AM. Of these movements, approximately 65% were arrivals, which tend to be quieter than departures. Table 3 summarizes the breakdown of the average night-time movements by aircraft type and operation.

[2] For this report, day-time is defined as the time period between 6:00 AM and mid-night.

[3] For this report, night-time is defined as the time period between midnight and 6:00 AM local.

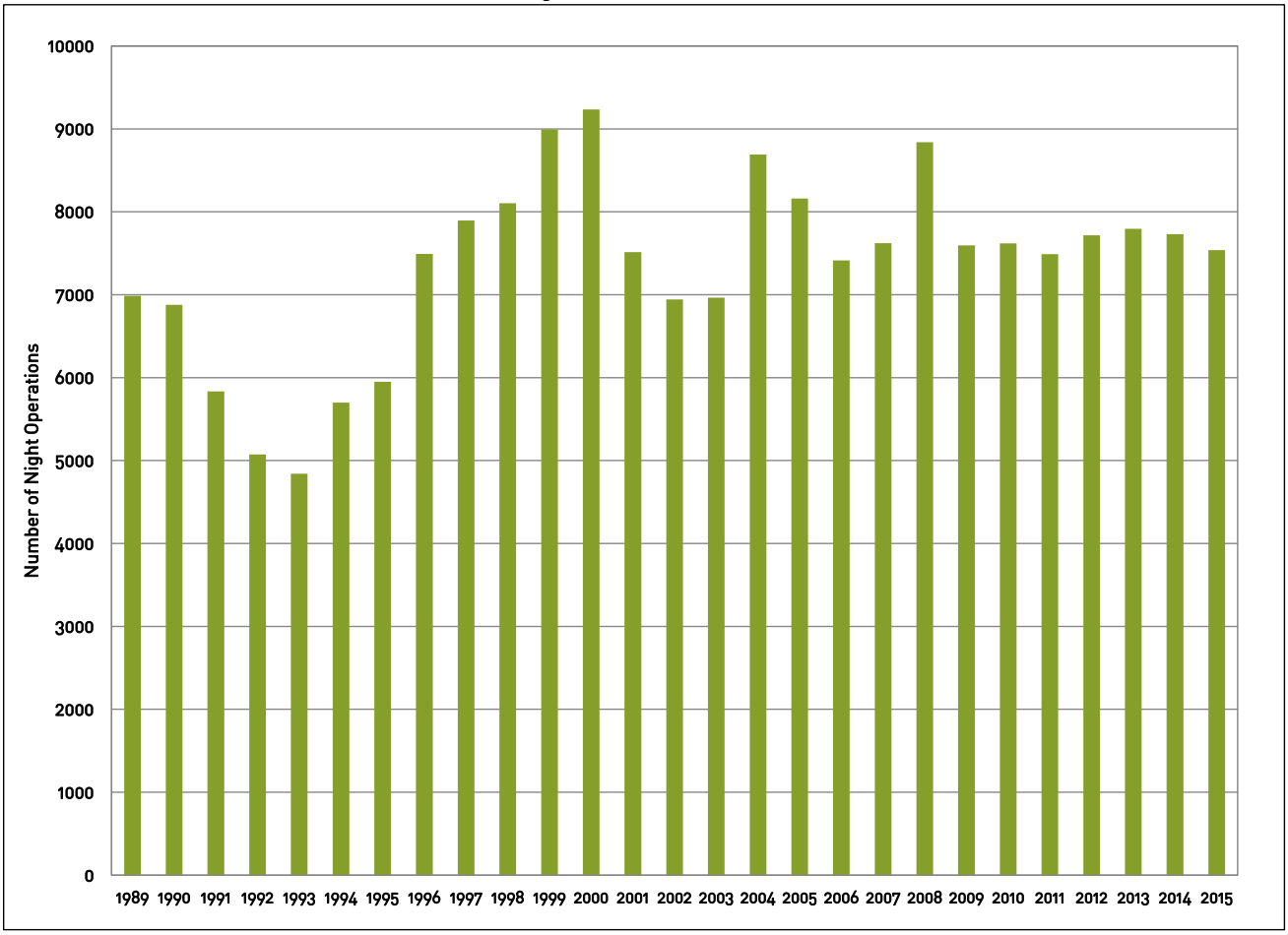
TABLE 3: Average Nightly Movements by Aircraft Type and Operation, 2015

Aircraft Type	Operation	
	Arrival	Departure
Propeller	3	1
Business Jet	1	1
Narrow Body Jet	6	1
Wide Body Jet	3	4

- Propeller aircraft include types such as the Dash-8, Navajo, Beech 1900, Saab 340, etc.
- Business jets include types such as the Citation, Learjet, etc.
- Narrow-body jets include types such as the A320, B737, CRJ, E190, etc.
- Wide-body jets include types such as the B787, B777, A340, A330, etc.

YVR has always been open 24-hours a day, including when the airport was managed by Transport Canada prior to the transfer to the Airport Authority in 1992. Figure 4 illustrates the annual night-time movements at YVR for the years 1989 to 2015. As illustrated by this figure, the number of night-time operations has remained relatively the same since 2009 and well below the peak years 1999 and 2000.

FIGURE 4: Annual Night-time Movements at YVR, 1989-2015



OPERATIONAL SNAPSHOT – JET FLEET MIX BY NOISE CERTIFICATION

The International Civil Aviation Organization ("ICAO") is an agency of the United Nations and establishes principles and techniques for the planning and development of international air transportation to ensure safe and orderly growth. The ICAO Committee on Aviation Environmental Protection ("CAEP") prescribes standards for noise with the goal of promoting reduction at the source. These standards are contained in *Annex 16: Volume I Environmental Protection - Aircraft Noise* and categorize jet aircraft as either Chapter 2, Chapter 3 or Chapter 4 depending on three measured noise levels (take-off, landing, and sideline) obtained during prototype development[4].

A new noise standard was confirmed at the 9th meeting of CAEP in February 2013. This new standard, Chapter 14, will apply to new large aircraft types certified after 2017 and to aircraft less than 55 tonnes after 2020. To meet the Chapter 14 standard, aircraft must be at least 7 EPNdB (Effective Perceived Noise in Decibels) quieter than the current Chapter 4 standard. This reduction is cumulative over three measurements points: take-off, landing and sideline.

An analysis was performed on jet operations occurring in 2015 to determine the percentage of Chapter 3 and Chapter 4 movements. Table 4 below presents the results of the analysis, and provides an additional breakdown by the Gross Take-off Weight ("GTOW") of the aircraft. As illustrated, 94% of all jet aircraft operating at YVR meet Chapter 4 noise standards.

TABLE 4: ICAO Noise Certification of Jet Operations at YVR, 2015

ICAO Noise Certification	All Jet Aircraft	GTOW less than 34,000kg (n~16,900)	GTOW greater than or equal to 34,000kg	
			Narrow Body (n~99,900)	Wide Body (n~29,300)
Chapter 3	5%	14%	5%	3%
Chapter 4	95%	86%	95%	97%

Approximately 93% of the jet operations occurring between the night-time hours of midnight and 6:00 AM are with Chapter 4 noise certified aircraft.

The aviation industry puts tremendous effort to reducing impacts from noise and emissions. Over the years, airlines worldwide have invested billions to upgrade their fleet to reduce both noise and emissions. Aircraft operating today are approximately 30 dB quieter (or a 90% reduction in noise footprint area) as compared to original commercial jet aircraft. Airlines in Canada have invested in new modern aircraft and are known to have one of the youngest fleets in the world.

[4] To reduce aircraft noise exposure on communities, the Government of Canada legislated the phase-out of Chapter 2 jet aircraft over 34,000kg from operation in Canada by the year 2002. These aircraft are no longer permitted to operate in Canada and were either retired from operation or modified to meet Chapter 3 standards. A few exemptions were granted to aircraft operating from airfields in northern Canada.

