

**Attachment A:  
Operational Analysis of Taxi Queuing Alternatives  
for Taxiway November  
at Logan International Airport**

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## 1 INTRODUCTION

This document represents Attachment A to the main report “Logan International Airport, Additional Taxiway Evaluation Report.”<sup>1</sup> This Attachment presents an operational analysis of the use of Taxiway November conducted by the Federal Aviation Administration (FAA) and Harris Miller Miller & Hanson Inc. (HMMH). The main report discusses the purpose, methodology and results of all of the assessments.

### 1.1 Study Purpose

This study is a result of the August 2, 2002 Record of Decision (ROD) for the Airside Improvements Planning Project for Logan International Airport and fulfills its requirements for Phase 1. In that ROD, the FAA deferred any decision to approve the Centerfield Taxiway pending an additional evaluation of taxiway operations north of Runway 15R/33L (see existing Logan Airport Layout Plan in Figure 1) to address concerns of residents adjacent to the northern portion of the airfield regarding the use of Taxiway November, pertaining to compliance with the “good neighbor” policy portion of the Noise Abatement Order.

### 1.2 Study Process

Following the requirements of the ROD, the Phase 1 study involved meetings with three representatives each from the affected East Boston and Winthrop neighborhoods; the representatives were appointed by their respective municipal officials. In the meetings, the study team (FAA and HMMH) reviewed neighborhood concerns about the use of Taxiway November, and addressed them in the context of current policies, regulations and directives. Meeting minutes and other correspondence are presented as Attachment G to the main report.

To address the neighborhood concerns, the study team evaluated sixteen candidate actions suggested by the community representatives and three actions identified by the FAA pertaining to Taxiway November. The evaluations addressed issues of safety, feasibility, and operational efficiency as well as the potential environmental benefits. As part of the evaluation process, the FAA held several in-house meetings to discuss the actions and coordinate among the appropriate FAA divisions. This Attachment presents the results of that evaluation with respect to airport and aircraft operations. The environmental analyses are summarized in the main report, and presented in detail in separate Phase 1 study reports,<sup>2,3</sup> which are included as Attachments B and C to the main report.

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<sup>1</sup> “Logan International Airport, Additional Taxiway Evaluation Report per FAA August 2, 2002 Record of Decision,” Harris Miller Miller & Hanson Inc. Report 300280.001, May 2006.

<sup>2</sup> “Attachment B: Noise Analysis of Taxi Queuing Alternatives for Taxiway November at Logan International Airport,” Harris Miller Miller & Hanson Inc. Report No. 300280.003, prepared for the Federal Aviation Administration, May 2006.

<sup>3</sup> “Attachment C: Air Quality Analysis of Aircraft Taxing & Queuing Alternatives for Taxiway November at Logan International Airport,” Report No. 300280.004, prepared by URS Corp. & KB Environmental Sciences, Inc., May 2006.

The remainder of this Attachment describes the candidate actions and the study's conclusions regarding those actions.

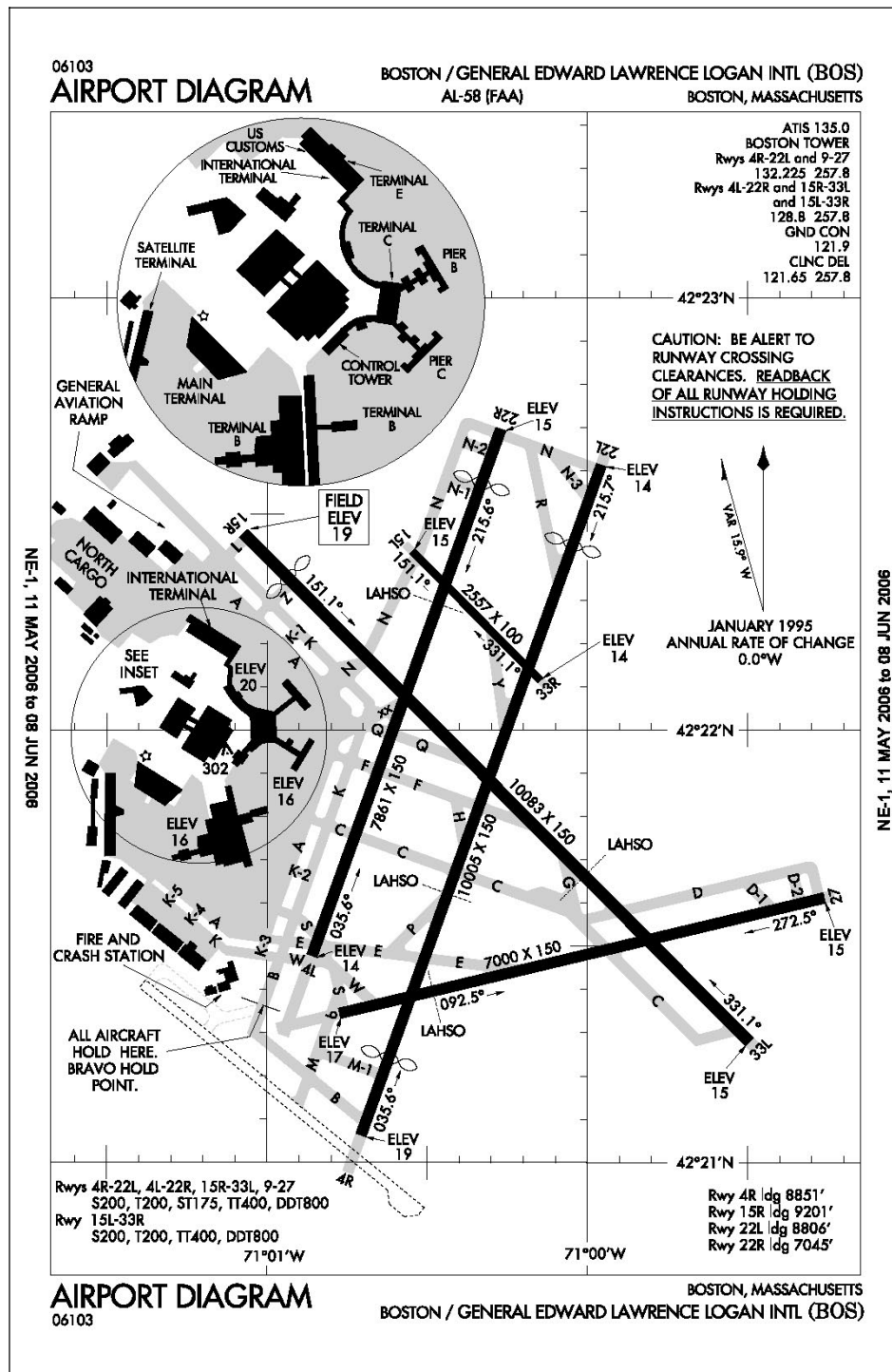


Figure 1 Boston Logan International Airport Layout



## 2 INITIAL EVALUATION OF CANDIDATE ACTIONS

This section lists first the sixteen actions suggested by the community representatives, and second, the three actions identified by the FAA. All nineteen candidate actions underwent an initial evaluation of their operational feasibility, safety implications and potential environmental benefits. The disposition of each action is discussed.

The information summarized below was presented to the community representatives on May 27, 2005. At this meeting, community representatives asked many questions. Some of these questions were answered at the time; others were answered later by incorporation into the meeting minutes. For some of the Actions presented below, the meeting minutes provide more detailed information. The minutes are included in Attachment G of this document.<sup>4</sup>

### 2.1 Action 1: Restrict the use of Taxiway November for queuing, including the use of a “hold line”

FAA previously used a hold line to limit queuing on Taxiway November. However, that hold line was in a non-standard location,<sup>5</sup> and it proved problematic because pilots became confused by it. Therefore, the FAA New England Runway Safety Program Manager was asked if the FAA could support the replacement of a noise abatement hold line that had previously been used on Taxiway November.<sup>6</sup> The Program Manager stated that the Program has been working with airport authorities across the U.S. to mark and sign all airports in accordance with current standards. This uniformity allows pilots to depart and arrive at any airport in the country and be familiar with the meaning of the markings and signage. The manager further stated that airports conforming to this standard have reduced pilot and vehicle operator confusion, thereby reducing the potential for runway incursions and aircraft accidents. As a result, the Runway Safety Program could not support the placement of a non-standard noise abatement hold line at Logan Airport.

In addition to the safety concerns, a hold line placed farther from the runway end impedes the efficient flow of aircraft onto Runway 22R, and is therefore problematic from an operational efficiency perspective.

### 2.2 Action 2: Revise the existing Noise Abatement Order to further limit the number of queued aircraft on Taxiway November

This action was determined to warrant further operational and environmental analysis. The approach, assumptions and results of the operational analysis are discussed below in Section 3. The noise and

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<sup>4</sup> “Attachment G: Correspondence and Meeting Minutes for Centerfield Taxiway Study, Logan International Airport,” Harris Miller Miller & Hanson Inc. Report No. 300280.008, prepared for the Federal Aviation Administration, May 2006.

<sup>5</sup> In accordance with FAA Advisory Circular 150/5340-1J, Standards for Airport Markings.

<sup>6</sup> Letter from Robert S. Bartanowicz, FAA Regional Administrator, to Thomas Kinton of Massport, dated February 8, 2002. The letter is included in Attachment G.

air quality environmental implications are summarized in the main report, and addressed in detail in the respective technical reports, Attachments B and C.

### **2.3 Action 3: Prohibit queuing of aircraft between Runways 22R and 22L**

The section of Taxiway November between Runway 22R and Runway 22L is used to stage aircraft for departure on Runway 22L and also when necessary to re-sequence aircraft departing on 22R due to traffic management initiatives or any other situation when an aircraft is not ready for departure. If this section of Taxiway November were not available for temporary queuing of aircraft, much longer queues and the potential for delays would be generated, thereby interfering with airport efficiency and increasing noise and air emissions.

### **2.4 Action 4: Queue aircraft farther south on Taxiway November**

This action requires the establishment of a hold line on Taxiway November south of the departure threshold. As a result, this action has the same problems with safety and efficiency issues as Action 1.

### **2.5 Action 5: Impose a curfew on the use of Taxiway November or Runways 22L and 22R during certain hours**

Closing the two primary runways or the access taxiway to those runways anytime winds are from the south or southwest would severely restrict airport usage and hamper airport operating efficiency. Therefore, such measures are not practical operationally. In addition, such action may constitute unjust discrimination of certain aeronautical activities.

### **2.6 Action 6: Restrict the use of Taxiway November to certain aircraft types during specified hours**

Such restrictions would limit the use of Runways 22L and 22R, and therefore have a negative impact on airport safety, efficiency and capacity. These runways represent one of the three most heavily-used configurations at Logan Airport, and such restrictions would have a serious impact on the airport's capacity.

### **2.7 Action 7: Build berms at the north end of the airport.**

Earth berms of sufficient height to provide any noticeable noise benefit would obstruct access to the approach ends of Runways 22L and 22R, resulting in a negative impact on safety. Also, due to the large footprint that berms require (four times as wide as tall), the adjacent wetlands would require fill, resulting in a negative wetlands impact.

### **2.8 Action 8: Tow aircraft to the departure end of 22R**

This action would significantly decrease departure rates, due to the increased time towing takes compared with taxiing. There is also a likelihood of increased dwell time on the taxiway as pilots complete their checklists while starting the engines. Therefore, it is considered to be an impractical and inappropriate action from the perspectives of the airport operator, the air carriers and air traffic

control. The following paragraphs provide more detail on the issues involved with towing aircraft to the ends of runways.

The merits of towing aircraft to the ends of runways as a means of reducing ground-based airport operational emissions has been deliberated for many years within the airport and environmental communities. While the concept appears to be a potential air quality mitigation measure, it has some hidden drawbacks that could inadvertently increase aircraft emissions and/or accidentally compromise the safety of the aircraft. Some of these considerations are briefly discussed in the paragraphs below.

Prior to take off, the pilots go through a mandatory and extensive check-list to ensure the aircraft is airworthy. An important part of this process requires the engines to be running so their performance and safety features can be verified. This pre-flight procedure is usually conducted at the terminal gate as the cargo and passengers are being loaded onto the aircraft. Towing the aircraft to the end of Runway 22R would require that this process be conducted closer to nearby communities (instead of in the terminal area) and likely increase the time each aircraft spends on the taxiway.

Similar to other internal combustion engines, aircraft engines go through a warm-up process as the dynamics of the combustion processes reach optimum temperatures and pressures. Until the engines reach this condition, the performance is less than ideal and excess emissions are generated. Towing the aircraft to the end of Runway 22R would require that the warm-up process be conducted closer to nearby communities (instead of in the terminal area) where these excess emissions would be released.

Most aircraft are designed to be towed with tugs and tractors and it is done on an “as needed” basis to maneuver the aircraft into or out off the terminal gate or to transport the aircraft from maintenance facilities or overnight parking areas. However, in many cases the aircraft landing gear are not designed to be towed over long distances or on a regular basis. Towing the aircraft to the end of Runway 22R could put additional stress on these aircraft and inadvertently compromise the structural integrity of the aircraft.

As a means of saving fuel, some pilots now elect to taxi the aircraft using one engine while maneuvering to the runway end. This measure also helps to reduce air emissions and is practiced at Logan by some airlines.

