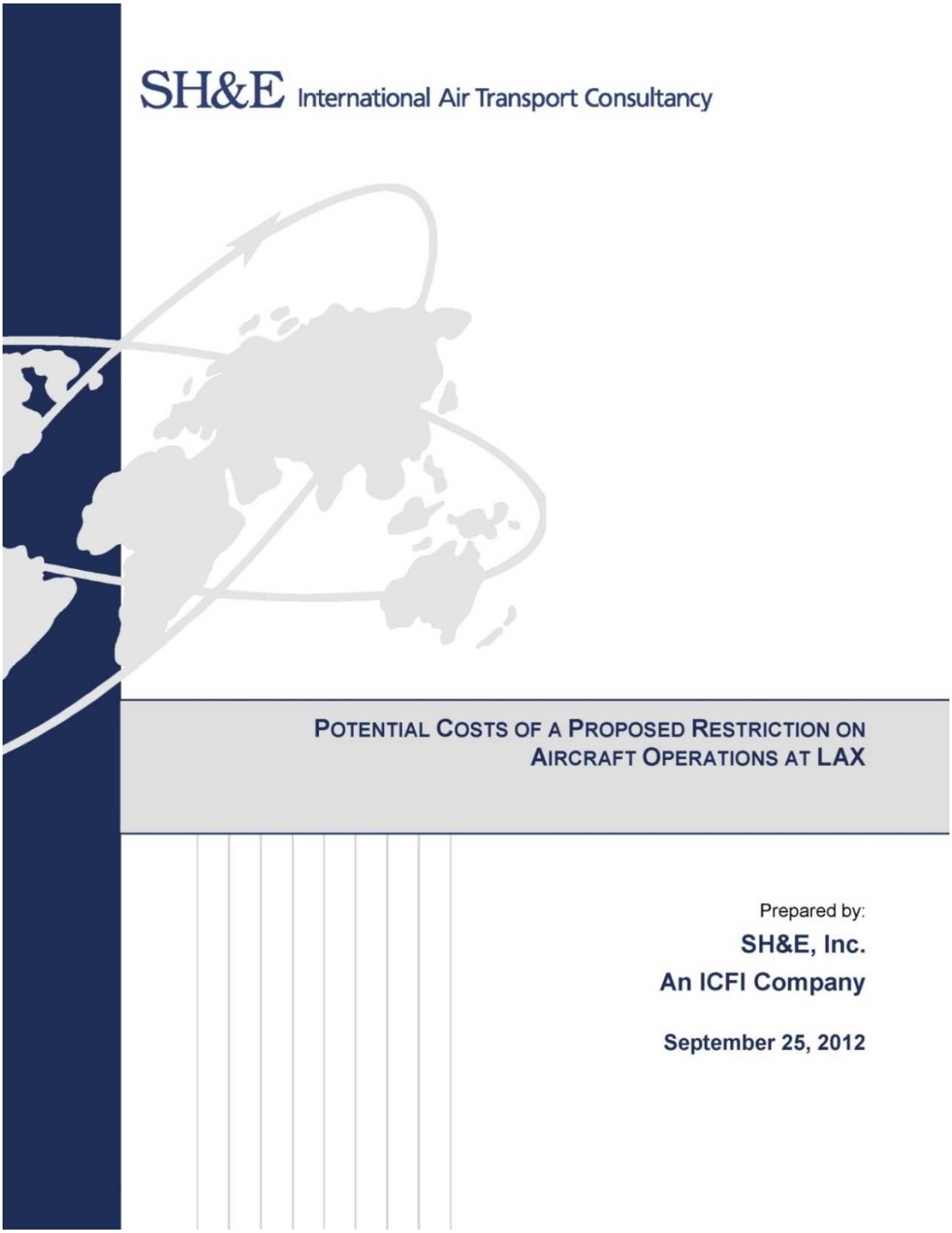
APPENDIX M USE RESTRICTION COST ANALYSES



1.0 Introduction

Los Angeles World Airports (LAWA) is conducting a Part 161 Study to determine the potential impacts of a proposed restriction on eastbound aircraft departures at Los Angeles International Airport (LAX) while the airport is in Over Ocean or Westerly Operations between midnight and 6:30 AM. These eastbound departures are termed "non-conforming".