AIR TRAFFIC FLOW

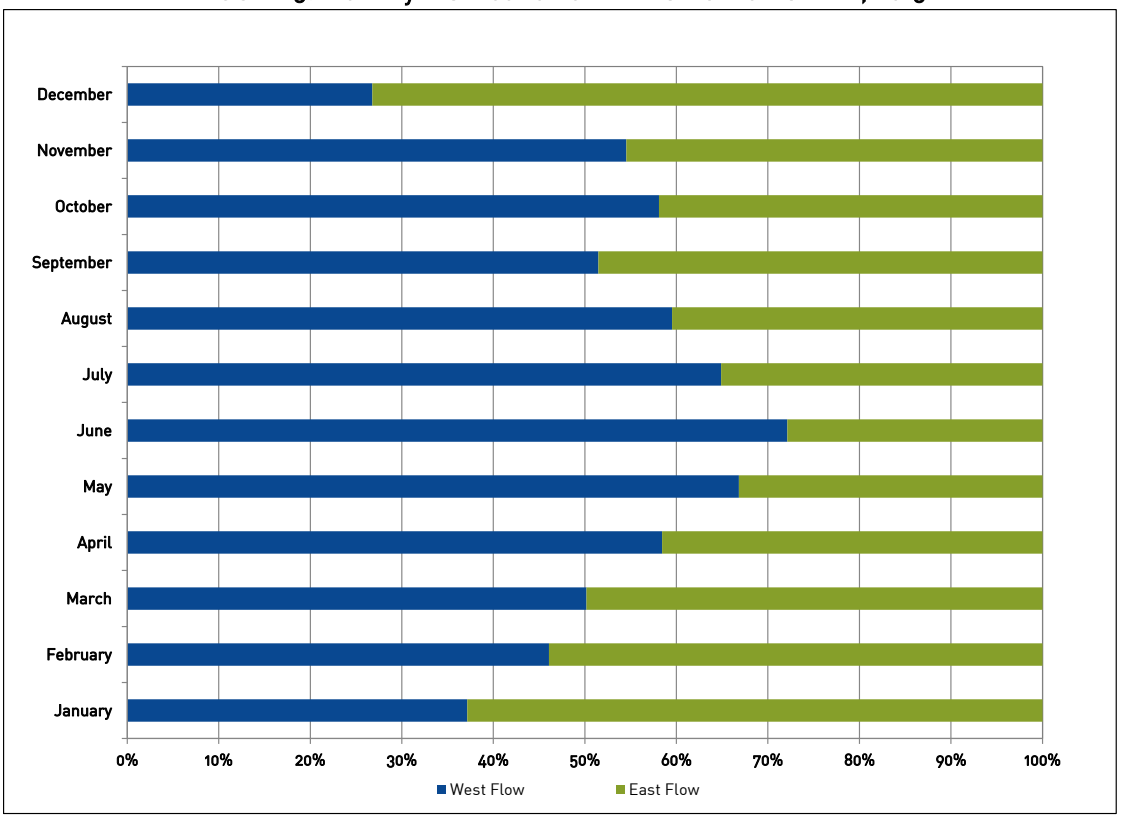
YVR has two parallel runways and a crosswind runway. The parallel runways, 08R/26L and 08L/26R, are aligned in an east-west direction (magnetic headings 083° and 263°) and the crosswind runway, 13/31, is oriented in a northwest and southeast direction (magnetic headings 125° and 305°).

For safety reasons, aircraft must land and take-off into the wind. The predominant winds at YVR are either in an easterly or westerly direction and are in line with the two main parallel runways. Air traffic patterns over the Lower Mainland are highly dependent on which runway is active as the aircraft flight routes will change to accommodate different arrival and departures paths associated with each runway. Based on historical observations, departures and arrivals in an easterly direction (runway 08L and 08R use) are more common during the fall and winter months, and departures and arrivals in a westerly direction (runway 26L and 26R use) are more common during the spring and summer months.

The published Noise Abatement Procedures for YVR prescribes westerly flow of traffic as the preferred mode of operation to reduce noise exposure on the community as this puts departures, the noisiest type of operation, over the Strait of Georgia. During the night-time hours, when the winds are calm, air traffic control will attempt to accommodate two-way flow by keep both arriving and departing aircraft over the Strait of Georgia in an effort to minimize over-flights and noise on the community. However, the use of two-way flow is dependent on traffic volume and weather conditions and cannot be used all the time.

Figure 5 illustrates the monthly distribution between easterly and westerly flow on the parallel runways. Overall, the wind conditions were well balanced in 2015 with a 54% westerly flow and 46% easterly flow observed. However, as illustrated, there are monthly and seasonal trends that can be observed.

FIGURE 5: Monthly Distribution of Air Traffic Flow at YVR, 2015



RUNWAY USE

There were no significant changes in how the runways were utilized at YVR in 2015 compared to 2014. However, extended closure of the south runway in 2015 for summer maintenance and construction work resulted in higher utilization of the north runway (08L/26R) for departures compared to the previous year.

Every year, YVR closes the south runway (08R/26L) at night for multiple weeks for routine maintenance or project related work, and aircraft are diverted to the north runway which is normally closed between the hours of 10:00 PM and 7:00 AM (except for emergencies, weather, and airfield maintenance activities). In 2015, extended closure of the south runway was required to accommodate the annual maintenance focused on RESA construction and emergency repairs to Taxiway Delta. This work lasted approximately 17 weeks.

Figure 6 and 7 illustrate the percentage of runway distribution for arrival and departures in 2015. As mentioned in the previous section, the published Noise Abatement Procedures for YVR specify Runway 26 use (westerly traffic flow) as a preferred mode of operation, weather permitting, as this places departures, the noisiest operation, over the Strait of Georgia. In 2015, 54% of take-offs occurred on Runway 26L and 26R as shown in Figure 7.

FIGURE 6: Runway Arrival Distribution, 2015

FIGURE 7: Runway Departure Distribution, 2015

RUN-UPS

Transport Canada requires regular maintenance of aircraft to ensure safe operations. Engine run-ups are performed as a part of maintenance work and involve running the engines at various power settings for a period of time to stress components and to simulate flight conditions. This ensures work has been done properly and that the aircraft is safe to return to service.

YVR RUN-UP DIRECTIVES AND PROCEDURES

In an effort to reduce community noise exposure from run-ups, the Airport Authority maintains directives and procedures that prescribe how and when run-ups can be performed. Maintenance operators must request permission from the Airport Authority prior to performing a run-up. Approved run-ups are assigned a location and heading to ensure safety and to minimize noise impacts on surrounding communities. All maintenance run-ups are logged, and these records are routinely analyzed to track run-up activity and identify trends.

YVR RUN-UP ACTIVITY

Over the last five years, the number of run-ups performed at YVR has decreased. This can be attributed to the advancement of aircraft technology. In 2015, there was a 5% decrease in the number of run-ups performed at YVR compared to 2014. Table 5 provides the number of run-ups performed each year at YVR for the time period of 2011-2015.

TABLE 5: Number of Run-ups Performed at YVR, 2011-2015

Year	Number of Approved Run-ups
2011	5,701
2012	5,706
2013	5,157
2014	4,916
2015	4,653

Operators performing run-ups can be divided into two distinct areas of the airfield - those that are located on the north airfield, and those that are located on the south airfield - with the south runway acting as the dividing line. In 2015, north airfield operators accounted for approximately 46% of all run-up activities at YVR and south airfield operators accounted for the remaining 54%. The run-ups by south airfield operators are generally performed on propeller aircraft, as many of the smaller operators have their maintenance facilities on the south airfield.