Based on the discussion above, it is unlikely that towing aircraft to the end of Runway 22R as a means of reducing emissions on the north end of the airport would be very effective, and it could even prove counterproductive. By comparison, the practice of single-engine taxing combined with the efficient movement of aircraft and adequate capacity on the taxiway system will serve to reduce emissions more effectively.

## **2.9 Action 9: Ensure compliance with regulations, orders and other commitments related to use of Taxiway November**

The FAA has been in compliance with all applicable regulations and orders relating to Taxiway November. The potential benefits of requiring the “good neighbor” policy at all times is addressed in the detailed evaluation of Action 2, discussed below in Section 3, and in Attachments B and C.

## **2.10 Action 10: Create an information system to monitor compliance with regulations, orders and other commitments related to use of Taxiway November**

Massport has existing systems to monitor airport operations and their impacts, including PASSUR, noise monitoring, and air quality monitoring. Data from these systems are accessible to members of the community. FAA has not identified any problems with compliance.

## **2.11 Action 11: Establish a telephone complaint line for citizens to report violations of regulations, orders and other commitments related to use of Taxiway November**

Massport has existing capabilities to receive complaints, questions and concerns at 617-561-3333. FAA reviews Massport's written reports of complaints that are received on the telephone hotline.

## **2.12 Action 12: Provide an air quality monitoring site for taxi operations at the north end of the airport**

Massport maintains an extensive network of 27 air quality monitoring sites both on the airport and in surrounding communities. Those sites in the vicinity of the north end of airport are in line with Runways 22L/22R, in East Boston and in Winthrop. These monitors are positioned strategically to monitor air quality impacts, including taxi operations at the north end of the airport. To date, there have been no recorded violations of the ambient air quality standards.

## **2.13 Action 13: Institute regulations or incentives to encourage shift to more "neighborhood-friendly" aircraft.**

While Massport or FAA cannot prohibit the use of aircraft that meet pertinent Federal regulations, Massport has worked with airlines to encourage use of quieter Stage 3 aircraft.

## **2.14 Action 14: Encourage development of more environmentally friendly aircraft engines.**

The Federal government (FAA and U.S. EPA) and international agencies (ICAO) are actively pursuing and mandating quieter and lower-emission aircraft engines. These developments are occurring on a global level, resulting from national and international agreements, and involving engine manufacturers, NASA and many other stakeholders. Massport and FAA have and will continue to support these efforts.

## **2.15 Action 15: Increase the use of other airports in the region to reduce traffic at Logan.**

FAA is funding and providing technical support to New England Regional Aviation System Plan (NERASP). The purpose of this study is to understand future air transportation needs of the region's population and economy and to assess the types of improvements that may be required to the region's system of commercial air service airports. It assumes that over the long term airline services will

continue to develop at both Logan and regional airports in order to offer passengers the most convenient access to scheduled air services.

Massport has committed to promoting increased utilization of other regional airports to relieve traffic at Logan, as stated in the Section 61 Findings published in the Logan Airside Improvements Project Final Environmental Impact Statement. FAA's funding decisions within the New England Region are consistent with that direction. From 1999 to 2003, the regional airports' share of commercial airline passengers has increased from 38% to 44%.<sup>7</sup>

### **2.16 Action 16: Close Taxiway November if/when the Centerfield Taxiway is built.**

The purpose of constructing the Centerfield Taxiway is to improve safety and the efficiency of operations by adding additional flexibility for taxiing aircraft in the north end of the airport. By closing Taxiway November, the existing constraints and queues would be transferred to the Centerfield taxiway, and the safety and efficiency benefits would be lost.

The following three actions were identified by the FAA's Boston Tower Work Group.

### **2.17 Action A: Install sound barriers around the north end of the airport, where possible, to shield the neighborhoods from aircraft visually and from some noise impacts.**

Massport has responsibility for construction on airport property, and has recently considered the construction of noise barriers at the north end of the airfield in connection with the removal of the blast fence. In consultation with community members, noise barriers were deemed costly and relatively ineffective. (Earth berms, an alternative form of barrier, are discussed above under Action 7.) Rather than pursue a noise barrier, Massport entered into an agreement with the Bayswater community that included a commitment of \$4,000,000 as mitigation for airport impacts on the community. Consistent with the removal of the blast fence, Massport has stated that its goal is to avoid adding new obstructions.

### **2.18 Action B: Plant trees around the north end of the airport, where possible, again to shield the neighborhoods from aircraft visually and from some noise impacts.**

Modest plantings of trees are not effective in reducing noise or air pollution noticeably. Only growths of trees several hundred feet deep with thick underbrush have been shown to reduce transportation noise levels noticeably.<sup>8</sup> Further, there is very little land available on or off the airport property where trees could be planted between the aircraft and the surrounding homes.

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<sup>7</sup> "2003 Environmental Data Report, Boston Logan International Airport," June 2004, p. 4-3.

<sup>8</sup> "Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation," International Standard ISO 9613-2, Dec. 1996.

**2.19 Action C: Hold aircraft waiting to depart on Runway 22R somewhere else on the airport surface, rather than on the north end of Taxiway November. Such a location could possibly be used either when traffic is light to keep queues from building at the north end of the airport and when traffic is heavy to reduce the number of aircraft that would otherwise be queued on Taxiway November.**

This action overlaps with Actions 1 through 4, above, and many of the difficulties with those actions are applicable to this one as well. The two primary difficulties with holding aircraft in locations other than on Taxiway November include 1) reduction of the efficient flow of aircraft and the introduction of delays, and 2) safety concerns relating to pilot confusion associated with holding in non-standard locations. The environmental effects associated with the modest changes to the aircraft queue locations associated with Action 2 are presented in the sections below.

### 3 CANDIDATE ACTION 2 OPERATIONAL EVALUATION

#### 3.1 Introduction

As described above in Section 2.2, Action 2 would revise the existing Noise Abatement Order (“good neighbor” policy) to limit the number of queued aircraft on Taxiway November at all times, rather than “when possible,” as the current order states. Such a revised order would state that no more than five jet aircraft would be permitted to queue north of Runway 15L.

Operational details of these revisions to the order were evaluated in detail and are reported here. The noise and air quality effects were also evaluated, and those are reported in summary form in the main report and in detail in the two technical reports included as Attachments B and C.

#### 3.2 Operations Model Overview

The approach taken to the operational evaluation was to “bracket” the potential environmental effects of changes to the Noise Abatement Order by examining two extremes of its use. One extreme would have the Order not implemented at all, and the other would have the Order implemented and required at all times. Therefore, two alternative scenarios of aircraft queuing on Taxiway November were developed:

1. Free Flow –Unconstrained queuing of aircraft operations on Taxiway November
2. Limit All Jets – A maximum of five turbojet aircraft queued north of the intersection with Runway 15L *at all times*.

In the summer of 2003 during a 24-hour period when Runways 22R and 22L were in continuous use for departures, FAA staff in the Boston Tower kept a detailed log of the status of the queue on Taxiway November. This log was used to develop a model of the taxi and queue/hold times for each aircraft during that day. The model was then extended to compute taxi/queue times under the Limit All Jets restricted flow condition. Finally, the times were scaled up to represent the number of operations on a worst-case busy day for use in the analysis of environmental effects.

#### 3.3 Operations Modeling Details

In the summer of 2003 during a 24-hour period when Runways 22R and 22L were in continuous use for departures, FAA staff in the tower kept a detailed log of the status of the queue on Taxiway November. The log includes a record for each departing aircraft, and lists the aircraft type, the time it arrived at the queue (to the nearest minute) and the time it departed. There were 629 departures logged on that day, representing a day with average traffic volume. The log is presented as Table 4 in Appendix A.

##### 3.3.1 Taxi/Queue times computed directly from FAA logs

To develop information needed for the noise and air quality analyses, Harris Miller Miller & Hanson Inc. (HMMH) used the FAA log to determine the amount of time each aircraft spends in each of 15 taxi/hold segments along Taxiway November between runway 15R and 22L. This determination was accomplished with a computer program developed for this purpose. Figure 2 shows the locations and

names of taxi and hold segments on Taxiway November developed for the model. Most of the positions are 80 meters (260 feet) long, representing an average spacing between queued aircraft. The “taxi/queue time” computer program was further refined with logical algorithms to calculate the times in each segment under the Limit All Jets restrictive condition where no more than five jets may hold north of Runway 15L. The model includes taxi-through time as well as queue hold time. Taxi speed is assumed at 15 knots. Appendix B provides more information on this model.

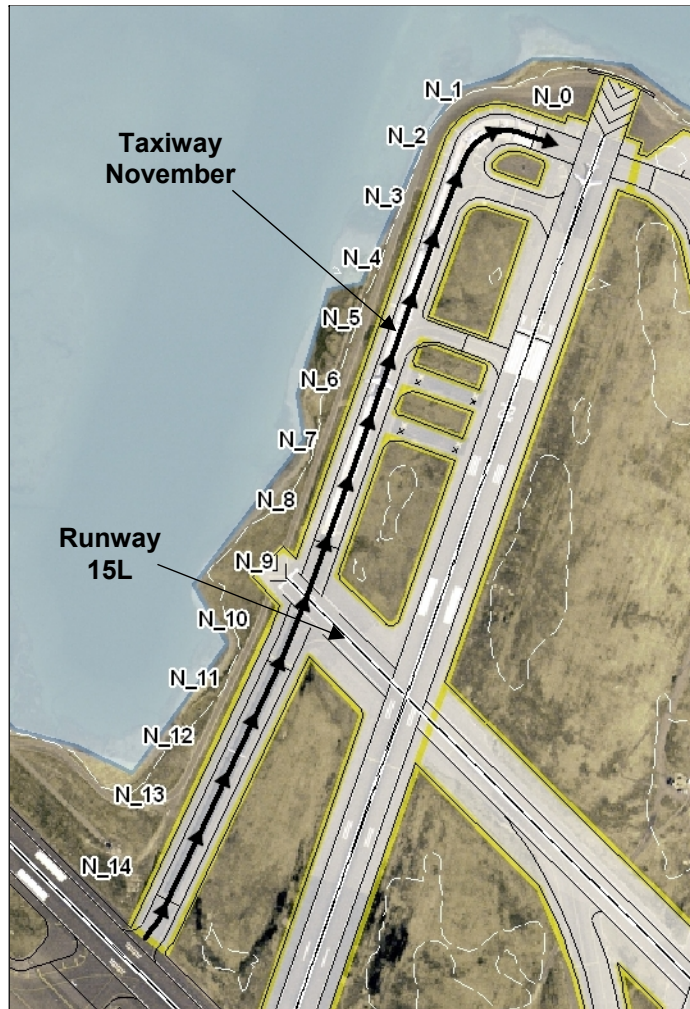


Figure 2 Taxi and Queue Positions on Taxiway November



Figure 3 shows a graph of state of the queue on Taxiway November for the Free Flow condition. The graph is a stacked bar chart showing vertically the taxiway locations that are filled, forming the queue, plotted against the time of day on the horizontal axis. The chart shows green where aircraft occupy taxiway locations N\_1 to N\_9, and orange for N\_10 and greater, which are the locations south of Runway 15L. Note that only during the peak queue periods does the queue length become long enough to extend south of Runway 15L.