To be approved, a Part 161 study must include:

Evidence, based on a cost-benefit analysis, that the estimated potential benefits of the restriction have a reasonable chance to exceed the estimated potential cost of the adverse effects on interstate and foreign commerce.[1]

This working paper presents the potential costs of the proposed restrictions and describes the analysis conducted to estimate those costs.

[1] http://ecfr.gpoaccess.gov/

PART 161—NOTICE AND APPROVAL OF AIRPORT NOISE AND ACCESS RESTRICTIONS
§ 161.305 Required analysis and conditions for approval of proposed restrictions.

2.0 Flights Affected by the Proposed Restriction

Exhibit 1 shows the flights expected to be affected in 2018 by the proposed restriction on non-conforming takeoffs. The forecast is based on the pattern of non-conforming operations from a 130 month sample (June 2000- March 2011) of non-conforming flight data in the LAWA East Departure Gate Penetration report. Potentially affected flights include 51 passenger aircraft departures and 14 all-cargo departures. Approximately half of the non-conforming departures take place between midnight and 1:00 AM, with the rest spread from 1:00 to 6:30 AM.

Exhibit 1: 2018 Departures Affected by Proposed Restriction by Time Period

	2400-0059	0100-0359	0400-0630	Total
Passenger	33	18	0	51
All Cargo	2	0	12	14
Total	35	18	12	65

Source: SH&E analysis

Exhibit 2 shows the types of aircraft that would be affected by the proposed restriction. Twin-engine models including Boeing 777-200, Boeing 777-300 and Boeing 767-300 freighter aircraft account for 36 of the 65 potentially affected departures.

Exhibit 2: 2018 Departures Affected by Proposed Restriction by Aircraft Type

Aircraft Type	Passenger	All-Cargo	Total
747-400	14	13	27
777-200	19		19
777-300	16		16
A380	2		2
767 Freighter		1	1
Total	51	14	65

Source: SH&E analysis

Exhibit 3 shows the potentially affected flights by market. All are international flights, and except for one all-cargo flight to Mexico City all the departures are to markets over 5,000 miles away, including 26 flights to markets over 7,000 miles distant.[2]

Exhibit 3: 2018 Departures Affected by Proposed Restriction by Market

Airport Code	Market	Distance (miles)	Departures
NRT	Tokyo	5,436	12
BNE	Brisbane	7,166	9
ICN	Seoul	5,982	9
SYD	Sydney	7,491	9
TPE	Taipei	6,783	9
HND	Tokyo	5,473	5
CAN	Guangzhou	7,227	3
HKG	Hong Kong	7,230	3
MEL	Melbourne	7,924	2
PEK	Beijing	6,232	2
MEX	Mexico City	1,554	1
NAN	Nadi, Fiji	5,522	1
Total			65

Source: SH&E analysis

LAX-NRT Flights

The 12 departures to Tokyo Narita are all-cargo operations. In 2010 747-400 freighter flights operated by Korean Air, Japan Air Lines, and Nippon Cargo Airlines to NRT accounted for 10 non-conforming departures. Japan Air Lines has since discontinued all of its freighter operations, but other carriers are expected to add service offsetting the loss in JAL freighter capacity.

[2] All distances shown represent the direct great-circle distance. The actual distance flown can be substantially greater.

LAX-BNE Flights

In 2018, nine passenger aircraft departures to Brisbane are expected to be affected by the proposed restriction. These include 747-400 service operated by Qantas and 777 service by V Australia.

Exhibit 4 presents information on Qantas Flight 16 operations from LAX to Brisbane from March 16 to March 28, 2012.