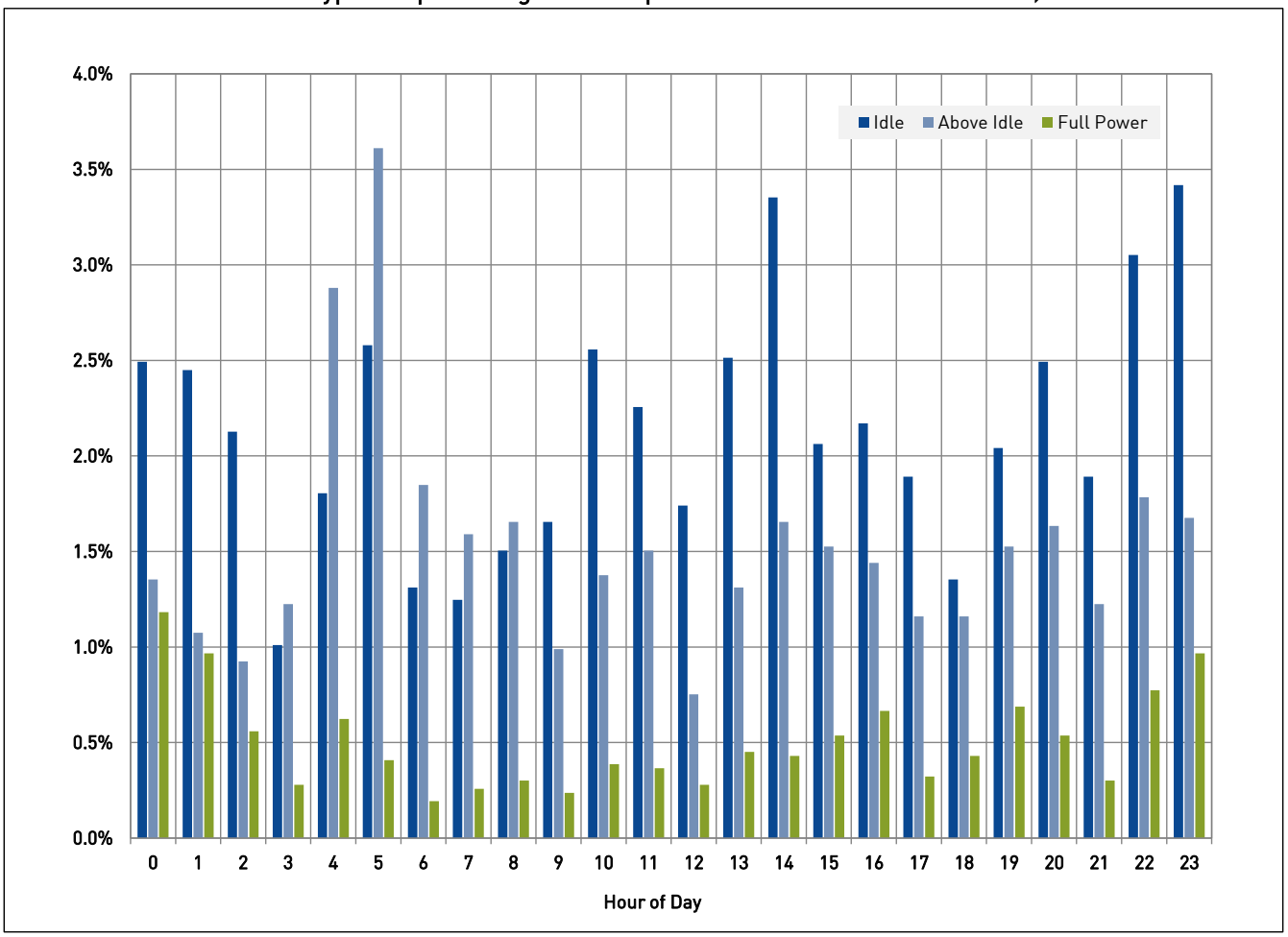
In general, there are three different power settings associated with run-ups: idle; above idle; and, full power. Full power run-ups are considered the nosiest because the engine is operated at maximum power. Run-ups performed at full power are very infrequent and are often shorter in duration when compared to idle and above idle run-ups. This is due to the increased engine wear and fuel consumption associated with running engines at full power for prolonged periods. Table 6 provides a breakdown of run-up types and per cent total at YVR for 2015.

TABLE 6: Run-up Type (by power setting) Distribution, 2015

Run-up Category	Percent Total of Runs
Idle	51%
Above Idle	37%
Full Power	12%

Run-ups are performed at all times of the day, but residents are generally more impacted by those occurring at night. As most aircraft are flying in service during the day, maintenance on aircraft and engine run-ups often need to be performed during the night-time hours to ensure the aircraft are airworthy before returning to service the next morning. Figure 7 provides a percentage breakdown for all run-ups (n=100%) carried out at YVR in 2015 by the power setting and hour of the day. As Figure 7 illustrates, idle run-ups are by far the most common, followed by above idle which are followed by very few full power run-ups. The busiest hours for idle run-ups were at 2:00PM and 11:00PM, above idle run-ups at 4:00AM and 5:00AM, and full power run-ups between 11:00PM and 1:00AM. However, as Figure 8 illustrates, operators are consistently busy throughout the day with run-ups being carried out at all times of the day.

FIGURE 8: Type and percentage of run-ups conducted for each hour at YVR, 2015



GROUND RUN-UP ENCLOSURE (GRE)

To reduce noise from the high number of propeller run-ups by operators located on the south airfield, the Airport Authority constructed Canada's first Ground Run-Up Enclosure (GRE) and the facility was opened on 25 January 2012. The GRE is designed to accommodate high power run-ups by propeller and business jet aircraft maintained on the south airfield. The facility is designed to provide an average of 15 dBA noise reduction and residents to the south of YVR experience a 50% reduction in run-up noise.

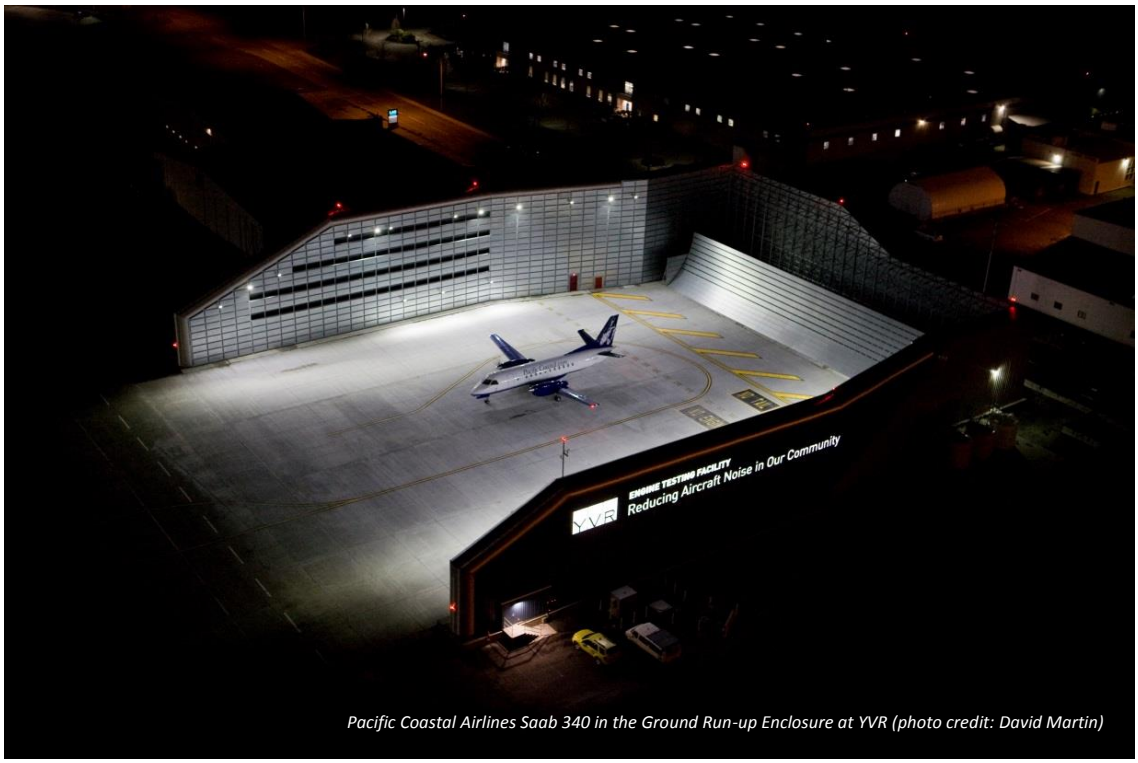
In 2015, 39% of all run-ups (idle, above idle and full power) on the south airfield were conducted in the GRE. Table 7 provides a more detailed breakdown of high power run-ups (above idle and full power only) on the south airfield and their location in comparison with the GRE.

TABLE 7: South Airfield High Power Run-up Locations, 2015

Power Setting	Location	Approx. % of South Airfield Run-ups
Above Idle	GRE	66%
	Apron III	32%
	Apron I, II	1%
	Other	<1%
Full Power	GRE	94%
	Apron I, II, III	5%
	Other	<1%

As illustrated in Table 7, the majority of high power run-ups on the south airfield were performed in the GRE.