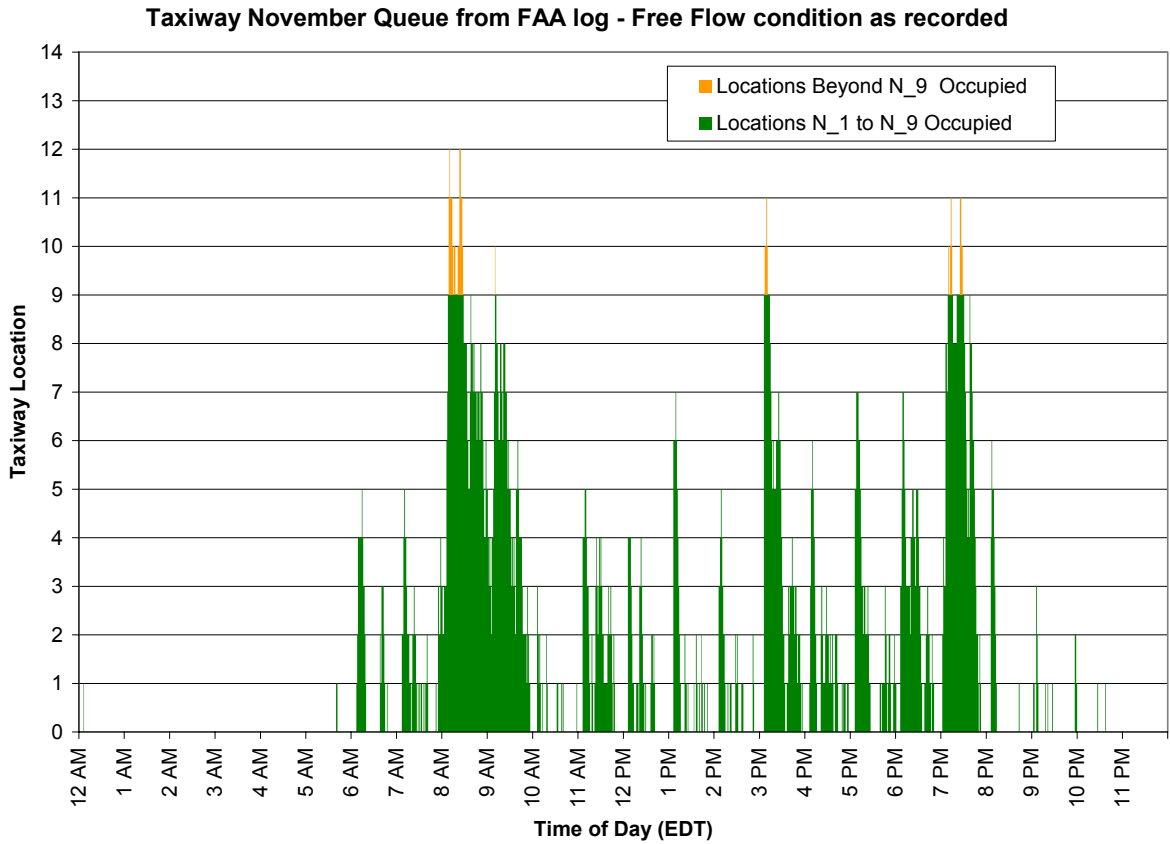
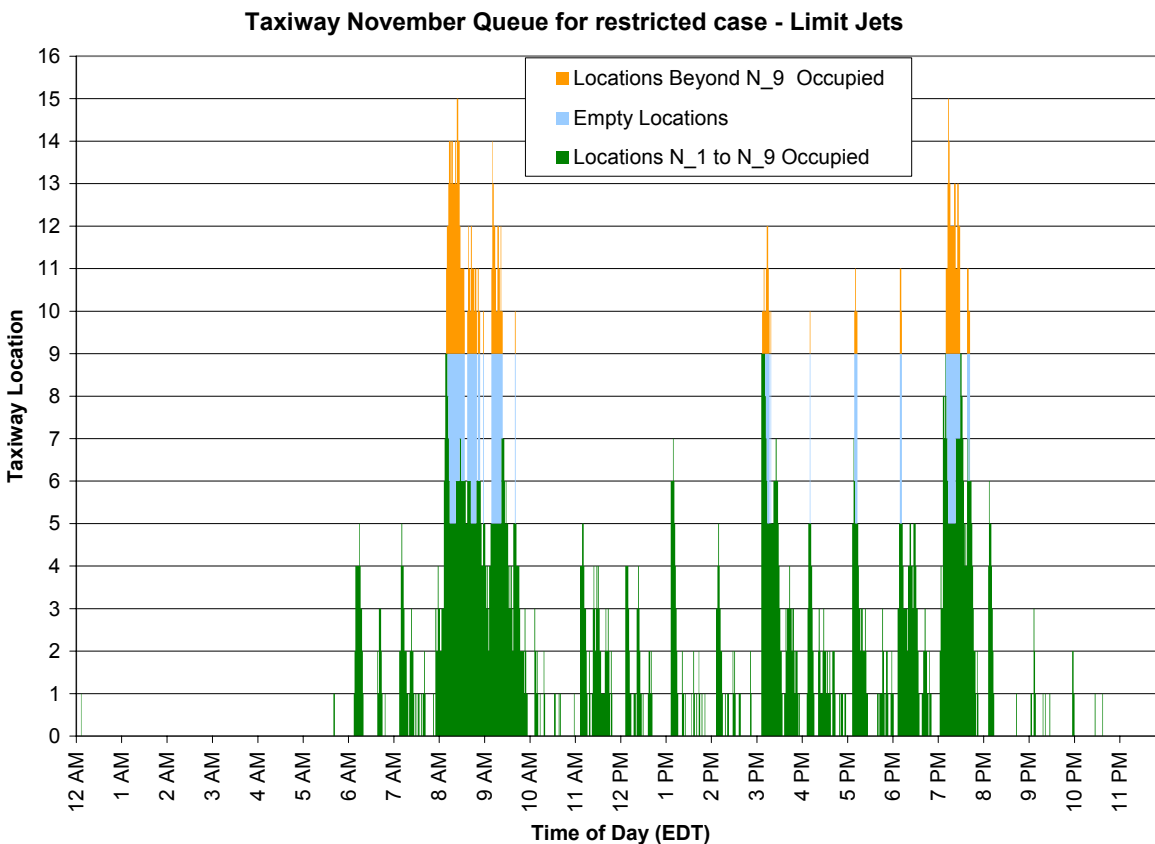


Figure 3 Taxiway November Queue from FAA log - Free Flow condition

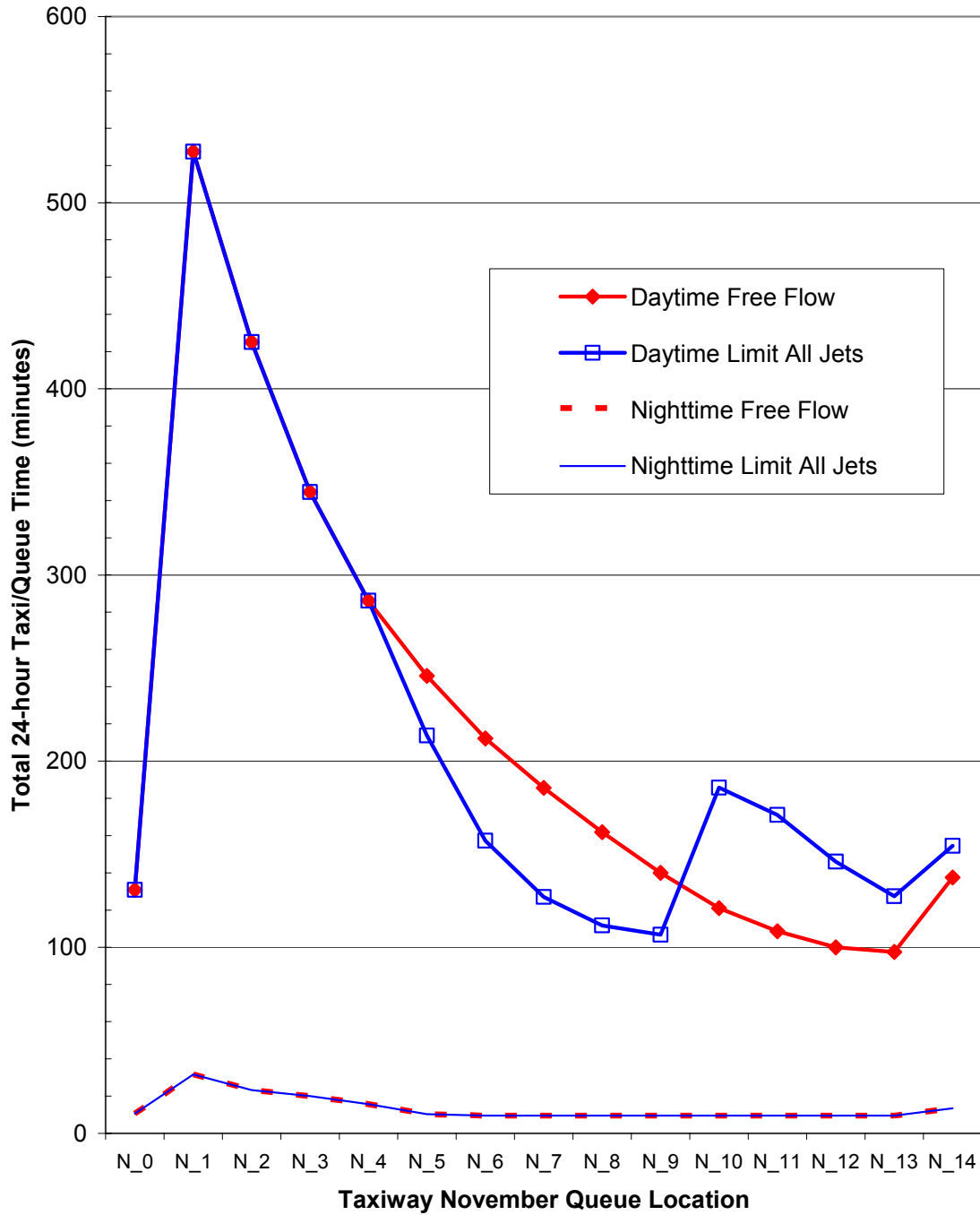
Figure 4 shows the taxi and queue times per location for the restricted Limit All Jets condition. As for the Free Flow condition, green shows where locations N\_1 to N\_9 are occupied and orange where locations N\_10 or greater are occupied. However, in this chart, light blue is used to designate the locations that are empty when the restrictions are working in locations N\_6 through N\_9. Note that the number of empty (blue) locations varies from moment to moment. The number of empty locations decreases with each turboprop aircraft entering the queue at N\_9, since they are not affected by the restriction. Also, note that for two brief periods, locations greater than N\_14 are shown as occupied. When this occurs, the queue along Taxiway November is full north of Runway 15R, and one aircraft would be required to hold south of Runway 15R for those periods.



**Figure 4 Taxiway November Queue – Limit All Jets condition**

The total time all aircraft spend in each taxi/queue segment/location was summed separately for the 7 AM to 10 PM period (the “daytime” period for DNL noise computations) and the 10 PM to 7 AM period (DNL nighttime). Figure 5 presents a graph that compares the total taxi/queue times by location for both the Free Flow and the Limit All Jets alternatives, for daytime and nighttime separately. The taxi/queue time modeling shows no differences between the alternatives in the daytime queue times at Positions N\_0 through N\_4, because there are no variables at those positions. That is, the Limit All Jets restrictions do not affect the closest positions to the runway end because the restriction allows up to five jets to be queued north of Runway 15L. During the peak daytime periods, the taxi/queue times at positions N\_5 through N\_9 are reduced in the Limit All Jets case.

**Comparison of Total 24-hour Aircraft Taxi/Queue time on November by Location from FAA Log: Free Flow vs. Limit All Jets**



**Figure 5 Comparison of Total Taxi/Queue time by Location on November from FAA log for Free Flow and Limit All Jets conditions**

The reduction in total queue time for the daytime period from the Free Flow case is between 13% and 31%, depending on location. However, there are commensurate increases in queue time at the N\_10 through N\_14 positions in the Limit All Jets case, such that the total queue times on the entire length of Taxiway November are nearly identical between the two cases. There are no differences between the cases during the DNL nighttime hours between 10 PM and 7 AM, since the queue lengths are always short. Location N\_0 has very little time because it is only used for taxi-through to the runway; no aircraft are held at this location. Location N\_14 has slightly greater times than the other locations because its segment length is slightly longer, so aircraft spend more time taxiing through it.

**3.3.2 Taxi/Queue times scaled up from logs to represent a worst-case busy day**

For the purposes of the noise and air quality analyses, FAA Boston Tower staff carefully reviewed the operations log with the objective of scaling the activity level up from a day of average operational volume, as represented by the log, to a busy peak-day scenario. Their evaluation examined both historical records of busy periods as well as the capacity of the operational configuration. The FAA staff determined that the most activity that could or would occur over a 24-hour period would represent a 30% increase in the activity recorded in the log. That 30% increase was incorporated into the noise and air quality studies with the assumption that the increased activity would occur uniformly throughout the day and night, with the same mix of aircraft as recorded in the log.

Table 1 presents the sums of all taxi and queue minutes over aircraft type and location to show the total daytime, nighttime and total minutes for the two alternatives. Again, these times are for a worst-case busy 24-hour period with Runways 22L and 22R in continuous use for departures. The times have been grouped into three different sections of the taxiway, north of Runway 15L, between Runways 15R and 15L, and south of Runway 15R. As described above, the times have been scaled up from the FAA logs by 30%. Also as mentioned above, differences between the alternatives are only apparent during the daytime period, when queues are long enough for the limiting case to be different. During the daytime period, there is a reduction of 254 minutes (8%) in aircraft queue time north of Runway 15L in the Limit All Jets alternative relative to the Free Flow case. The corresponding 254 minute increase in queue time south of Runway 15L in the Limit All Jets alternative represents a 28% increase over the Free Flow alternative.

**Table 1 Total 24-hour Taxi/Queue Time by Section of Taxiway by Alternative on a Worst-case Day**

Section of Taxiway	Free Flow Alt. (minutes)			Limit All Jets Alt. (minutes)		
	Day	Night	Day+Night	Day	Night	Day+Night
North of 15L	3,275	182	3,457	3,021	182	3,203
15R to 15L	916	79	995	1,159	79	1,238
South of 15R	0	0	0	11	0	11
Total	4,191	261	4,452	4,191	261	4,452

In the taxi/queue time model, the daily taxi/queue times were summed across aircraft types into the appropriate aircraft “group,” by location. (See Attachment B to the main report entitled “Noise Analysis of Taxi Queuing Alternatives for Taxiway November at Logan International Airport” for details on the grouping of aircraft types for purposes of the noise analysis.) Table 2 and Table 3 show

the number of “equivalent” minutes by each aircraft group at each location for the Free Flow and Limit All Jets conditions. For purposes of computing DNL in the noise model, the daytime and nighttime minutes of taxi time for each aircraft type at each location was condensed by expressing the taxi time in “equivalent minutes.” To compute this, the minutes of taxi time that occurred at night between 10 PM and 7 AM were multiplied by 10, since each minute of nighttime operation is equivalent to 10 daytime minutes in DNL computations. These “weighted” nighttime minutes were then added to all of the daytime minutes for a total 24 hours of “equivalent minutes” of taxi operations for each aircraft type at each taxi segment/location.