Exhibit 4: Qantas Flight 16 Operations – March 16 to March 28, 2012

Scheduled Date	Aircraft	Departure	Arrival	Duration
28-Mar-12	B744	23:53 PDT	05:43 EST (+2)	12:50
27-Mar-12	B744	23:45 PDT	06:01 EST (+2)	13:16
26-Mar-12	B744	00:32 PDT	07:16 EST (+1)	13:44
25-Mar-12	B744	00:03 PDT	06:45 EST (+1)	13:42
24-Mar-12	B744	00:08 PDT	06:43 EST (+1)	13:35
23-Mar-12	B744	00:24 PDT	06:56 EST (+1)	13:32
22-Mar-12	B744	00:30 PDT	07:01 EST (+1)	13:31
21-Mar-12	B744	00:17 PDT	06:40 EST (+1)	13:23
19-Mar-12	B744	00:14 PDT	06:38 EST (+1)	13:24
18-Mar-12	B744	00:08 PDT	06:36 EST (+1)	13:28
17-Mar-12	B744	00:25 PDT	06:40 EST (+1)	13:15
16-Mar-12	B744	00:25 PDT	06:24 EST (+1)	12:59
Average				13:23

Source: http://flightaware.com

QF16 is scheduled to depart LAX at 23:50 and utilizes 747-400 aircraft. The scheduled date represents the day the aircraft was scheduled to take off. When departures are delayed until after midnight, the actual departure date is one day later than the scheduled date.

Two of the 12 flights shown departed before midnight. If the pilots of these flights chose to make eastbound departures, they would not be considered non-conforming and would not be affected by the proposed restriction. The other 10 flights were delayed past midnight and would not be permitted to take off to the east under the proposed restriction.

These are very long flights. The direct great-circle distance between LAX and BNE is 7,166 miles, and the 12 flights shown had an average duration of 13:23. Brisbane Airport does not have curfews that limit airline flight scheduling, and QF16 is timed to give passengers an early morning arrival.

Exhibit 5 shows the average passenger load factor and average air cargo payload by aircraft type for 2009, 2010, and the first six months of 2011.

Exhibit 5: LAX-BNE Passenger Load Factor and Air Cargo Traffic

Aircraft Type	2009	2010	Jan to Jun 2011
Average Passenger Load Factor			
Boeing 747-400	79.5%	79.6%	85.5%
Boeing 777-200/200LR	71.4%	88.0%	84.3%
Average Cargo Payload in Metric Tonnes			
Boeing 747-400	3.4	4.1	5.6
Boeing 777-200/200LR	6.9	9.8	8.4

Source: USDOT T100 data

The average passenger load factor for both aircraft types is strong for the first half of 2011, and both typically carry substantial amounts of freight.

LAX-ICN Flights

In 2018, nine passenger aircraft departures to Seoul Incheon International Airport are expected to be affected by the proposed restriction, including flights by Korean Air and Asiana. Exhibit 6 presents information on Asiana Flight 203 (OZ203) operations, between March 16 and March 28, 2012, one of the flights that would be affected by the proposed restriction.

Exhibit 6: Asiana Flight 203 Operations – March 16 to March 28, 2012

Scheduled Date	Aircraft	Departure	Arrival	Duration
28-Mar-12	B772	0:43	04:39 KST (+1)	11:56
27-Mar-12	B772	0:47	04:57 KST (+1)	12:10
26-Mar-12	B772	1:16	05:48 KST (+1)	12:32
25-Mar-12	B772	0:59	05:15 KST (+1)	12:16
24-Mar-12	B772	1:00	05:05 KST (+1)	12:05
23-Mar-12	B772	0:44	05:18 KST (+1)	12:34
22-Mar-12	B772	0:56	05:30 KST (+1)	12:34
21-Mar-12	B772	0:55	05:23 KST (+1)	12:28
20-Mar-12	B772	0:50	05:28 KST (+1)	12:38
19-Mar-12	B772	1:09	06:44 KST (+1)	13:35
18-Mar-12	B772	1:17	05:59 KST (+1)	12:42
17-Mar-12	B772	0:55	05:28 KST (+1)	12:33
16-Mar-12	B772	1:06	05:28 KST (+1)	12:22
Average				12:29