The GRE has reduced noise in the community and has been a great success with operators, who often request use of the facility for their run-ups due to its safe and controlled setting.



Pacific Coastal Airlines Saab 340 in the Ground Run-up Enclosure at YVR (photo credit: David Martin)

NOISE CONCERNS

One of the goals of the YVR Aeronautical Noise Management Program is to provide the community with up-to-date information on noise management efforts and initiatives. The community is able to contact the Airport Authority with their questions and concerns through one of the following means:

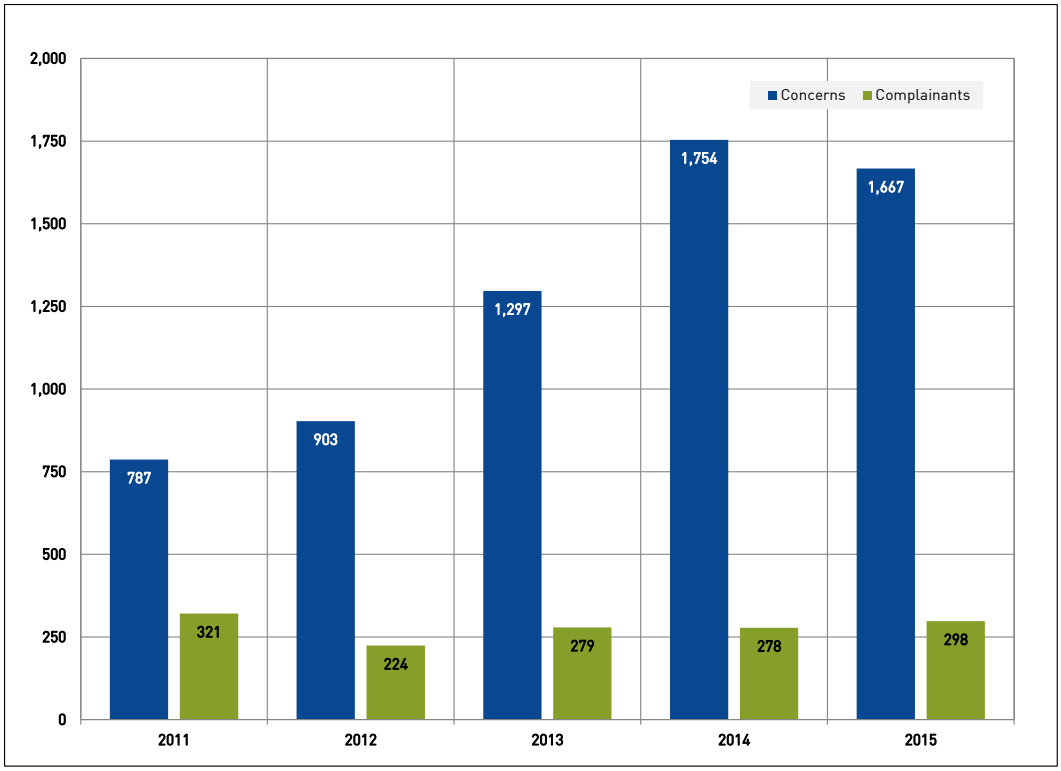
- Dedicated e-mail (noise@yvr.ca)
- Real-time flight and noise tracking system (WebTrak)
- YVR Noise Information Line (604-207-7097), 24-hours.

Information provided by the complainant and investigation results are logged in a database, which is used to identify trends. The YVR Aeronautical Noise Management Committee is provided a summary of complaints at each meeting and will review and discuss issues.

NUMBER OF CONCERNS

In 2015, the Airport Authority received 1,667 noise concerns from 298 individuals. This represents a 5% decrease in concerns and a 7% increase in the number of complainants compared to 2014. Figure 9 presents a breakdown on the number of concerns and individuals for the past five years (2011-2015).

FIGURE 9: Number of Noise Concerns and Individuals, 2011-2015



As illustrated, there are a number of individuals who registered multiple concerns throughout the year. In 2015, five individuals were responsible for registering 77% (n=1,281) of all concerns, resulting in the remaining of 293 individuals registering 386 concerns. These five individuals registered at least 27 complaints each with the range being between 27 and 1,015 complaints.

NOISE CONCERNS BY LOCATION

Whenever possible, individuals are asked to provide information on which city they live in to help determine where in the Lower Mainland concerns are originating from. Figure 10 shows the number of concerns related to YVR aircraft operations and individuals for the various cities in the Lower Mainland.

FIGURE 10: Number of Concerns & Individuals by Location, 2015

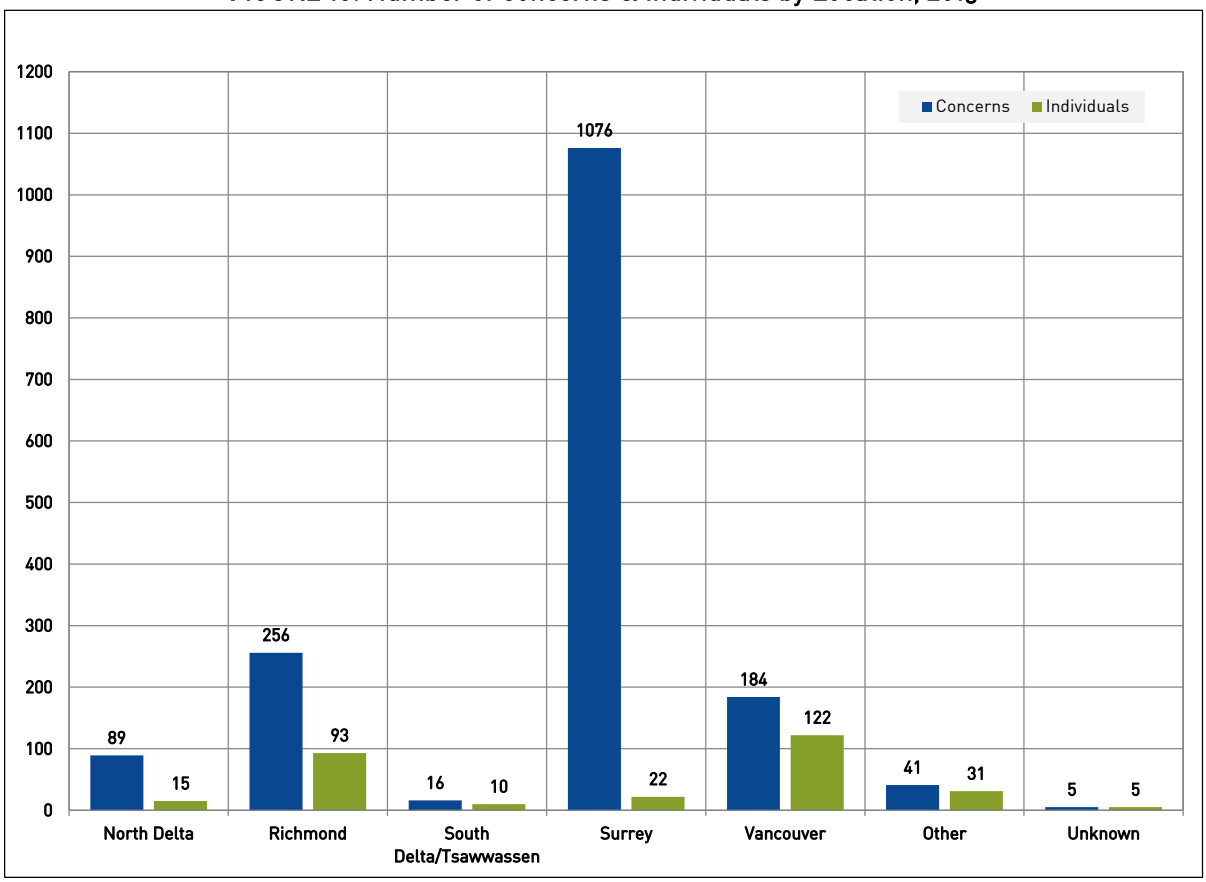
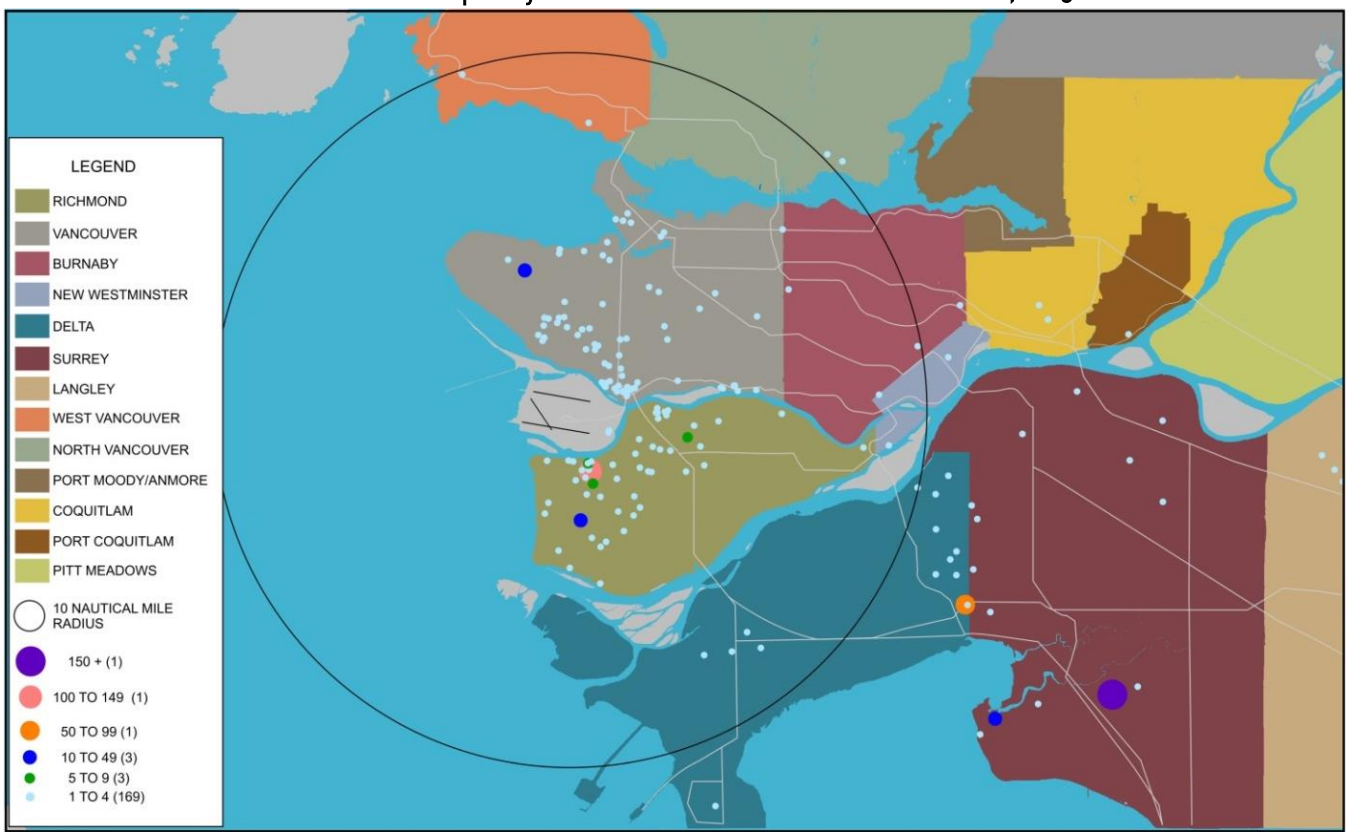