Table 2 and Table 3 show that as a group, the Large air carrier jets contribute the most time on the taxiway with over 3000 equivalent minutes. The next largest contributing group is regional and corporate jets with about 2000 minutes in each scenario. The times in the tables follow the same trends as the graph in Figure 5, that is, the Limit All Jets Alternative shows fewer taxi/queue minutes than the Free Flow alternative at locations N\_5 through N\_9, and more minutes at locations N\_10 through N\_14. The total number of taxi minutes is very slightly different in the two scenarios, because Table 3 does not include the 11 minutes of taxi/hold time that was south of Runway 15R in the Limit All Jets scenario. Appendix C presents tables showing the more detailed breakdown of equivalent minutes by aircraft *type* at each location for each study alternative. The appendix also presents a table that provides for each aircraft type, the aircraft manufacturer, model number and noise group it falls into.

**Table 2 Free Flow Condition – Equivalent Taxi and Hold Minutes by Location and Aircraft Group**

Group	Equivalent Minutes (day+10*night)															All Locations
	N_0	N_1	N_2	N_3	N_4	N_5	N_6	N_7	N_8	N_9	N_10	N_11	N_12	N_13	N_14	
Jumbo	7	18	12	12	15	14	12	12	11	10	9	8	8	8	11	168
Heavy	17	74	51	26	21	18	17	15	15	15	13	13	13	13	19	340
Large	133	498	445	375	298	208	172	159	143	131	121	115	107	105	148	3155
RJCJ	96	320	200	171	149	133	127	116	108	96	88	81	79	78	110	1952
Prop	54	186	148	124	93	82	72	63	57	54	49	47	46	46	65	1189
All Groups	307	1097	856	708	576	454	400	365	334	306	281	265	254	250	353	6805

**Table 3 Limit All Jets Condition – Equivalent Taxi and Hold Minutes by Location and Aircraft Group**

Group	Equivalent Minutes (day+10*night)															All Locations
	N_0	N_1	N_2	N_3	N_4	N_5	N_6	N_7	N_8	N_9	N_10	N_11	N_12	N_13	N_14	
Jumbo	7	18	12	12	15	11	8	8	8	8	12	11	12	11	13	167
Heavy	17	74	51	26	21	17	16	13	13	13	15	15	15	15	20	340
Large	133	498	445	375	298	183	133	121	110	109	179	158	133	118	158	3150
RJCJ	96	320	200	171	149	120	102	91	88	84	113	105	98	94	116	1947
Prop	54	186	148	124	93	82	68	56	49	48	46	57	56	52	68	1189
All Groups	307	1097	856	708	576	412	328	289	269	262	365	346	314	289	376	6794

### 3.4 Efficiency and Safety Evaluation

After experience with implementing the “good neighbor” policy portion of Noise Abatement Order in recent years, and consideration of the proposed Limit All Jets Alternative, the FAA’s Boston Tower Work Group concluded that the restrictions would have an adverse impact on operational efficiency, flexibility and safety. The following paragraphs describe these specific operational concerns and conflicts.

- When utilizing either a northeast- or southwest-flow configuration that includes Runways 4L/22R and/or Runways 4R/22L, the available taxiway area around the terminals is extremely limited. Alpha and Kilo taxiways, which surround all five airfield terminals, provide the only taxi routes between the runways and terminal gate areas for arriving and departing aircraft. The ground controller(s) must exercise extreme vigilance to prevent aircraft from becoming gridlocked on Alpha, Kilo and interconnecting taxiways, while handling all of the arrival and departure traffic and providing for a safe and expeditious departure flow.
- Sequencing of departures by ground control is critical when utilizing the southwest-flow configuration (27/22L/R), because all jet aircraft fly the Standard Instrument Departure (SID), which turns them eastbound over the water following each other. Before aircraft reach Taxiway November and establish the final aircraft departure queue, FAA ground controllers must consider many factors to determine an appropriate and efficient aircraft sequence. These factors include appropriate sequencing/queuing of propeller aircraft with the jets as well as wake turbulence separation requirements for each aircraft, which are based on aircraft type, initial route of flight, and traffic management restrictions imposed for certain destinations or routes of flight.
- Limiting the Taxiway November queue to no more than five jets north of Runway 15L at all times would result in:
  - Additional communication (“phraseology”) requirements that would increase radio-frequency congestion,
  - A requirement to monitor the number of aircraft north of Runway 15L, which would distract the ground controller from his/her critical and primary safety-related duties,
  - Increased aircraft traffic volume in the terminal areas due to the increased length of the taxi queues, directly affecting the expeditious flow of both arriving and departing aircraft, which ultimately has a negative impact on the National Airspace System.

## APPENDIX A FAA LOG OF QUEUING ON TAXIWAY NOVEMBER

This appendix presents the detailed log of aircraft queuing on Taxiway November kept by FAA Boston Tower personnel that formed the basis for the operations analysis for this study. The log was kept for a 24-hour period in the summer of 2003 when Runways 22R and 22L were in continuous use for departures. The log includes a record for each departing aircraft and lists the proposed departure time, the time the aircraft arrives at the queue (to the nearest minute), the actual departure time, the aircraft type, the airline and the destination. There were 629 departures logged on that day, which represents a day with average traffic volume.

Table 4 FAA 24-hour Log of Aircraft Queuing Activity on Taxiway November

Eastern Std. Time (hr)	Proposed time from strip: zulu time	Arrival at taxiway queue: zulu time	Actual departure time: zulu time	Aircraft type	Airline	Destination
00	0400	0406	0406	H25B	GA	FRG
00	0400	0406	0407	LJ35	USC	TEB
00	0415	0421	0421	PA31	USC	BDL
00	0430	0436	0436	PA32	GA	MVY
00	0445	0451	0451	BE58	USC	BDL
02	0630	0636	0636	LJ35	USC	CMH
02	0645	0651	0651	PA31	USC	BDL
02	0650	0656	0656	LJ35	GHP	PHL
03	0725	0731	0731	BE58	USC	TEB
05	0923	0932	0932	B72Q	FDX	PWM
05	0930	0940	0940	A319	USA	PHL
05	0930	0940	0941	B733	USA	CLT
05	0931	0941	0942	CRJ2	COM	DCA
05	0940	0948	0948	B752	DAL	CVG
06	1000	1007	1007	A320	NWA	DTW
06	1000	1007	1008	E135	EGF	LGA
06	1000	1008	1009	B737	COA	IAH
06	1000	1008	1010	B752	AMT	MDW
06	1000	1009	1012	A306	AAL	MIA
06	1000	1009	1014	A319	USA	LGA
06	1000	1009	1015	B733	USA	DCA
06	1000	1010	1016	B733	DAL	LGA
06	1005	1012	1017	A320	UAL	IAD
06	1005	1014	1018	MD80	AAL	ORD
06	1005	1014	1019	MD80	AAL	STL
06	1010	1017	1020	A319	NWA	MSP
06	1015	1023	1023	J328	BLR	PHL
06	1020	1027	1027	E135	EGF	DCA
06	1030	1038	1038	B733	COA	CLE

<b>Eastern Std. Time (hr)</b>	<b>Proposed time from strip: zulu time</b>	<b>Arrival at taxiway queue: zulu time</b>	<b>Actual departure time: zulu time</b>	<b>Aircraft type</b>	<b>Airline</b>	<b>Destination</b>
06	1030	1038	1039	B733	COA	EWR
06	1030	1038	1040	B763	DAL	ATL
06	1030	1040	1042	B733	DAL	LGA
06	1030	1040	1043	B733	USA	PHL
06	1030	1040	1044	B734	USA	PIT
06	1036	1042	1045	BE58	USC	BDL
06	1040	1048	1048	B712	MEP	MKE
06	1040	1048	1049	CRJ1	ACA	CYUL
06	1045	1053	1053	J328	BLR	EWR
06	1050	1058	1058	A319	ACA	CYYZ
07	1100	1107	1107	B712	TRS	BWI
07	1100	1107	1108	B762	UAL	SFO
07	1100	1107	1110	E135	EGF	LGA
07	1100	1108	1111	B752	DAL	RSW
07	1100	1109	1113	A319	USA	LGA
07	1100	1109	1114	B733	USA	DCA
07	1100	1110	1115	B752	USA	CLT
07	1100	1110	1117	B752	USA	PHL
07	1105	1115	1119	A306	AAL	TJSJ
07	1111	1120	1121	MD80	AAL	DFW
07	1115	1121	1122	B190	UCA	HPN
07	1115	1121	1123	C402	KAP	ACK
07	1115	1122	1124	B752	UAL	ORD
07	1115	1123	1126	B190	CJC	RUT
07	1115	1123	1127	J328	BLR	PWM
07	1120	1128	1128	A319	ACA	CYVR
07	1120	1128	1129	J328	BLR	JFK
07	1120	1130	1130	A320	AJM	MKJS
07	1120	1130	1131	B752	AAL	MTPP
07	1125	1132	1133	E135	EGF	BWI
07	1125	1133	1134	CRJ2	COM	CVG
07	1130	1136	1136	ASTR	GA	BRL
07	1131	1136	1137	B190	SKK	CYHZ
07	1130	1138	1138	B733	COA	EWR
07	1130	1138	1139	B752	DAL	TPA
07	1130	1139	1141	MD80	AAL	FLL
07	1130	1140	1142	B738	DAL	LGA
07	1140	1147	1147	E135	EGF	RIC
07	1140	1149	1149	A306	FDX	IND
07	1145	1152	1152	B712	TRS	PHL
07	1143	1152	1153	B72Q	FDX	IND
07	1145	1154	1154	B752	AAL	LAX
07	1145	1155	1156	A320	TAI	
07	1145	1155	1157	B752	AAL	TXKF



Eastern Std. Time (hr)	Proposed time from strip: zulu time	Arrival at taxiway queue: zulu time	Actual departure time: zulu time	Aircraft type	Airline	Destination
07	1145	1155	1159	B752	USA	PHL
08	1150	1157	1201	B752	UAL	DEN
08	1150	1158	1203	B733	COA	IAH
08	1150	1158	1204	B752	AWE	LAS
08	1155	1203	1206	B190	CJC	BHB
08	1155	1203	1207	B764	DAL	ATL
08	1155	1204	1209	A306	FDX	MEM
08	1200	1206	1211	C402	KAP	ACK
08	1200	1206	1212	C402	KAP	ACK
08	1200	1206	1213	C402	KAP	MVY
08	1200	1206	1214	C402	KAP	PVC
08	1200	1207	1215	B752	NWA	MSP
08	1200	1207	1217	E135	EGF	LGA
08	1200	1208	1218	B738	DAL	DFW
08	1200	1208	1219	CRJ1	ACA	CYUL
08	1200	1209	1220	A319	USA	LGA
08	1200	1209	1221	B733	USA	DCA
08	1200	1209	1222	B737	ASA	SEA
08	1200	1210	1223	A319	USA	TXKF
08	1205	1212	1224	E135	EGF	PHL
08	1205	1213	1225	B752	DAL	FLL
08	1207	1216	1227	B738	AAL	ORD
08	1210	1217	1228	E135	EGF	RIC
08	1213	1219	1229	C402	KAP	MVY
08	1210	1220	1230	B772	BAW	EGLL
08	1215	1221	1232	FA50	GA	HPN
08	1215	1221	1233	LR45	LXJ	HVN
08	1215	1222	1234	A320	UAL	ORD
08	1215	1223	1235	B190	CJC	HPN
08	1215	1223	1236	B752	DAL	MCO
08	1215	1223	1238	J328	BLR	CYUL
08	1215	1224	1239	MD80	AAL	MIA
08	1221	1230	1240	MD80	AAL	DFW
08	1225	1232	1241	E135	EGF	DCA
08	1230	1236	1242	PA31	USC	BDL
08	1230	1237	1243	B752	UAL	SFO
08	1230	1237	1245	E135	EGF	CMH
08	1230	1238	1246	B735	COA	EWR
08	1230	1238	1247	CRJ2	ASH	PHL
08	1230	1238	1248	E145	CHQ	BUF
08	1230	1240	1249	B733	DAL	LGA
08	1235	1242	1250	B752	UAL	LAX
08	1235	1242	1252	E135	EGF	CYYZ
08	1235	1245	1253	CRJ2	COM	DCA

<b>Eastern Std. Time (hr)</b>	<b>Proposed time from strip: zulu time</b>	<b>Arrival at taxiway queue: zulu time</b>	<b>Actual departure time: zulu time</b>	<b>Aircraft type</b>	<b>Airline</b>	<b>Destination</b>
08	1240	1247	1254	E135	EGF	CYQB
08	1240	1247	1255	E135	EGF	RDU
08	1240	1248	1256	SF34	CJC	PQI
08	1240	1249	1257	B752	AAL	SJC
08	1245	1251	1259	C56X	EJA	AUG
09	1245	1251	1300	H25B	OPT	HTO
09	1245	1253	1301	J328	BLR	BTV
09	1250	1257	1302	B752	NWA	DTW
09	1250	1258	1304	CRJ1	ACA	CYOW
09	1250	1258	1305	E145	LOF	RIC
09	1253	1300	1306	B712	TRS	BWI
09	1255	1303	1307	DH8A	ALO	SYR
09	1300	1306	1308	B190	UCA	HPN
09	1300	1306	1309	C402	KAP	MVY
09	1300	1306	1310	H25C	EJA	IAD
09	1300	1307	1311	E135	EGF	LGA
09	1300	1308	1312	A319	ACA	CYYZ
09	1300	1308	1313	J328	BLR	PHL
09	1300	1309	1314	A319	USA	LGA
09	1300	1309	1315	B733	USA	DCA
09	1300	1309	1316	DC10	FDX	MEM
09	1300	1310	1318	B732	RYN	ACY
09	1300	1310	1319	B734	USA	CLT
09	1300	1310	1320	B763	DAL	TXKF
09	1300	1310	1322	B772	AAL	EGLL
09	1305	1313	1324	B752	DAL	CVG
09	1307	1316	1326	MD80	AAL	DFW
09	1310	1317	1327	B712	TRS	ATL
09	1310	1317	1328	E135	EGF	BWI
09	1310	1318	1329	J328	BLR	CYHZ
09	1315	1321	1330	C402	KAP	ACK
09	1315	1321	1331	C402	KAP	ACK
09	1315	1322	1332	B752	UAL	ORD
09	1320	1328	1334	B762	DAL	ATL
09	1320	1328	1336	E145	CHQ	IND
09	1320	1330	1337	B752	USA	PIT
09	1325	1333	1339	DH8A	ALO	MDT
09	1325	1335	1340	CRJ2	COM	DCA
09	1330	1338	1341	B738	COA	EWR
09	1330	1338	1342	E145	CHQ	CMH
09	1329	1338	1343	MD80	AAL	ORD
09	1330	1339	1344	B763	AAL	SFO
09	1330	1340	1346	B733	DAL	LGA
09	1330	1340	1347	B734	USA	PHL