Source: http://flightaware.com

OZ203 is scheduled to depart LAX at 00:20 and generally arrives at Incheon International Airport (ICN) between 0500 and 0600 local time. It utilizes 777-200ER aircraft. The flights shown in Exhibit 6 were late taking off by an average of 38 minutes, which indicates that Asiana would have to re-schedule OZ203 departures by an hour or more earlier to give pilots the option of eastbound take-offs if the proposed restriction were enacted. Seoul Incheon International Airport has no noise curfews that limit flight scheduling.

Although the great circle distance between LAX and ICN is 1,184 miles less than the distance from LAX to BNE, the average flight duration for the

sample of ICN flights averages only 54 minutes less than the average for the sample of QF16 flights to BNE. The LAX-ICN flight duration primarily reflects the headwinds often encountered on westbound North Pacific flights and the need to fly more circuitous routes, including routes circling over Russia and China to approach Incheon from the west while avoiding North Korean airspace.[3]

Exhibit 7 shows the average passenger load factor and average air cargo payload by aircraft type for 2009, 2010, and the first six months of 2011 for LAX-ICN passenger aircraft operations. Like the LAX-BNE flights, the average passenger load factors for all aircraft types are strong, and all aircraft types typically carry substantial cargo payloads.

Exhibit 7: LAX-ICN Passenger Load Factor and Air Cargo Traffic

Aircraft Type	2009	2010	Jan to Jun 2011
Average Passenger Load Factor			
Boeing 747-400	80.8%	80.9%	81.5%
Boeing 777-200/200LR	82.3%	88.2%	88.8%
Boeing 777-300/300ER	85.3%	85.1%	82.7%
Average Cargo Payload in Metric Tonnes			
Boeing 747-400	4.2	4.4	5.1
Boeing 777-200/200LR	3.2	3.3	3.4
Boeing 777-300/300ER	9.9	6.3	6.7

Source: USDOT T100 data

[3] The typical cruise speed for 747s used on the LAX-BNE route is approximately 7 miles per hour faster than the typical cruise speed for 777s used for Asiana LAX-ICN service. This impact is small compared to the impacts of headwinds and greater circuitry.

LAX-SYD Flights

Nine departures to Sydney are expected to be affected in 2018 by the proposed restriction. These include flights operated by Delta, Qantas, and United.

Qantas Flight 108 (QF108) accounted for four non-conforming departures in 2010, the majority of the non-conforming LAX-SYD departures that year. QF108 is currently operated by a mix of 747-400 and A380 aircraft, and is a continuation of a flight originating at New York JFK International with an aircraft change at LAX. In 2018 all QF108 flights are expected to be operated by A380 aircraft.

Exhibit 8 shows QF108 operations conducted between March 16 and March 28, 2012.

Exhibit 8: Qantas Flight 108 Operations – March 16 to March 28, 2012

Scheduled Date	Aircraft	Departure	Arrival	Duration
28-Mar-12	B744	00:29 PDT	08:33 EST (+1)	14:04
27-Mar-12	B744	00:30 PDT	08:37 EST (+1)	14:07
26-Mar-12	B744	01:13 PDT	09:35 EST (+1)	14:22
25-Mar-12	B744	00:28 PDT	08:41 EST (+1)	14:13
24-Mar-12	B744	00:03 PDT	08:32 EST (+1)	14:29
23-Mar-12	B744	00:35 PDT	08:47 EST (+1)	14:12
22-Mar-12	B744	00:25 PDT	08:28 EST (+1)	14:03
21-Mar-12	A388	00:24 PDT	08:53 EST (+1)	14:29
20-Mar-12	B744	23:39 PDT	08:10 EST (+2)	14:31
19-Mar-12	B744	00:02 PDT	08:03 EST (+1)	14:01
18-Mar-12	B744	00:32 PDT	08:42 EST (+1)	14:10
17-Mar-12	B744	00:54 PDT	08:48 EST (+1)	13:54
16-Mar-12	B744	01:10 PDT	08:33 EST (+1)	13:23
Average				14:09