Figure 11 represents the geo-distribution of concerns in the Lower Mainland based on postal code reference. Locations closer to the airport generally exhibit a greater density of noise concerns due to the lower altitude of aircraft and regularity of aircraft activity in these locations. Figure 12 represents the geo-distribution and the frequency of concerns in the Lower Mainland. The size of each dot represents the volume of concerns originating from that postal code.

FIGURE 11: Geo-distribution of Noise Concerns, 2015

FIGURE 12: Frequency and Geo-distribution of Noise Concerns, 2015



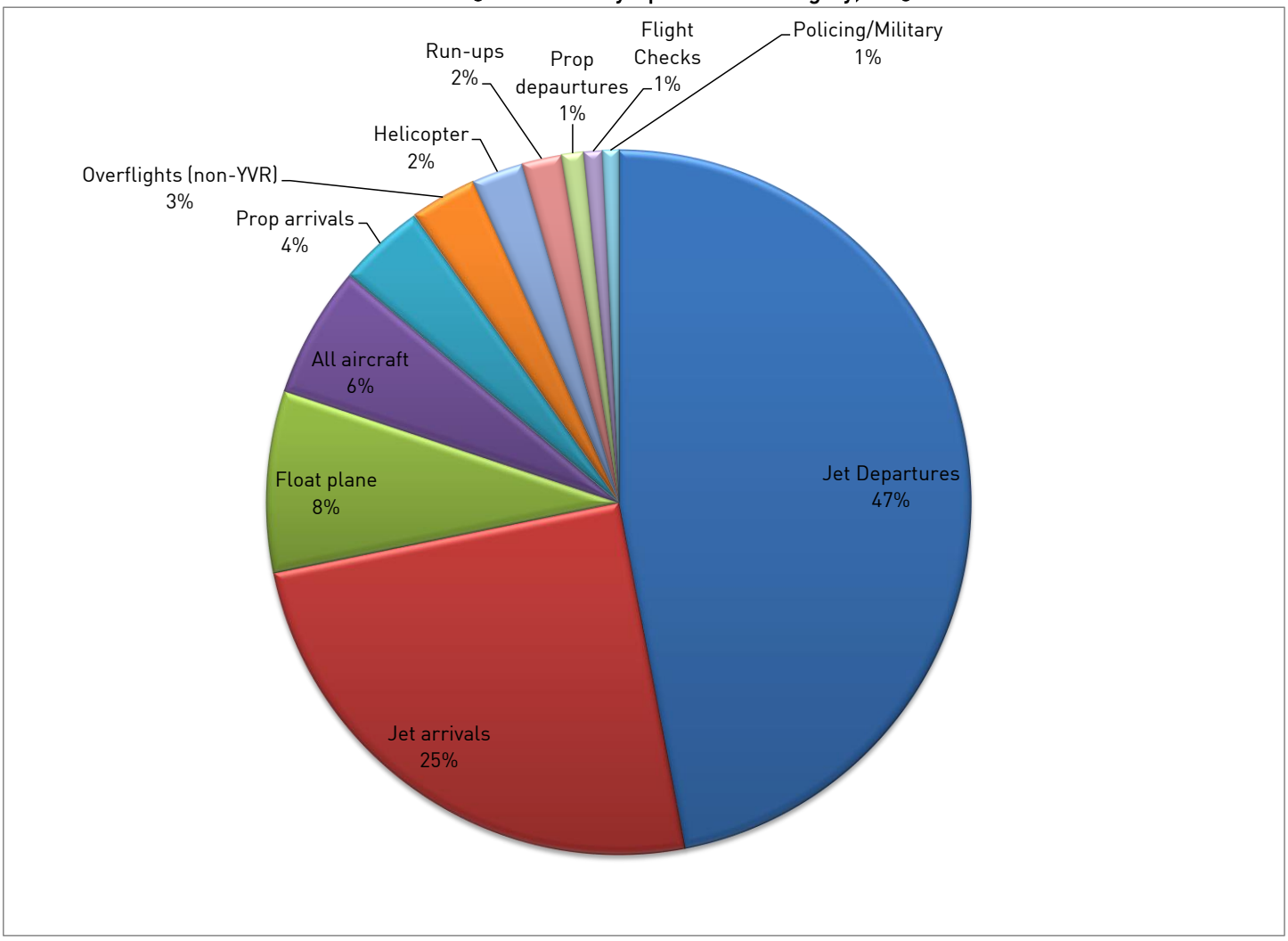
As illustrated, most concerns originated from the areas within a 10 nautical mile (nm) radius from the airport in 2015. However, some of the most frequent complainants reside in areas well outside a 10nm radius. Aircraft noise concerns outside the 10 nm radius are generally related to over-flight activities and the air traffic routing over populated areas.