Eastern Std. Time (hr)	Proposed time from strip: zulu time	Arrival at taxiway queue: zulu time	Actual departure time: zulu time	Aircraft type	Airline	Destination
09	1335	1343	1348	J328	BLR	JFK
09	1335	1344	1349	B752	AAL	STL
09	1340	1348	1351	E145	CHQ	ROC
09	1340	1349	1352	B752	AAL	SEA
09	1345	1351	1354	B190	UCA	ALB
09	1345	1353	1355	A320	AWE	PHX
09	1245	1353	1356	J328	BLR	BGR
09	1350	1356	1357	DH8A	JZA	CYHZ
10	1355	1403	1403	B752	DAL	TPA
10	1400	1406	1406	C402	KAP	ACK
10	1400	1406	1407	C402	KAP	MVY
10	1400	1406	1408	C525	OPT	OSU
10	1400	1406	1409	LJ60	PCJ	CYYZ
10	1400	1409	1410	A319	USA	LGA
10	1400	1409	1411	B733	USA	DCA
10	1405	1413	1413	B735	COA	CLE
10	1405	1413	1414	J328	BLR	CYUL
10	1410	1417	1417	B752	UAL	IAD
10	1410	1418	1419	B190	CJC	RKD
10	1410	1418	1420	J328	BLR	PHL
10	1415	1421	1421	C402	KAP	ACK
10	1415	1423	1423	B738	DAL	SLC
10	1420	1427	1427	E135	EGF	DCA
10	1435	1432	1432	DC95	NWA	DTW
10	1425	1432	1433	E135	EGF	JFK
10	1425	1433	1434	B732	ACA	CYYZ
10	1430	1436	1436	C402	KAP	PVC
10	1430	1437	1437	E135	EGF	JFK
10	1430	1438	1438	B733	COA	IAH
10	1430	1438	1439	E145	CHQ	PIT
10	1430	1440	1440	A319	USA	PHL
10	1430	1440	1441	B733	DAL	LGA
10	1440	1447	1447	E135	EGF	PHL
10	1450	1458	1458	B190	CJC	AUG
10	1452	1458	1459	C402	KAP	HYA
11	1455	1503	1503	B752	DAL	ATL
11	1500	1506	1506	C402	KAP	ACK
11	1500	1506	1507	C402	KAP	ACK
11	1500	1506	1508	C402	KAP	ACK
11	1500	1506	1509	C402	KAP	MVY
11	1500	1506	1510	C402	KAP	MVY
11	1500	1507	1511	E135	EGF	LGA
11	1500	1508	1512	B190	CJC	BHB
11	1500	1509	1513	A319	USA	LGA

<b>Eastern Std. Time (hr)</b>	<b>Proposed time from strip: zulu time</b>	<b>Arrival at taxiway queue: zulu time</b>	<b>Actual departure time: zulu time</b>	<b>Aircraft type</b>	<b>Airline</b>	<b>Destination</b>
11	1500	1509	1514	B733	USA	DCA
11	1500	1510	1515	B733	USA	CLT
11	1505	1513	1516	B190	CJC	PWM
11	1510	1518	1518	CRJ1	COM	PWM
11	1509	1518	1519	MD80	AAL	DFW
11	1509	1518	1520	MD80	AAL	ORD
11	1515	1522	1522	B735	UAL	ORD
11	1515	1522	1523	B752	UAL	DEN
11	1515	1523	1525	B190	CJC	ACK
11	1518	1523	1526	B752	AMT	MDW
11	1515	1523	1528	CRJ1	ACA	CYUL
11	1515	1524	1529	B752	AAL	MIA
11	1520	1527	1531	E135	EGF	BWI
11	1520	1528	1532	DC93	MEP	MKE
11	1520	1528	1533	E145	CHQ	GSO
11	1520	1530	1534	CRJ1	COM	DCA
11	1525	1533	1535	B752	DAL	FLL
11	1528	1535	1537	A320	NWA	MSP
11	1530	1537	1538	B752	UAL	SFO
11	1530	1538	1540	B735	COA	EWR
11	1530	1539	1541	B762	AAL	LAX
11	1530	1540	1543	A319	USA	PHL
11	1530	1540	1544	B738	DAL	LGA
11	1535	1543	1545	B738	DAL	DFW
11	1535	1543	1546	B752	DAL	FLL
11	1540	1547	1548	B712	TRS	ATL
11	1540	1547	1549	E135	EGF	RDU
11	1545	1551	1551	C402	KAP	PVC
12	1555	1603	1603	MD80	DAL	CVG
12	1600	1606	1606	BE20	OPT	RKD
12	1600	1606	1607	C402	KAP	ACK
12	1600	1606	1608	C402	KAP	ACK
12	1600	1606	1609	C402	KAP	MVY
12	1600	1606	1610	C402	KAP	MVY
12	1600	1607	1611	CRJ2	BLR	MHT
12	1600	1608	1612	J328	BLR	BGR
12	1600	1609	1613	A319	USA	LGA
12	1605	1613	1614	J328	BLR	JFK
12	1610	1617	1617	B752	NWA	DTW
12	1610	1617	1619	E135	EGF	DCA
12	1610	1619	1620	A306	AAL	MIA
12	1611	1621	1622	B752	AAL	TJSJ
12	1615	1621	1624	C402	KAP	ACK
12	1614	1621	1625	E135	EGF	BGR

Eastern Std. Time (hr)	Proposed time from strip: zulu time	Arrival at taxiway queue: zulu time	Actual departure time: zulu time	Aircraft type	Airline	Destination
12	1615	1622	1626	B752	UAL	ORD
12	1615	1623	1628	B763	DAL	ATL
12	1620	1629	1630	MD80	AAL	STL
12	1625	1631	1631	B462	JZA	CYHZ
12	1625	1632	1632	E135	EGF	CYYZ
12	1630	1636	1636	H25B	GA	HOU
12	1630	1636	1637	LJ60	LXJ	DEN
12	1630	1637	1638	E135	EGF	EWR
12	1630	1637	1639	E135	EGF	JFK
12	1630	1638	1640	E145	CHQ	BUF
12	1630	1640	1641	B733	DAL	LGA
12	1630	1640	1642	B733	USA	PHL
12	1635	1643	1643	A320	AWE	PHX
12	1640	1646	1646	PA32	GA	LHY
12	1640	1648	1648	SF34	CJC	PQI
12	1648	1655	1655	B712	TRS	BWI
12	1650	1657	1657	E135	EGF	RIC
12	1650	1658	1658	B190	CJC	RKD
13	1655	1701	1701	C560	EJA	CYHZ
13	1655	1703	1703	J328	BLR	BTV
13	1700	1706	1706	BE20	GA	BTV
13	1700	1706	1707	C402	KAP	ACK
13	1700	1706	1708	C402	KAP	HYA
13	1700	1706	1709	C402	KAP	HYA
13	1700	1706	1710	C402	KAP	MVY
13	1700	1706	1711	C402	KAP	MVY
13	1700	1706	1712	C402	KAP	PVC
13	1700	1707	1713	E135	EGF	LGA
13	1700	1708	1714	B733	COA	EWR
13	1700	1709	1715	A319	USA	LGA
13	1700	1709	1716	B733	USA	DCA
13	1710	1718	1718	MD80	DAL	CVG
13	1715	1721	1721	C402	KAP	ACK
13	1715	1721	1722	C402	KAP	PVC
13	1715	1721	1723	LJ60	LXJ	BTV
13	1715	1723	1724	J328	BLR	JFK
13	1715	1725	1725	B734	USA	PHL
13	1715	1725	1726	CRJ2	COM	DCA
13	1720	1728	1728	B190	CJC	PWM
13	1725	1733	1733	B190	CJC	ACK
13	1725	1733	1734	B763	DAL	ATL
13	1730	1736	1736	BE9L	GA	BED
13	1730	1736	1737	C56X	EJA	RUT
13	1730	1736	1738	GALX	EJM	TEB

<b>Eastern Std. Time (hr)</b>	<b>Proposed time from strip: zulu time</b>	<b>Arrival at taxiway queue: zulu time</b>	<b>Actual departure time: zulu time</b>	<b>Aircraft type</b>	<b>Airline</b>	<b>Destination</b>
13	1730	1740	1740	A319	USA	PHL
13	1730	1740	1741	B733	DAL	LGA
13	1735	1742	1742	B752	NWA	MSP
13	1735	1743	1744	E145	CHQ	IND
13	1735	1743	1745	J328	BLR	PHL
13	1740	1747	1747	E135	EGF	RDU
13	1738	1747	1748	MD80	AAL	ORD
13	1745	1751	1751	C402	KAP	MVY
13	1745	1751	1752	LJ60	GA	HPN
13	1745	1753	1753	B733	COA	IAH
13	1750	1758	1758	B190	CJC	ALB
14	1755	1803	1803	DH8A	ALO	SYR
14	1800	1806	1806	C402	KAP	ACK
14	1800	1806	1807	C402	KAP	ACK
14	1800	1806	1808	C750	EJA	TEB
14	1800	1806	1809	LJ60	GA	PIH
14	1800	1807	1810	E135	EGF	LGA
14	1800	1808	1811	B190	CJC	BHB
14	1800	1808	1812	B735	COA	EWR
14	1800	1809	1813	A319	USA	LGA
14	1800	1809	1814	B733	USA	DCA
14	1805	1813	1815	B733	COA	CLE
14	1810	1818	1818	E145	LOF	RIC
14	1810	1818	1819	J328	BLR	RDU
14	1815	1821	1821	C402	KAP	ACK
14	1815	1821	1822	GLF4	GA	BDL
14	1815	1822	1823	B752	UAL	ORD
14	1816	1825	1825	B752	AAL	DFW
14	1820	1827	1827	B752	UAL	IAD
14	1820	1828	1829	E145	CHQ	CMH
14	1820	1828	1830	J328	BLR	YHZ
14	1823	1830	1831	DC93	NWA	DTW
14	1824	1830	1832	F2TH	GA	PHL
14	1830	1836	1836	B190	UCA	HPN
14	1830	1836	1837	C402	GA	ACK
14	1830	1837	1838	E135	EGF	ISP
14	1830	1838	1839	DH8A	ALO	MDT
14	1830	1840	1840	B733	USA	PHL
14	1840	1847	1847	E135	EGF	ORF
14	1842	1848	1848	C402	KAP	PVC
14	1845	1851	1851	BE9L	GA	TEB
14	1845	1851	1852	C402	KAP	MVY
14	1845	1851	1853	C421	GA	MVY
14	1850	1858	1858	B752	DAL	RSW

Eastern Std. Time (hr)	Proposed time from strip: zulu time	Arrival at taxiway queue: zulu time	Actual departure time: zulu time	Aircraft type	Airline	Destination
15	1854	1901	1901	B712	TRS	ATL
15	1855	1904	1904	MD80	AAL	ORD
15	1857	1906	1906	B752	AAL	MIA
15	1900	1906	1908	C402	KAP	ACK
15	1900	1906	1909	C402	KAP	ACK
15	1900	1906	1910	C402	KAP	ACK
15	1900	1906	1911	C402	KAP	HYA
15	1900	1906	1912	C402	KAP	MVY
15	1900	1906	1913	C402	KAP	PVC
15	1900	1906	1914	C402	KAP	PVC
15	1900	1906	1915	F900	GA	AGC
15	1900	1906	1916	LJ60	GA	PHL
15	1900	1907	1917	E135	EGF	LGA
15	1900	1908	1918	CRJ1	COM	PWM
15	1900	1909	1919	A319	USA	LGA
15	1900	1909	1920	B733	USA	DCA
15	1905	1912	1921	A320	NWA	MSP
15	1905	1913	1922	CRJ1	ACA	CYUL
15	1910	1918	1923	B752	DAL	MCO
15	1910	1918	1925	MD82	MEP	MKE
15	1910	1920	1926	B752	USA	CLT
15	1915	1921	1928	C402	KAP	ACK
15	1915	1922	1929	A320	UAL	ORD
15	1915	1922	1930	E135	EGF	BWI
15	1915	1923	1931	B764	DAL	ATL
15	1919	1925	1933	C402	KAP	ACK
15	1916	1925	1934	MD80	AAL	MCO
15	1930	1936	1936	C402	KAP	ACK
15	1930	1936	1937	F900	GA	BTV
15	1930	1937	1938	E135	EGF	BGR
15	1930	1938	1939	B190	CJC	AUG
15	1930	1938	1940	B190	CJC	HPN
15	1930	1938	1941	E145	CHQ	ROC
15	1930	1940	1942	B733	DAL	LGA
15	1930	1940	1943	B734	USA	PHL
15	1932	1941	1944	B752	AAL	DFW
15	1935	1942	1946	B752	UAL	SFO
15	1935	1943	1948	B190	CJC	SYR
15	1935	1943	1949	MD80	DAL	CVG
15	1941	1947	1950	C402	KAP	MVY
15	1940	1948	1951	CRJ1	ACA	CYYZ
15	1945	1951	1952	C402	KAP	MVY
15	1945	1951	1953	DH8A	JZA	CYHZ
15	1945	1952	1954	E135	EGF	JFK