Source: http://flightaware.com

QF108 is scheduled to depart LAX at 2350, and usually arrives at Sydney Kingsford Smith Airport (SYD) between 0800 and 0900 local time. All but one of the 13

departures shown in Exhibit 8 took place after 2400, when the proposed restriction would prohibit eastbound departures when LAX is in Over Ocean operations.

SYD has curfews restricting aircraft operations from 2300 to 0600 daily extended to 0600-0700 and 2200-2300 on weekends.[4] Qantas could schedule earlier departures from LAX and still meet the curfew requirements at SYD, but this would affect the scheduling of all segments of the SYD-LAX-JFK-LAX-SYD round trip and require Qantas offer a very early arrival at LAX on the eastbound leg from SYD, a time that many passengers might find inconvenient.

Exhibit 9 shows the average passenger load factors and cargo payload for aircraft used for LAX-SYD service. As with the previously shown routes, the airlines operating LAX-SYD generally achieve strong passenger load factors and substantial cargo payloads.

Exhibit 9: LAX-SYD Passenger Load Factor and Air Cargo Traffic

Aircraft Type	2009	2010	Jan to Jun 2011
Average Passenger Load Factor			
Airbus A380-800	85.4%	79.7%	79.9%
Boeing 747-400	83.7%	83.7%	82.1%
Boeing 777-200/200LR	70.3%	83.9%	84.0%
Average Cargo Payload in Metric Tonnes			
Airbus A380-800	4.4	4.5	3.8
Boeing 747-400	2.5	2.9	2.2
Boeing 777-200/200LR	8.8	7.8	7.3

Source: USDOT T100 data

[4] Sydney Airport Curfew Regulations include concessions for international passenger aircraft that allow no more than 24 landings between 0500-0600 local time in any one week for all operators. See http://www.boeing.com/commercial/noise/sydney.html.

LAX-TPE Flights

Nine departures to Taipei are expected to be affected in 2018 by the proposed restriction, including eight EVA and one China Airlines passenger flights. Exhibit 10 shows EVA Flight 15 (BR15) operations from March 16 to March 28, 2012.

Exhibit 10: EVA Flight 15 Operations – March 16 to March 28, 2012

Scheduled Date	Aircraft	Departure Time	Arrival Time	Duration
28-Mar-12	B77W	00:38 PDT	04:46 CST (+1)	13:08
27-Mar-12	B77W	00:22 PDT	na	na
26-Mar-12	B77W	01:20 PDT	na	na
25-Mar-12	B77W	00:37 PDT	04:58 CST (+1)	13:21
24-Mar-12	B77W	00:32 PDT	05:12 CST (+1)	13:40
23-Mar-12	B77W	00:40 PDT	06:22 CST (+1)	14:42
22-Mar-12	B77W	00:44 PDT	05:56 CST (+1)	14:12
21-Mar-12	B77W	00:28 PDT	05:13 CST (+1)	13:45
20-Mar-12	B77W	00:32 PDT	05:25 CST (+1)	13:53
19-Mar-12	B77W	00:37 PDT	06:08 CST (+1)	14:31
18-Mar-12	B77W	00:42 PDT	05:35 CST (+1)	13:53
17-Mar-12	B77W	00:06 PDT	05:28 CST (+1)	14:22
16-Mar-12	B77W	00:31 PDT	05:01 CST (+1)	13:30
Average				**13:54**

Source: http://flightaware.com

BR15 is scheduled to depart LAX at 0010 and utilizes 777-300ER aircraft. The flight would have to be re-scheduled to depart before midnight to receive permission for eastbound departures under the proposed restriction, but flights delayed past midnight would be required to take off to the west regardless of pilot preferences. Taipei Taoyuan International Airport (TPE) has no curfews that limit aircraft operations.