NOISE CONCERN BY OPERATION TYPE

When reporting noise concerns, complainants generally provide details of date, time, and location of the noise event. Based on the information provided, each concern is registered into an operational category such as jet departure, jet arrival, helicopter and run-ups. In some cases, the information provided by the complainant is not sufficient to match it against an operational category. In these instances, Airport Authority staff will review flight tracks and procedures to best categorize the nature of the complaint. The nature of concerns varies greatly and often depends on where the individual lives with respect to the airport.

Figure 13 shows a breakdown of all YVR related noise concerns received in 2015 by operational category. Jet departures (47%) and arrivals (25%) were the top categories. Approximately 91% of the concerns associated with jet departures were submitted by two complainants from areas located more than 10 nm from the airport, and their concerns were generally related to the routing of departing aircraft leaving the airspace around YVR. Float plane activities generated 8% of the total concerns, and most of these were generated from one individual from the City of Richmond.

FIGURE 13: Concerns by Operational Category, 2015

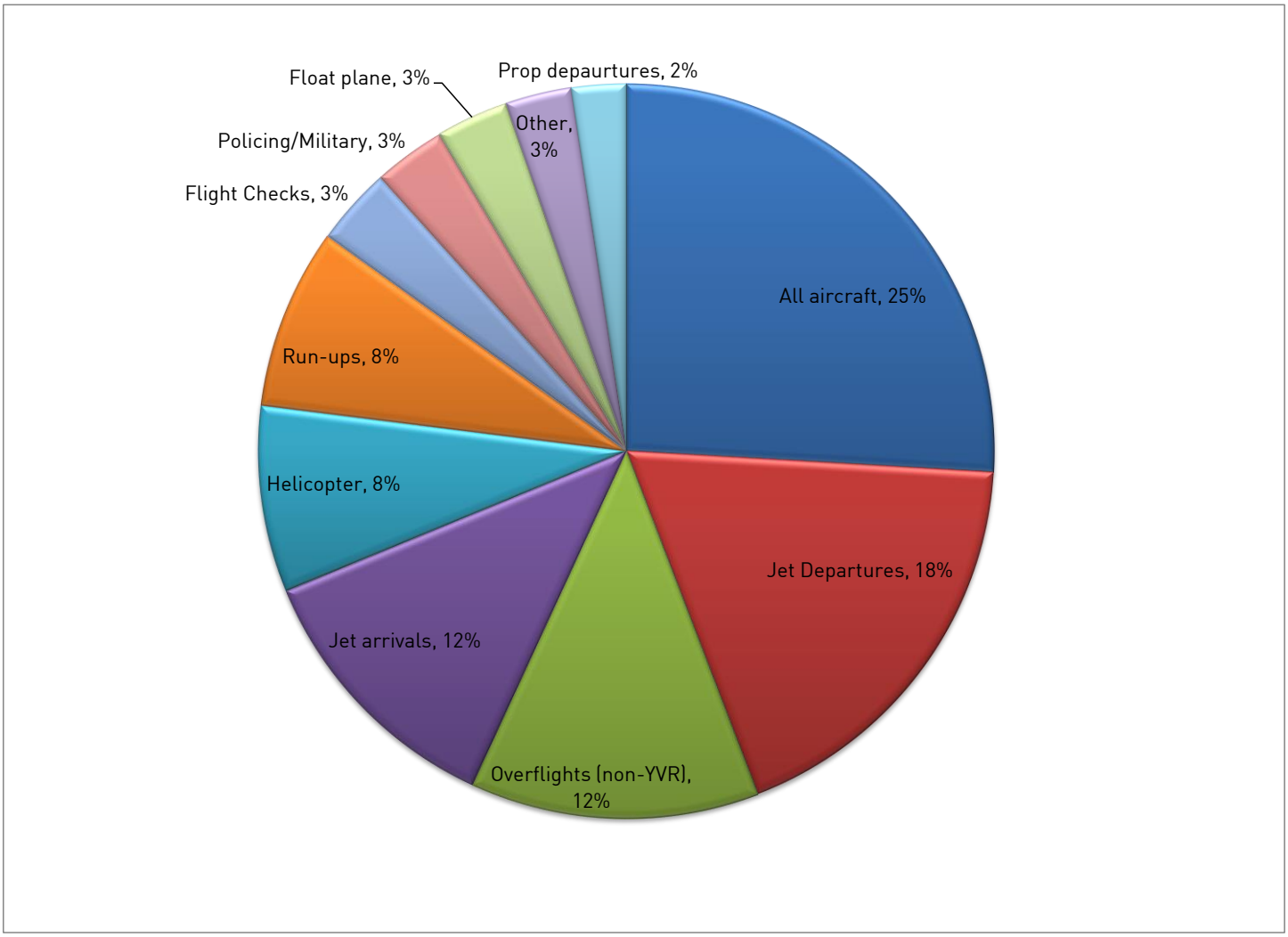


Further analysis excluding the five individuals who registered 77% of all concerns in 2015 was done to better understand the nature and trends of concerns from the other complainants. Figure 14 illustrates a breakdown of the concerns by operation types without these individuals and their concerns.

General concerns with no specific operations referenced by the complainant are categorized as "All aircraft", and this category made up 25% of all concerns. The combined categories of jet departures and arrivals were the next largest, making up 30% of all concerns.

Helicopter and run-up operations each made up 8% of all concerns. Over 70% of the concerns related to helicopter operations were registered by City of Vancouver residents. Helicopter operations are often associated with traffic and news reporting, filming, and air ambulance services. Due to the nature of operations, helicopters typically operate at lower altitude than commercial aircraft over the City. The majority of the concerns associated to run-up activities were registered by residents living in close proximity to south of the airport where a number of operators maintain their aircraft.