<b>Eastern Std. Time (hr)</b>	<b>Proposed time from strip: zulu time</b>	<b>Arrival at taxiway queue: zulu time</b>	<b>Actual departure time: zulu time</b>	<b>Aircraft type</b>	<b>Airline</b>	<b>Destination</b>
15	1945	1953	1955	B190	CJC	RUT
15	1950	1956	1956	BE40	GA	ACK
15	1950	1956	1957	C525	FIV	BHB
15	1950	1958	1958	B752	DAL	TPA
16	2000	2006	2006	C402	KAP	MVY
16	2000	2006	2007	CL64	GA	PWK
16	2000	2007	2008	E135	EGF	CMH
16	2000	2007	2009	E135	EGF	CYYZ
16	2000	2007	2010	E135	EGF	LGA
16	1959	2008	2011	MD80	AAL	ORD
16	2000	2008	2012	B733	COA	EWR
16	2008	2008	2013	J328	BLR	CYUL
16	2000	2009	2014	A319	USA	LGA
16	2003	2010	2015	B712	TRS	BWI
16	2003	2010	2016	B752	UAL	DEN
16	2015	2021	2021	C402	KAP	ACK
16	2015	2021	2022	C402	KAP	MVY
16	2015	2021	2023	C402	KAP	PVC
16	2015	2022	2024	B733	UAL	ORD
16	2015	2022	2026	B752	NWA	DTW
16	2020	2026	2028	C56X	GA	SAT
16	2020	2027	2029	E135	EGF	DCA
16	2020	2028	2030	B752	DAL	FLL
16	2020	2028	2032	B752	DAL	PBI
16	2020	2030	2034	B752	AAL	TJSJ
16	2025	2033	2036	E145	CHQ	BUF
16	2030	2036	2037	BE40	OPT	ACY
16	2030	2036	2038	C56X	EJA	HTO
16	2030	2040	2040	A332	DLH	EDDF
16	2030	2040	2042	B733	DAL	LGA
16	2030	2040	2043	B733	USA	PHL
16	2034	2042	2044	MD82	COA	IAH
16	2040	2048	2048	SF34	CJC	PWM
16	2040	2049	2049	MD80	AAL	ORD
16	2040	2049	2050	MD80	AAL	STL
16	2045	2051	2051	C402	KAP	ACK
16	2045	2051	2052	HS25	GA	FOE
16	2045	2052	2053	A320	UAL	DEN
16	2045	2053	2054	B762	DAL	ATL
16	2050	2058	2056	CRJ1	ACA	CYUL
17	2055	2103	2103	B190	CJC	BHB
17	2100	2106	2106	C402	KAP	ACK
17	2100	2106	2107	C402	KAP	ACK
17	2100	2106	2108	C402	KAP	ACK



Eastern Std. Time (hr)	Proposed time from strip: zulu time	Arrival at taxiway queue: zulu time	Actual departure time: zulu time	Aircraft type	Airline	Destination
17	2100	2106	2109	C402	KAP	MVY
17	2100	2106	2110	C402	KAP	PVC
17	2100	2106	2111	F2TH	GA	HPN
17	2100	2107	2112	E135	EGF	GLA
17	2100	2108	2113	B733	COA	EWR
17	2100	2108	2114	B733	COA	EWR
17	2100	2108	2115	CRJ2	CAA	JFK
17	2100	2109	2116	A319	USA	LGA
17	2100	2110	2117	B752	USA	CLT
17	2105	2112	2119	E135	EGF	EWR
17	2110	2116	2120	C402	KAP	GYA
17	2110	2118	2121	B738	DAL	DFW
17	2110	2119	2122	B752	AAL	SFO
17	2114	2121	2124	B712	TRS	ATL
17	2115	2122	2125	B752	UAL	ORD
17	2115	2123	2127	J328	BLR	BTV
17	2125	2131	2131	BE20	OPT	SYR
17	2130	2136	2136	C402	KAP	ACK
17	2128	2137	2137	MD80	AAL	ORD
17	2130	2138	2138	MD80	DAL	CVG
17	2130	2139	2139	B733	USA	DCA
17	2130	2139	2140	B738	AAL	SEA
17	2130	2140	2141	A319	USA	PHL
17	2135	2142	2142	B752	UAL	SFO
17	2135	2142	2144	E135	EGF	PHL
17	2135	2144	2145	B763	AAL	LAX
17	2135	2145	2147	A319	USA	PIT
17	2140	2146	2148	C402	KAP	PVC
17	2139	2146	2149	E135	EGF	BWI
17	2142	2150	2150	B733	COA	CLE
17	2140	2150	2151	B772	AFR	LFBG
17	2145	2151	2153	C402	KAP	MVY
17	2145	2151	2154	C402	KAP	MVY
17	2150	2156	2156	B190	UCA	ALB
17	2150	2157	2157	B752	NWA	MSP
17	2150	2157	2159	E135	EGF	JFK
18	2150	2158	2200	CRJ1	ACA	CYOW
18	2150	2200	2201	B744	BAW	EGLL
18	2155	2203	2203	B752	DAL	SLC
18	2200	2206	2206	C402	KAP	ACK
18	2200	2206	2207	C402	KAP	MVY
18	2200	2206	2208	C402	KAP	PVC
18	2200	2206	2209	LJ35	GA	PNS
18	2200	2207	2210	E135	EGF	LGA

<b>Eastern Std. Time (hr)</b>	<b>Proposed time from strip: zulu time</b>	<b>Arrival at taxiway queue: zulu time</b>	<b>Actual departure time: zulu time</b>	<b>Aircraft type</b>	<b>Airline</b>	<b>Destination</b>
18	2200	2208	2211	A319	ACA	CYYZ
18	2200	2208	2212	A320	AWE	PHX
18	2200	2208	2213	B735	COA	EWR
18	2200	2209	2214	A319	USA	LGA
18	2202	2209	2215	B712	TRS	BWI
18	2200	2209	2216	B752	AAL	SJC
18	2200	2210	2218	CRJ2	COM	DCA
18	2207	2215	2219	B752	AMT	MDW
18	2207	2216	2221	B739	ASA	SEA
18	2209	2218	2222	B752	AAL	DFW
18	2210	2220	2224	B763	AAL	LFPG
18	2210	2220	2226	B763	AZA	LIMC
18	2215	2221	2228	C402	KAP	ACK
18	2215	2222	2229	A320	UAL	ORD
18	2215	2222	2230	B712	TRS	PHL
18	2220	2227	2231	A319	NWA	MEM
18	2220	2227	2232	DC95	NWA	DTW
18	2220	2228	2233	B738	DAL	ATL
18	2220	2229	2234	B733	USA	DCA
18	2222	2232	2235	B733	USA	PIT
18	2230	2236	2236	GLF2	GA	HYA
18	2230	2237	2237	B752	UAL	LAX
18	2230	2238	2239	DH8A	ALO	SYR
18	2230	2239	2240	B733	USA	DCA
18	2230	2240	2241	A332	SWR	LSZH
18	2230	2240	2243	B733	USA	PHL
18	2235	2241	2244	B462	JZA	CYHZ
18	2235	2242	2245	E135	EGF	RDU
18	2235	2244	2246	MD80	AAL	STL
18	2237	2246	2247	A306	AAL	MIA
18	2240	2248	2249	B190	CJC	RUT
18	2240	2248	2250	E145	LOF	RIC
18	2240	2250	2251	DC10	NWA	EHAM
18	2247	2253	2253	B190	UCA	HPN
18	2245	2254	2254	MD80	AAL	ORD
18	2245	2255	2255	A343	DLH	EDDM
19	2250	2300	2300	B772	AAL	EGLL
19	2255	2302	2302	B752	UAL	IAD
19	2255	2302	2304	E135	EGF	DCA
19	2255	2302	2305	E135	EGF	RDU
19	2255	2303	2306	B733	COA	IAH
19	2255	2303	2307	DH8A	ALO	MDT
19	2255	2305	2308	CRJ1	COM	DCA
19	2300	2306	2309	C402	KAP	ACK

Eastern Std. Time (hr)	Proposed time from strip: zulu time	Arrival at taxiway queue: zulu time	Actual departure time: zulu time	Aircraft type	Airline	Destination
19	2300	2306	2310	C402	KAP	ACK
19	2300	2306	2311	C402	KAP	HYA
19	2300	2306	2312	C402	KAP	MVY
19	2300	2306	2313	C402	KAP	PVC
19	2300	2306	2314	C550	GA	UGN
19	2300	2307	2315	E135	EGF	LGA
19	2300	2309	2316	A319	USA	LGA
19	2300	2309	2317	B733	USA	DCA
19	2300	2309	2318	B738	AAL	SAN
19	2300	2310	2319	B727	RYN	FLL
19	2300	2310	2320	B733	DAL	LGA
19	2305	2312	2321	B712	TRS	BWI
19	2305	2312	2322	E135	EGF	BGR
19	2315	2313	2323	B752	DAL	MCO
19	2305	2313	2325	J328	BLR	BTV
19	2310	2317	2326	E135	EGF	BWI
19	2310	2318	2327	A319	ACA	CYYZ
19	2310	2319	2328	B738	AAL	DFW
19	2310	2320	2329	A333	EIN	EIDW
19	2315	2321	2331	C402	KAP	ACK
19	2315	2321	2332	C402	KAP	ACK
19	2315	2322	2333	B733	UAL	ORD
19	2315	2323	2334	E145	CHQ	CMH
19	2315	2325	2335	A321	USA	PIT
19	2315	2325	2336	B733	DAL	LGA
19	2315	2325	2337	B733	USA	CLT
19	2320	2326	2338	C402	KAP	PVC
19	2320	2328	2339	B190	CJC	ACK
19	2330	2336	2340	BE40	OPT	FRG
19	2330	2336	2341	C402	KAP	ACK
19	2330	2338	2342	B737	COA	EWR
19	2330	2338	2343	CRJ1	ACA	CYUL
19	2330	2338	2344	CRJ1	COM	PWM
19	2330	2338	2345	E145	CHQ	ROC
19	2330	2338	2346	MD80	DAL	CVG
19	2330	2338	2347	SF34	CJC	PQI
19	2330	2340	2348	B733	USA	PHL
19	2336	2343	2349	C402	KAP	PVC
19	2340	2348	2350	MD81	MEP	MKE
19	2345	2351	2351	C402	KAP	MVY
19	2345	2351	2352	C402	KAP	MVY
19	2345	2351	2353	H25B	OPT	FOK
19	2347	2356	2356	B738	AAL	ORD
19	2350	2357	2357	E135	EGF	EWR

Eastern Std. Time (hr)	Proposed time from strip: zulu time	Arrival at taxiway queue: zulu time	Actual departure time: zulu time	Aircraft type	Airline	Destination
19	2352	2358	2358	C402	GA	ACK
20	2355	0003	0003	J328	BLR	CYHZ
20	2355	0005	0005	A343	AFR	LFPG
20	0000	0006	0007	C402	KAP	ACK
20	0000	0006	0008	C402	KAP	ACK
20	0000	0006	0009	C402	KAP	ACK
20	0000	0006	0010	C402	KAP	MVY
20	2359	0007	0011	E145	CHQ	IND
20	0000	0007	0012	B712	TRS	BWI
20	0000	0007	0013	C402	KAP	ACK
20	0000	0009	0014	A319	USA	LGA
20	0010	0017	0017	A320	NWA	MSP
20	0010	0019	0019	B752	AAL	LAS
20	0015	0021	0021	C402	KAP	PVC
20	0015	0023	0023	J328	BLR	BGR
20	0017	0024	0024	A320	NWA	DTW
20	0019	0025	0025	C402	KAP	MVY
20	0020	0027	0027	E135	EGF	JFK
20	0020	0028	0028	E145	CHQ	BUF
20	0020	0030	0030	A332	EIN	EINN
20	0025	0032	0032	E135	EGF	DCA
20	0025	0033	0033	B190	CJC	BHB
20	0030	0036	0036	C402	KAP	PVC
20	0030	0038	0038	J328	BLR	ACY
20	0030	0040	0040	B733	DAL	LGA
20	0033	0041	0041	A320	AWE	LAS
20	0035	0043	0043	J328	BLR	BTV
20	0035	0043	0044	J328	BLR	CYUL
20	0040	0048	0048	B190	CJC	HPN
20	0045	0053	0053	CRJ1	ACA	CYOW
20	0045	0055	0055	B744	BAW	EGLL
21	0055	0102	0102	E135	EGF	JFK
21	0055	0102	0103	E135	EGF	RDU
21	0055	0103	0104	E145	CHQ	GSO
21	0100	0106	0106	C402	KAP	HYA
21	0100	0106	0107	C402	KAP	HYA
21	0100	0106	0108	C402	KAP	MVY
21	0100	0106	0109	C402	KAP	MVY
21	0100	0110	0110	B744	VIR	EGLL
21	0106	0114	0114	B762	DAL	ATL
21	0108	0117	0117	A306	FDX	MEM
21	0110	0118	0119	J328	BLR	RDU
21	0115	0121	0121	C402	KAP	ACK
21	0115	0121	0122	C402	KAP	ACK