Exhibit 11 shows the passenger load factors and cargo payload for LAX-TPE passenger flights.

Exhibit 11: LAX-TPE Passenger Load Factor and Air Cargo Traffic

Aircraft Type	2009	2010	Jan to Jun 2011
Average Passenger Load Factor			
Boeing 747-400	76.1%	84.8%	83.6%
Boeing 777-200/200LR	74.8%	80.0%	79.3%
Boeing 777-300/300ER	81.4%	82.6%	83.2%
Average Cargo Payload in Metric Tonnes			
Boeing 747-400	3.5	2.9	1.5
Boeing 777-200/200LR	2.1	3.4	1.7
Boeing 777-300/300ER	7.6	6.7	7.0

Source: USDOT T100 data

SH&E

Potential Costs of a Proposed Restriction on
Aircraft Operations at LAX September 25, 2012

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LAX-HND Flights

Five departures to Tokyo International Airport (Haneda – HND) are expected to be affected in 2018 by the proposed restriction, all operated by All Nippon Airways utilizing 777-200ER aircraft[5]. All Nippon Airways Flight 1005 (NH1005) is scheduled to depart LAX at 0040 and generally arrives at Tokyo between 0430 and 0530. Exhibit 12 shows NH1005 operations from March 16 to March 28, 2012.

Exhibit 12: All Nippon Flight 1005 Operations – March 16 to March 28, 2012

Scheduled Date	Aircraft	Departure Time	Arrival Time	Duration
28-Mar-12	B772	01:36 PDT	04:33 JST (+1)	10:57
27-Mar-12	B772	01:03 PDT	03:58 JST (+1)	10:55
26-Mar-12	B772	02:05 PDT	05:20 JST (+1)	11:15
25-Mar-12	B772	00:58 PDT	04:40 JST (+1)	11:42
24-Mar-12	B772	01:13 PDT	04:52 JST (+1)	11:39
23-Mar-12	B772	01:15 PDT	04:53 JST (+1)	11:37
22-Mar-12	B772	01:12 PDT	04:54 JST (+1)	11:42
21-Mar-12	B772	01:07 PDT	04:48 JST (+1)	11:41
20-Mar-12	B772	01:19 PDT	05:24 JST (+1)	12:05
19-Mar-12	B772	01:26 PDT	05:52 JST (+1)	12:26
18-Mar-12	B772	01:21 PDT	04:58 JST (+1)	11:37
17-Mar-12	B77W	01:39 PDT	04:55 JST (+1)	11:16
16-Mar-12	B772	01:27 PDT	04:34 JST (+1)	11:07
Average				11:32

Source: http://flightaware.com

All departures took place after 2400, so none of the flights shown would be permitted to take off to the east under the proposed restriction. Rescheduling the LAX departure to an earlier time to permit eastbound departures when the pilots request them would result in Tokyo arrivals even earlier than the current 0430-0530 time

[5] All Nippon Airways usually uses 777-200ER aircraft for its night service from LAX to Tokyo Haneda and 777-300ER aircraft for its midday service from LAX to Tokyo Narita. Occasionally ANA uses 777-300ERs for service to Haneda when 777-200ERs require maintenance.

frame, potentially inconveniencing travelers. Tokyo Haneda International Airport has no curfews that limit flight scheduling.

Exhibit 13 shows the average passenger load factor and cargo payload for the All Nippon flights which began in 2010.