FIGURE 14: Concerns by Operational Category (excluding top 5 individuals), 2015

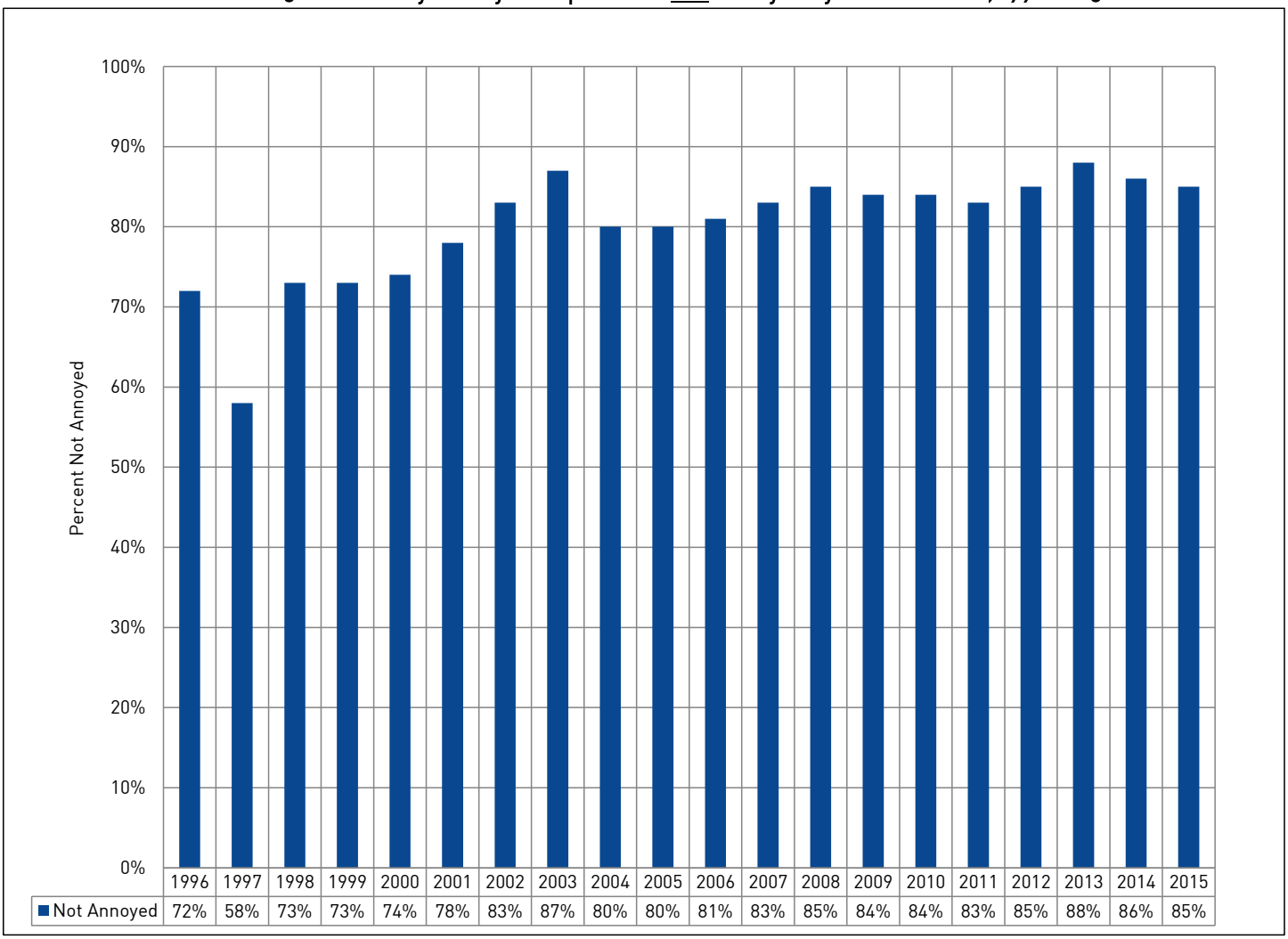


COMMUNITY SURVEY

Since the mid-1990s, the Airport Authority has commissioned a third party survey to track public attitudes and opinions about YVR on a number of topics including aircraft noise. This community survey represents the opinions of approximately 1,000 residents from across communities of the Lower Mainland and provides one means to gauge the level of community annoyance triggered by aircraft noise.

When asked, "*While you have been at home during the past year, have you been annoyed by aircraft noise in your neighbourhood?*" approximately 85% of the respondents in 2015 stated that they were *not* annoyed by aircraft noise. Figure 15 illustrates the trend since 1996.

FIGURE 15: Community Survey - Respondents Not Annoyed by Aircraft Noise, 1996-2015



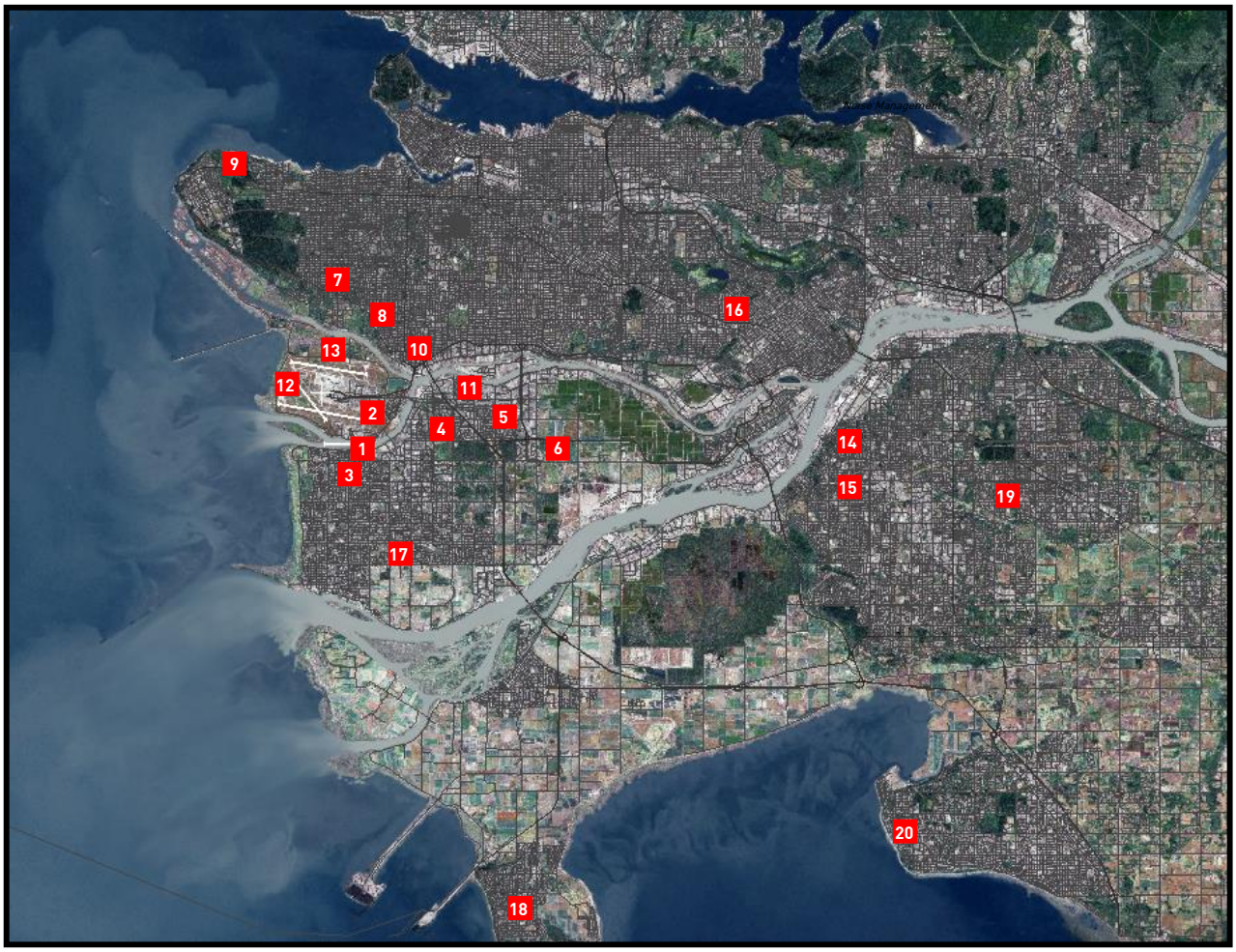
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Not Annoyed	72%	58%	73%	73%	74%	78%	83%	87%	80%	80%	81%	83%	85%	84%	84%	83%	85%	88%	86%	85%

NOISE MONITORING DATA

The monitoring of noise levels and aircraft activity in the vicinity of the airport is a major component of the YVR Aeronautical Noise Management Program. To achieve this, the Airport Authority uses a Brüel & Kjær Aircraft Noise & Operations Monitoring System ("ANOMS"), which allows for an objective assessment of aircraft noise levels in the surrounding communities. The system also allows the identification of trends, supports proposed changes to procedures, and checks for compliance with published procedures.

ANOMS combines noise data collected at Noise Monitoring Terminals ("NMT") with radar flight tracking data from NAV CANADA and mapping data from a Geographic Information System. ANOMS correlates flight track data with noise monitoring data collected at each NMT, which then allows an understanding of the contribution of aircraft noise at each site. Figure 16 illustrates the NMT network and their relationship to runways at YVR. In 2009, the Airport Authority replaced and upgraded all hardware at the NMT sites and expanded the network from 16 to 20 NMTs.

FIGURE 16: NMT Locations in the Lower Mainland



ANNUAL AVERAGE NOISE LEVELS (LEQ)

There are numerous metrics available to assess noise. One common metric for community noise assessment is the equivalent sound level, or average noise level ("Leq") measured over a given period of time. Table 8 presents the annual average Leq, measured in units of A-weighted decibel or dBA, at each NMT location for the last five years. The average noise levels, presented below, include contributions from all sources, including aircraft, motor vehicles, people, lawn mower, barking dogs, etc.