<b>Eastern Std. Time (hr)</b>	<b>Proposed time from strip: zulu time</b>	<b>Arrival at taxiway queue: zulu time</b>	<b>Actual departure time: zulu time</b>	<b>Aircraft type</b>	<b>Airline</b>	<b>Destination</b>
21	0115	0123	0123	CRJ2	ASH	PHL
21	0120	0127	0127	E135	EGF	BGR
21	0120	0127	0128	E135	EGF	ISP
21	0130	0136	0136	BE40	OPT	PTK
21	0130	0140	0140	B752	ICE	BIKF
21	0137	0145	0145	B190	CJC	RKD
21	0140	0146	0146	B190	UCA	ALB
21	0140	0150	0150	A343	DLH	EDDF
21	0149	0157	0157	DC8Q	ABX	ILN
21	0150	0157	0159	E135	EGF	CYQB
22	0150	0157	0200	E135	EGF	CYYZ
22	0200	0210	0210	CRJ2	COM	DCA
22	0205	0212	0212	E135	EGF	CMH
22	0207	0215	0215	A306	UPS	SDF
22	0210	0217	0217	E135	EGF	BGR
22	0215	0225	0225	DC10	FDX	MEM
22	0219	0227	0227	DC9Q	ABX	ILN
22	0220	0227	0228	E135	EGF	RIC
22	0224	0231	0231	E135	EGF	RIC
22	0227	0235	0235	B72Q	DHL	CVG
22	0230	0237	0237	E135	EGF	ORF
22	0230	0237	0238	E135	EGF	PHL
22	0235	0244	0244	DC10	FDX	EWR
22	0250	0257	0257	E135	EGF	BGR
23	0258	0308	0308	B722	XNA	ROC
23	0315	0323	0323	B72Q	KHA	PHL
23	0030	0336	0336	LJ35	BKA	PHL
23	0345	0355	0355	A310	RZO	LPPD



## APPENDIX B DETAILS OF TAXI/QUEUE TIME MODEL

In the summer of 2003 during a 24-hour period when Runways 22R and 22L were in continuous use for departures, FAA staff in the Boston Tower kept a detailed log of the status of the queue on Taxiway November. The log is included as Table 4 in Appendix A of this report. The outline below provides details on the way the log was used within a computer program developed to compute taxi/queue times on the taxiway for both the unrestricted Free Flow and restricted Limit All Jets conditions.

### B.1 Summary of Model Concept

The FAA log recorded each aircraft that taxied on Taxiway November for departure on Runway 22R or 22L. The log includes a record (row in a database file) for each aircraft that includes the aircraft type, the time of arrival at the queue, and the time of departure, as well as other information not used in the model. Both times are given to the nearest whole minute. The log includes 629 departures, from midnight to the following midnight.

Some fundamental characteristics and assumptions of the “taxi/queue time” computer model are as follows:

- Model operates in a step-wise fashion, one minute at a time.
- Model distributes the time between the arrival at the queue (as noted in the FAA log) and the aircraft departure (also as noted in the FAA log) over the remaining locations in the queue by keeping track of the particular aircraft’s location in the queue over time
- So that all taxi time for each aircraft on November is accounted for, the model adds time to the FAA logged times to include taxi time from location N\_14 to the end of the queue
- Taxi speed modeled at 15 knots, except half speed through location N\_0 if from a stop
- Taxi/queue locations and segment lengths as noted in text and graphics in body of the report (see Figure 3 and Section 3.3)
- In restricted Limit All Jets case only, no more than 5 jets ahead of location N\_10

### B.2 Program Flow for “Free Flow” unrestricted condition

The following outline represents the logical program flow for the Free Flow unrestricted case. The process is repeated for each minute of time.

1. Count number of departures in the minute (always 0 or 1)
2. Compile list of arrivals to the queue and add them to the end of the queue
3. If a departure occurs in the minute:
  - 3.1. Add taxi-through times for N\_0 (double if aircraft did not enter the queue in this minute)
  - 3.2. Remove first aircraft from the queue
  - 3.3. Advance the queue one space
4. Add taxi-through times for all aircraft that entered the queue this minute (from N\_14 to the location before their final location)
5. Add one minute of queue time for each aircraft in the queue at each aircraft’s final location

### **B.3 Program Flow for “Limit All Jets” restricted condition**

The following outline represents the logical program flow for the Limit All Jets restricted flow case. The process is repeated for each minute of time.

1. Count number of departures in the minute (always 0 or 1)
2. Compile list of arrivals to the queue
3. If a departure occurs with no aircraft in the queue:
  - 3.1. Add taxi through times for all locations for first aircraft in list of arrivals to queue
  - 3.2. Remove first aircraft from list of arrivals to queue
4. If a departure occurs with an aircraft in the queue:
  - 4.1. Remove aircraft from location N\_1 and add double taxi-through time for aircraft currently in N\_1 to location N\_0
  - 4.2. Advance aircraft in locations N\_2 to N\_9 one space forward
5. Add one minute of queue time for aircraft in locations N\_1 through N\_9
6. Advance aircraft at locations N\_10 and above, being sure that no more than five jets are queued ahead of location N\_10, and assign taxi-through time if they move more than one space. The remainder of the minute is assigned to their final location.
7. Remove aircraft one by one from the arrivals list and add them to the queue being sure that no more than five jets are queue ahead of location N\_10. Add one minute at the final location. Add taxi-through time for all locations from N\_14 through the location before final location. Add an additional wait time at the location before the final location (equal to the taxi-through time for the number of empty spaces in the middle of the queue) to account for the fact that with a longer queue in the restricted case, the aircraft arrive at the queue slightly earlier than the log indicates for the free flow case.



## APPENDIX C TAXI OPERATIONS DETAILS

This appendix provides first in Table 5, the aircraft type names, manufacturers, models, weight class and associated noise group used for the noise modeling. Second, the appendix includes tables of the daily total “equivalent” minutes of taxi/hold time by aircraft type and by location along Taxiway November for the two alternative scenarios evaluated, Free Flow (Table 9) and Limit All Jets (Table 10). Equivalent minutes were developed for the noise analysis, and represent total daytime plus 10 times total nighttime minutes, since that amount of taxi/queue time is used to compute DNL. Also, these tables list the minutes derived directly from the FAA log, without the 30% increase needed to scale up for worst-case busy-day conditions. By comparison, the summary totals in Tables 2 and 3 in the body of the report have been scaled up by the 30% factor. Values in the tables are rounded to whole minutes to facilitate reading, but decimal values were used in the computations.

**Table 5 Aircraft types, manufacturers, models and noise group**

Aircraft type	Manufacturer	Model(s)	Type/Wt Class	Noise Group
A306	AIRBUS	A-300B4-600	L2J/H	Heavy Air Carrier Jet
A310	AIRBUS	A-310 (CC-150 Polaris)	L2J/H	Heavy Air Carrier Jet
B762	BOEING	767-200	L2J/H	Heavy Air Carrier Jet
B763	BOEING	767-300	L2J/H	Heavy Air Carrier Jet
B764	BOEING	767-400	L2J/H	Heavy Air Carrier Jet
DC8Q	DOUGLAS	DC-8 Stage 3 (US ONLY)	L4J/H	Heavy Air Carrier Jet
A332	AIRBUS	A-330-200	L2J/H	Jumbo Air Carrier Jet
A333	AIRBUS	A-330-300	L2J/H	Jumbo Air Carrier Jet
A343	AIRBUS	A-340-300	L4J/H	Jumbo Air Carrier Jet
B744	BOEING	747-400 (International, winglets) (AL-1)	L4J/H	Jumbo Air Carrier Jet
B772	BOEING	777-200	L2J/H	Jumbo Air Carrier Jet
DC10	DOUGLAS	DC-10 MD-10 (KC-10 Extender, KDC-10)	L3J/H	Jumbo Air Carrier Jet
A319	AIRBUS	A-319, ACJ	L2J/L	Large Air Carrier Jet
A320	AIRBUS	A-320	L2J/L	Large Air Carrier Jet
A321	AIRBUS	A-321	L2J/L	Large Air Carrier Jet
B462	BRITISH AEROSPACE	BAe-146-200, Quiet Trader, Statesman	L4J/M	Large Air Carrier Jet
B712	BOEING	717-200	L2J/L	Large Air Carrier Jet
B722	BOEING	727-200	L3J/L	Large Air Carrier Jet
B727	BOEING	727 Stage 3 (US ONLY)	L3J/L	Large Air Carrier Jet
B72Q	BOEING	727 Stage 3 (US ONLY)	L3J/L	Large Air Carrier Jet
B732	BOEING	737-200, Surveiller (CT-43, VC-96)	L2J/L	Large Air Carrier Jet
B733	BOEING	737-300	L2J/L	Large Air Carrier Jet
B734	BOEING	737-400	L2J/L	Large Air Carrier Jet
B735	BOEING	737-500	L2J/L	Large Air Carrier Jet

<b>Aircraft type</b>	<b>Manufacturer</b>	<b>Model(s)</b>	<b>Type/Wt Class</b>	<b>Noise Group</b>
B737	BOEING	737-700, BBJ, C-40	L2J/L	Large Air Carrier Jet
B738	BOEING	737-800, BBJ2	L2J/L	Large Air Carrier Jet
B739	BOEING	737-900	L2J/M	Large Air Carrier Jet
B752	BOEING	757-200 (C-32)	L2J/L	Large Air Carrier Jet
DC93	DOUGLAS	DC-9-30	L2J/M	Large Air Carrier Jet
DC95	DOUGLAS	DC-9-50	L2J/M	Large Air Carrier Jet
DC9Q	DOUGLAS	DC-9 Stage 3 (US ONLY)	L2J/L	Large Air Carrier Jet
MD80	BOEING	MD-81	L2J/M	Large Air Carrier Jet
MD81	BOEING	MD-81	L2J/M	Large Air Carrier Jet
MD82	BOEING	MD-82	L2J/M	Large Air Carrier Jet
B190	BEECH	1900 (C-12J)	L2T/S+	Propeller Aircraft
BE20	BEECH	200, 1300 Super King Air, Commuter (C-12A to F, C-12L/R, UC-12, RC-12, Tp101, Huron)	L2T/S+	Propeller Aircraft
BE58	BEECH	58 Baron	L2P/S	Propeller Aircraft
BE9L	BEECH	90, A90 to E90 King Air (T-44, VC-6)	L2T/S	Propeller Aircraft
C402	CESSNA	401, 402, Utililiner, Businessliner	L2P/S	Propeller Aircraft
C421	CESSNA	421, Golden Eagle, Executive Commuter	L2P/S	Propeller Aircraft
DH8A	DE HAVILLAND CANADA	DHC-8-100 Dash 8 (E-9, CT-142, CC-142)	L2T/S+	Propeller Aircraft
PA31	AICSA	PA-31 Navajo, Navajo Chieftain, Chieftain	L2P/S	Propeller Aircraft
PA32	AICSA	PA-32 Cherokee Six, Six, Saratoga, Turbo Saratoga	L1P/S	Propeller Aircraft
SF34	SAAB	340 (S100 Argus, Tp100)	L2T/S+	Propeller Aircraft
ASTR	IAI	1125 Astra, Gulfstream 100 (C-38)	L2J/S+	Regional/Corporate Jet
BE40	BEECH	400 Beechjet (T-1 Jayhawk, T-400)	L2J/S+	Regional/Corporate Jet
C525	CESSNA	525 CitationJet Citation CJ1	L2J/S	Regional/Corporate Jet
C550	CESSNA	550, S550, 552 Citation 2/S2/Bravo (T-47, U-20)	L2J/S+	Regional/Corporate Jet
C560	CESSNA	560 Citation 5/5 Ultra/5 Ultra Encore (UC-35.OT-47, TR-20)	L2J/S+	Regional/Corporate Jet
C56X	CESSNA	560XL Citation Excel	L2J/M	Regional/Corporate Jet
C750	CESSNA	750 Citation 10	L2J/S+	Regional/Corporate Jet
CL64	CANADAIR	CL-600 Challenger600/601/604 (CC-144, CE-144)	L2J/M	Regional/Corporate Jet