Exhibit 13: LAX-HND Passenger Load Factor and Air Cargo Traffic

Aircraft Type	2009	2010	Jan to Jun 2011
Average Passenger Load Factor			
Boeing 777-200/200LR		74.1%	73.8%
Average Cargo Payload in Metric Tonnes			
Boeing 777-200/200LR		5.1	7.0

Source: USDOT T100 data

Other LAX Markets with Potentially Affected Flights

The six markets described above are expected to have a total of 53 potentially affected departures in 2018 if the proposed restriction is enacted. Six other international markets are expected to have a total of 12 additional potentially affected departures in 2018. These markets include: Guangzhou, Hong Kong, Melbourne, Beijing, Mexico City, and Nadi, Fiji. With the exception of Mexico City, all are long haul trans-Pacific flights.

3.0 Potential Airline Responses to the Proposed Restriction

Airlines could respond to the proposed restriction on eastbound departures in several ways. These include scheduling departures before midnight when eastbound departures are permitted, delaying departures until after 0630 when Over Ocean operations end or until the wind abates, cancelling flights, moving operations to another airport, reducing the amount of fuel on board at takeoff by utilizing tech stops to refuel en route to the final destination, or reducing payload to ensure safe take-offs when there is a limited tailwind. Airlines can be expected to choose the response that offers the lowest direct cost, minimizes disruption for their customers, and minimizes disruption to their operations.

The evaluation of potential airline responses is based largely on information provided by airlines that account for a large share of the non-conforming departures at LAX. Seven airlines that have had 346 non-conforming departures or 45 percent of all non-conforming departures since June 2000 gave detailed answers to the following questions about their operations at LAX:

- What is the largest tailwind component that is acceptable to take off on runway 25R at maximum gross weight? Please provide information for all the aircraft/engine combinations that your airline uses for long-haul service at LAX.
- How large is the weight penalty for each knot of tailwind component up to 10 knots?
- How much cargo does your airline usually carry on its nighttime trans-Pacific departures from LAX? Please indicate if this varies by season.
- Does your airline ever need to restrict the sale of seats or bump passengers when westbound flights face unusually strong headwinds over the Pacific? If yes, please estimate the revenue impact of each restricted seat or bumped passenger.
- The European Aviation Safety Agency (EASA) recommends a planning weight of 105 kg per adult passenger on large aircraft, including 88 kg per person and 17 kg for bags. How does this compare with the passenger weight estimates your airline uses for flight planning purposes?

Key factors that will influence airline responses to the proposed restriction include the infrequency of these events and the difficulty predicting when they will occur. Non-conforming departures represent an extremely small share of total aircraft operations at LAX. During the three year period from 2009 to 2011, the five airlines with the largest number of non-conforming departures had a total of 21,359 departures at LAX. Of these, only 77 or 0.36% were nonconforming.[6] During this time only three airline flights had over ten non-conforming departures: Qantas Flight 16 to Brisbane (15 non-conforming departures), Qantas Flight 108 to Sydney (14 non-conforming departures), and China Airlines Flight 7 to Taipei (11 non-conforming departures). Airlines will be reluctant to make major changes in schedules or operations because of events like this occurring on average 5 or fewer times per year.

Non-conforming departures usually take place in a very narrow window of wind conditions. Most aircraft can accept a 2 to 5 knot tailwind without difficulty and the control tower generally switches airport operations from Over-Ocean or West Flow to East Flow when tailwinds exceed 10 knots. Because it is difficult to anticipate when 5 to 10 knot tailwind conditions will occur, airlines are most likely to respond to the proposed restriction in a way that offers the maximum flexibility.

Passenger aircraft departures between 2400 and 0100 could be rescheduled to times before 2400 when eastbound departures would still be permitted, but this would make the arrival times in key Asian markets less convenient for passengers and make the timing of other segments of round trip operations less marketable. In addition, if flights rescheduled to depart shortly before midnight were delayed, they would then not be able to utilize east departures if desired, reducing the benefits of this potential response. Airlines have scheduled their LAX operations to maximize their marketability and to enhance airline operating efficiency. They would be unlikely to reschedule year-round departures of potentially affected flights when only a handful of those departures would be affected by the proposed restriction.