TABLE 8: Annual Average Noise Level (in dBA), 2011-2015

YEAR	NMT#1	NMT#2	NMT#3	NMT#4	NMT#5	NMT#6	NMT#7	NMT#8	NMT#9	NMT#10
2011	-	65.3	53.2	61.6	60.8	58.2	51.6	51.8	50.4	54.2
2012	-	65.5	53.5	60.9	58.8	58.2	-	52.2	50.7	54.0
2013	-	65.8	53.4	60.1	58.6	60.1	-	53.0	51.0	55.3
2014		65.0	52.7	60.6	58.5	69.4	-	55.4	50.3	54.4
2015	**61.4**	**65.1**	**52.7**	**60.3**	**58.4**	**61.7**	**58.4**	**52.0**	**50.1**	**54.3**

YEAR	NMT#11	NMT#12	NMT#13	NMT#14	NMT#15	NMT#16	NMT#17	NMT#18	NMT#19	NMT#20
2011	60.9	68.3	60.8	56.4	52.4	54.9	56.5	53.4	55.9	54.4
2012	60.1	63.9	59.5	55.1	52.9	54.9	53.5	53.9	53.9	53.4
2013	61.2	67.4	60.6	55.3	52.9	55.3	53.7	57.8	53.3	54.4
2014	60.8	74.7	61.0	65.7	53.1	54.5	54.0	57.5	55.7	54.3
2015	**61.4**	**65.1**	**61.5**	**64.1**	**53.5**	**56.3**	**56.2**	**54.7**	**55.9**	**53.0**

SINGLE EVENT NOISE LEVEL

Another metric used to assess noise is the single event noise level ("SEL"), measured in dBA. For an aircraft fly-over, either a landing or take-off, the SEL represents the total acoustic energy above a prescribed reference threshold. In general, the SEL is typically 10 dBA greater than the maximum noise level experienced during the aircraft fly-over. The primary use of the SEL is to provide a comparison of noise events with different noise levels and durations.

While reference thresholds are set individually at each NMT according to the ambient noise levels in the area, thresholds are typically set between 65 and 70 dBA during the day (7:00 AM – 10:00 PM) and between 55 and 60 dBA during the night.

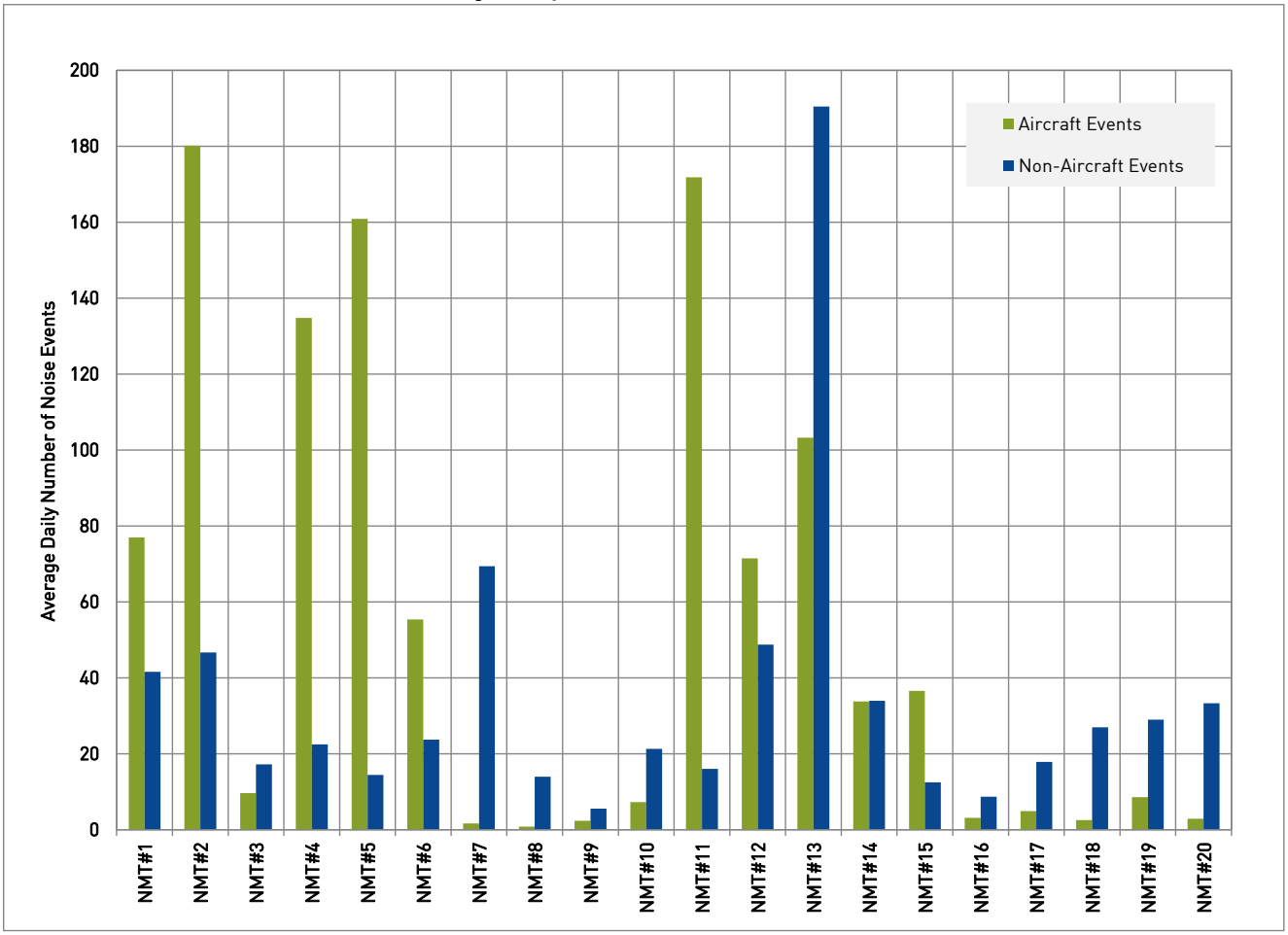
ANOMS categorizes noise events into types: correlated and uncorrelated. Correlated events are those associated with aircraft and uncorrelated events are those associated with other sound sources in the community. For NMTs located close to flight paths, noise events are primarily made up of aircraft related events, whereas noise events at NMTs located farther away from the airport and flight path are primarily made up of non-aircraft related events.

Table 9 presents the 2015 daily average number of aircraft and non-aircraft noise events above 70 dBA at each of the NMT locations and Figure 17 presents this same information graphically.

TABLE 9: Average Daily Number of Noise Events at NMTs, 2015

NMT #	Name	Location	Average number of DAILY noise events ≥ 70 dBA		
			Aircraft	Non-Aircraft	Total
1	Richmond Olympic Oval	6111 River Rd., Richmond	77	42	119
2	Airside Burkeville	Templeton St., Richmond	180	47	227
3	Lynas Lane Park	Lynas Lane & Walton Rd., Richmond	10	17	27
4	Tomsett Elementary	Odlin Rd. and No. 4 Rd., Richmond	135	23	157
5	Bath Slough	Bath Rd. & Bath Slough, Richmond	161	14	175
6	Outer Marker	Westminster Hwy & No. 7 Rd., Richmond	55	24	79
7	Crofton School	W41st & Blenheim St., Vancouver	2	69	71
8	McKechnie School	W59th & Maple St., Vancouver	1	14	15
9	UBC	Northwest Marine Dr., Vancouver	2	6	8
10	Marpole	W67th & Cartier St., Vancouver	7	21	29
11	Bridgeport	No. 4 Rd. & Finlayson Dr., Richmond	172	16	188
12	West Sea Island	Airside YVR, Richmond	71	49	120
13	North Sea Island	Ferguson Rd., Richmond	103	190	294
14	Annieville-Delview Second	9111-116th St., Delta	34	34	68
15	Alex Fraser Bridge	North Delta Rec. Ctr. 11415-84th Ave., Delta	37	12	49
16	Burnaby - St. Francis	6610 Balmoral St., Burnaby	3	9	12
17	Maple Lane Elementary	Alouette Dr. & Tweedsmuir Ave., Richmond	5	18	23
18	South Delta - Tsawwassen	53rd Street & 8A Ave., Delta	3	27	29
19	North Surrey	82A Ave. & 146th St., Surrey	9	29	38
20	South Surrey	20th Ave. & Ocean Forest Dr., Surrey	3	33	36

FIGURE 17: Average Daily Number of Noise Events at NMTs, 2015



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REPORTING:
Rachel Min, B.A. – Noise Information Officer
Mark Christopher Cheng, M.Eng. (mech) – Supervisor Noise Abatement & Air Quality

Note on Reported Figures and Data:

The Airport Authority receives aircraft operations data from NAV CANADA. This data includes daily aircraft arrivals and departures at YVR as well as aircraft transiting through the Vancouver Control Zone. Every effort is made to verify and correct anomalies in the dataset, and numbers stated in this report may vary slightly from those reported by others.

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