<b>Aircraft type</b>	<b>Manufacturer</b>	<b>Model(s)</b>	<b>Type/Wt Class</b>	<b>Noise Group</b>
CRJ1	CANADAIR	CL-600 Regional Jet CRJ-100, RJ-100	L2J/M	Regional/Corporate Jet
CRJ2	CANADAIR	CL-600 Regional Jet CRJ-200, RJ-200	L2J/M	Regional/Corporate Jet
E135	EMBRAER	EMB-135, ECJ-135, Legacy	L2J/M	Regional/Corporate Jet
E145	EMBRAER	EMB-145, ERJ-145 (R-99)	L2J/L	Regional/Corporate Jet
F2TH	DASSAULT	Falcon 2000	L2J/S+	Regional/Corporate Jet
F900	DASSAULT	Falcon 900, Mystère 900	L3J/L	Regional/Corporate Jet
FA50	DASSAULT	Falcon 50, Mystère 50	L3J/S+	Regional/Corporate Jet
GALX	IAI	1126 Galaxy, Gulfstream 200	L2J/M	Regional/Corporate Jet
GLF2	GRUMMAN	G-1159, G-1159B Gulfstream 2/2B/2SP (C-20J, VC-11)	L2J/L	Regional/Corporate Jet
GLF4	GULFSTREAM AEROSPACE	G-1159C Gulfstream 4/4SP/SRA-4 (C-20F/G/H, S102, Tp102, U-4)	L2J/L	Regional/Corporate Jet
H25B	BRITISH AEROSPACE	BAe-125-700/800 (C-29, U-125)	L2J/S+	Regional/Corporate Jet
H25C	BRITISH AEROSPACE	BAe-125-1000	L2J/S+	Regional/Corporate Jet
HS25	DE HAVILLAND	DH-125	L2J/S+	Regional/Corporate Jet
J328	FAIRCHILD DORNIER	328JET, Envoy 3	L2J/M	Regional/Corporate Jet
LJ35	GATES LEARJET	35, 36 (C-21, RC-35, RC-36, U-36)	L2J/S+	Regional/Corporate Jet
LJ60	LEARJET	60	L2J/S+	Regional/Corporate Jet
LR45	LEARJET	45	L2J/M	Regional/Corporate Jet

**Table 6 Free Flow Case – Equivalent Minutes by Aircraft Type by Taxiway Location**

Aircraft		EQUIVALENT MINUTES (day+10*night) by Aircraft Type by Taxiway Position														TOTAL	
Type	Group	N_0	N_1	N_2	N_3	N_4	N_5	N_6	N_7	N_8	N_9	N_10	N_11	N_12	N_13		N_14
A306	Heavy	5	28	15	6	4	4	4	4	4	4	4	4	4	4	6	105
A310	Heavy	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	26
A319	Large	14	59	53	44	25	20	17	17	14	15	13	12	12	11	16	341
A320	Large	7	23	21	20	30	8	7	8	7	7	7	6	6	6	8	172
A321	Large	0	1	1	1	1	2	1	1	1	1	0	0	0	0	0	11
A332	Jumbo	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	9
A333	Jumbo	0	1	1	1	1	2	1	1	1	0	0	0	0	0	0	10
A343	Jumbo	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	8
ASTR	RJCJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
B190	Prop	6	25	16	10	9	7	7	7	8	8	7	5	5	5	7	134
B462	Large	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	8
B712	Large	4	12	12	13	12	11	6	6	5	5	4	4	4	4	6	106
B722	Large	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	26
B727	Large	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	10
B72Q	Large	4	6	5	5	5	5	5	5	5	5	5	5	5	5	7	81
B732	Large	1	3	1	1	1	1	1	1	0	0	0	0	0	0	0	13
B733	Large	27	113	93	77	63	37	31	29	28	24	24	21	19	19	27	632
B734	Large	4	13	15	23	4	4	4	3	3	2	2	2	2	2	3	89
B735	Large	1	5	5	4	4	3	2	2	1	1	1	1	1	1	1	32
B737	Large	3	12	4	4	4	3	4	3	3	3	3	4	2	2	3	55
B738	Large	3	12	13	9	7	6	6	7	6	4	3	2	2	2	3	85
B739	Large	0	2	1	2	0	0	0	0	0	0	0	0	0	0	0	7
B744	Jumbo	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	9
B752	Large	18	70	70	44	35	31	27	23	20	19	17	16	14	14	20	439
B762	Heavy	1	5	3	2	2	2	1	1	1	1	1	1	1	1	1	22
B763	Heavy	4	20	16	8	6	5	4	4	4	3	3	3	3	3	4	90
B764	Heavy	1	2	3	2	2	1	2	0	0	0	0	0	0	0	0	16
B772	Jumbo	1	4	2	2	4	2	2	2	2	2	2	1	1	1	1	30
BE20	Prop	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	8
BE40	RJCJ	1	2	2	2	2	1	1	1	1	1	1	1	1	1	1	15
BE58	Prop	5	13	13	13	5	5	5	5	5	5	5	5	5	5	7	104
BE9L	Prop	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
C402	Prop	22	86	69	58	45	38	33	26	22	19	17	17	17	17	24	510
C421	Prop	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	4
C525	RJCJ	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	8
C550	RJCJ	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	9
C560	RJCJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
C56X	RJCJ	1	6	2	2	2	2	2	2	1	1	1	1	1	1	1	22
C750	RJCJ	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	4
CL64	RJCJ	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	4
CRJ1	RJCJ	6	25	13	14	10	9	7	7	8	7	5	4	4	4	6	129
CRJ2	RJCJ	6	21	12	11	10	8	8	8	6	5	5	5	5	5	7	122
DC10	Jumbo	3	5	5	5	5	5	5	5	4	4	4	4	4	4	5	64
DC8Q	Heavy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
DC93	Large	1	2	2	1	0	0	0	0	0	0	0	0	0	0	0	10
DC95	Large	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	9
DC9Q	Large	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	26
DH8A	Prop	2	8	5	5	4	1	1	1	1	1	1	1	1	1	2	38
E135	RJCJ	32	100	59	50	44	42	40	37	34	29	29	26	26	26	36	609
E145	RJCJ	5	20	16	12	12	7	7	6	5	6	3	3	3	3	5	113
F2TH	RJCJ	1	2	2	1	1	1	0	0	0	0	0	0	0	0	0	11
F900	RJCJ	1	2	1	1	1	1	1	1	2	0	0	0	0	0	0	14
FA50	RJCJ	0	2	1	1	1	2	1	1	1	1	0	0	0	0	0	12
GALX	RJCJ	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	4
GLF2	RJCJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
GLF4	RJCJ	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	4
H25B	RJCJ	2	4	5	3	3	3	3	3	2	2	2	2	2	2	3	43
H25C	RJCJ	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	6
HS25	RJCJ	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	4
J328	RJCJ	9	28	20	19	15	14	13	11	10	9	10	9	9	8	11	197
LJ35	RJCJ	7	16	8	8	7	7	7	7	7	7	7	7	7	7	10	118
LJ60	RJCJ	2	6	4	4	2	2	2	2	2	3	1	1	1	1	1	33
LR45	RJCJ	0	1	2	1	1	1	2	1	1	1	1	0	0	0	0	13
MD80	Large	10	39	36	34	30	21	13	12	11	8	8	9	8	7	10	257
MD81	Large	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	4
MD82	Large	1	3	2	1	1	1	1	0	0	0	0	0	0	0	0	13
PA31	Prop	3	4	4	4	4	5	4	4	4	4	4	4	4	4	5	59
PA32	Prop	1	2	2	2	2	2	2	2	2	2	2	2	2	2	3	28
SF34	Prop	1	2	2	2	2	3	2	2	2	2	1	1	1	1	1	25
<b>Total</b>		<b>236</b>	<b>844</b>	<b>658</b>	<b>544</b>	<b>443</b>	<b>349</b>	<b>307</b>	<b>281</b>	<b>257</b>	<b>235</b>	<b>216</b>	<b>204</b>	<b>195</b>	<b>193</b>	<b>272</b>	<b>5234</b>

Note: The values in this table are directly from the FAA log, and have not been scaled up by 30% for busy-day conditions.

**Table 7 Limit All Jets Case – Equivalent Minutes by Aircraft Type by Taxiway Location**

Aircraft		EQUIVALENT MINUTES (day*10*night) by Aircraft Type by Taxiway Position														TOTAL	
Type	Group	N_0	N_1	N_2	N_3	N_4	N_5	N_6	N_7	N_8	N_9	N_10	N_11	N_12	N_13		N_14
A306	Heavy	5	28	15	6	4	4	4	4	4	4	4	4	4	4	6	105
A310	Heavy	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	26
A319	Large	14	59	53	44	25	18	14	14	13	14	15	14	17	12	16	341
A320	Large	7	23	21	20	30	8	6	6	6	6	8	9	7	7	9	172
A321	Large	0	1	1	1	1	2	1	1	0	0	1	1	1	0	0	11
A332	Jumbo	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	9
A333	Jumbo	0	1	1	1	1	1	1	0	0	0	1	1	1	1	0	10
A343	Jumbo	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	8
ASTR	RJCJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
B190	Prop	6	25	16	10	9	7	7	6	6	7	5	7	7	6	8	134
B462	Large	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	8
B712	Large	4	12	12	13	12	9	4	4	4	4	6	7	6	4	6	106
B722	Large	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	26
B727	Large	0	1	1	1	1	0	0	0	0	0	4	0	0	0	0	10
B72Q	Large	4	6	5	5	5	5	5	5	5	5	5	5	5	5	7	81
B732	Large	1	3	1	1	1	0	0	0	0	0	1	1	1	0	0	13
B733	Large	27	113	93	77	63	34	26	23	20	19	38	27	22	21	28	632
B734	Large	4	13	15	23	4	3	2	2	2	4	4	3	3	3	3	89
B735	Large	1	5	5	4	4	3	1	1	1	1	2	2	1	1	1	32
B737	Large	3	12	4	4	4	2	2	2	2	4	8	2	2	3	5	55
B738	Large	3	12	13	9	7	5	4	5	4	3	4	4	4	4	5	85
B739	Large	0	2	1	2	0	0	0	0	0	0	0	0	0	0	0	7
B744	Jumbo	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	9
B752	Large	18	70	70	44	35	26	20	16	14	14	25	21	21	19	24	437
B762	Heavy	1	5	3	2	2	2	1	1	1	1	1	1	1	1	1	22
B763	Heavy	4	20	16	8	6	4	3	3	3	4	4	4	4	5	9	90
B764	Heavy	1	2	3	2	2	1	2	0	0	0	0	0	0	0	0	16
B772	Jumbo	1	4	2	2	4	2	1	1	1	1	2	2	2	2	2	30
BE20	Prop	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	8
BE40	RJCJ	1	2	2	2	2	1	1	1	1	1	1	1	1	1	1	15
BE58	Prop	5	13	13	13	5	5	5	5	5	5	5	5	5	5	7	104
BE9L	Prop	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
C402	Prop	22	86	69	58	45	38	31	22	18	17	17	21	21	20	25	510
C421	Prop	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	4
C525	RJCJ	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	8
C550	RJCJ	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	9
C560	RJCJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
C56X	RJCJ	1	6	2	2	2	2	1	1	1	1	2	1	1	1	1	22
C750	RJCJ	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	4
CL64	RJCJ	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	4
CRJ1	RJCJ	6	25	13	14	10	8	7	6	7	6	6	5	6	5	6	129
CRJ2	RJCJ	6	21	12	11	10	7	6	6	5	5	7	7	7	5	7	122
DC10	Jumbo	3	5	5	5	5	4	4	4	4	4	5	5	4	4	5	64
DC8Q	Heavy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
DC93	Large	1	2	2	1	0	0	0	0	0	0	0	0	0	0	0	10
DC95	Large	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	9
DC9Q	Large	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	26
DH8A	Prop	2	8	5	5	4	1	1	1	1	1	1	1	1	1	2	38
E135	RJCJ	32	100	59	50	44	35	31	29	27	26	36	35	33	32	38	608
E145	RJCJ	5	20	16	12	12	7	6	5	3	3	6	6	4	4	5	113
F2TH	RJCJ	1	2	2	1	1	1	0	0	0	0	0	0	0	0	0	11
F900	RJCJ	1	2	1	1	1	1	1	1	2	0	0	0	0	0	0	14
FA50	RJCJ	0	2	1	1	1	2	0	0	0	1	1	0	1	1	1	12
GALX	RJCJ	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	4
GLF2	RJCJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
GLF4	RJCJ	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	4
H25B	RJCJ	2	4	5	3	3	3	3	2	2	2	3	4	2	2	3	43
H25C	RJCJ	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	6
HS25	RJCJ	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	4
J328	RJCJ	9	28	20	19	15	12	9	8	8	8	13	11	9	11	13	194
LJ35	RJCJ	7	16	8	8	7	7	7	7	7	7	7	7	7	7	10	118
LJ60	RJCJ	2	6	4	4	2	2	2	2	2	3	1	1	1	1	1	33
LR45	RJCJ	0	1	2	1	1	1	1	0	0	0	1	1	1	0	1	12
MD80	Large	10	39	36	34	30	20	10	8	7	7	14	12	8	7	12	255
MD81	Large	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	4
MD82	Large	1	3	2	1	1	0	0	0	0	0	1	1	0	0	0	13
PA31	Prop	3	4	4	4	4	5	4	4	4	4	4	4	4	4	5	59
PA32	Prop	1	2	2	2	2	2	2	2	2	2	2	2	2	2	3	28
SF34	Prop	1	2	2	2	2	3	2	1	1	1	1	3	2	1	1	25
<b>Total</b>		<b>236</b>	<b>844</b>	<b>658</b>	<b>544</b>	<b>443</b>	<b>317</b>	<b>252</b>	<b>222</b>	<b>207</b>	<b>202</b>	<b>281</b>	<b>266</b>	<b>241</b>	<b>223</b>	<b>289</b>	<b>5226</b>

Note: The values in this table are directly from the FAA log, and have not been scaled up by 30% for busy-day conditions.