Delaying departures to times after 0630 when eastbound departures are permitted may create operational problems, since the increase in aircraft arrivals at LAX after 0630 could make it difficult to fit eastbound departures into the mix. Delaying departures would likely also lead to problems with

[6] . Source: LAWA records. Airlines with the largest number of non-conforming departures include Qantas, Korean Air, China Airlines, Cathay Pacific, and Japan Air Lines

aircraft crew hours of service regulations. Cancelling flights inconveniences passengers and leaves aircraft out of position. Airlines would be very unlikely to shift international passenger flights to other airports, because LAX is by far the largest international air passenger market on the West Coast. Exhibit 14 compares international jet passenger service at LAX to service at SFO and SEA for December, 2011. LAX serves almost twice as many international markets as SFO and almost four times as many as SEA, and has a similar advantage in weekly aircraft departures and seat-departures. Airlines would not move service away from the dominant West Coast international passenger market because of a restriction that affected only a small number of flights if there were other ways to meet the new requirements.

Exhibit 14: International Jet Passenger Service at LAX, SFO and SEA – December 2011

Airport	International Markets	Weekly Departures	Weekly Seats
LAX	57	868	207,616
SFO	31	442	101,977
SEA	14	97	24,744

Source: OAG schedule tapes, SH&E analysis

Airlines would also be unlikely to move all-cargo flights to other airports because of the proposed restriction. LAX is the center of the international air cargo market in southern California, and efforts to shift all-cargo flights to Ontario International Airport and other airports in the region have had very limited success because the international air freight forwarding community is concentrated near LAX, where forwarders can utilize passenger aircraft as well as freighters to carry their clients shipments.

Using tech stops to reduce the amount of fuel required at take-off would be costly and potentially disruptive. This response would involve landing fees and other airport charges at the intermediate airport, cause delays for passengers, and create crew and aircraft scheduling problems.

To comply with the proposed restriction, airlines would most likely decide to reduce aircraft take-off weight to ensure safe operations while maintaining their basic service schedule. The most cost-effective and least disruptive way

for airlines to reduce take-off weight will almost certainly involve off-loading cargo first and off-loading passengers and bags if a larger payload reduction is required. How much payload would have to be removed will be a function of the strength of the tailwind, the type of aircraft operated, temperature and barometric pressure, and airline company policies and practices.

The strength of the tailwind depends on wind velocity and direction. Usually, Runway 25R is the preferred runway for heavy aircraft taking off during Over Ocean or Westerly operations. If the wind is blowing from a 70 degree direction, the full force of the wind is applied as a tailwind. When the wind is blowing from a direction north or south of 70 degrees, part of the wind strength is applied as a tailwind and part as a crosswind. For example, on Runway 25R a wind blowing from 110 degrees at 6 knots produces a tailwind of 4.6 knots and a crosswind of 3.8 knots from left to right. Airlines operating at LAX have different policies and practices regarding the maximum tailwind permitted for takeoff. One major airline will accept tailwinds up to 10 knots, while another will not accept tailwinds over 5 knots.

Of the 736 records of non-conforming departures from June 2000 through December 2011, 402 have data on wind speed and direction. Not including 10 records where non-conforming departures took place even though there was a headwind on Runway 25R, the tailwind on Runway 25R when non-conforming departures took place averaged 5.5 knots. Exhibit 15 shows the distribution of tailwind velocity for the sample of records with wind data.

Exhibit 15: Tailwind Recorded for Non-Conforming Departures

Tailwind	Departures	Share
Under 2 knots	29	7.2%
2 to 4 knots	67	16.7%
4 to 6 knots	135	33.6%
6 to 8 knots	117	29.1%
Over 8 knots	54	13.4%
Total	402	100.0%

Source LAWA records, SH&E analysis

The different types of aircraft that are expected to operate non-conforming departures in the future have differing capabilities regarding take-off performance with tailwinds. Exhibit 16 outlines information provided by airlines operating at LAX about the greatest tailwind that is acceptable when operating at maximum take-off weight (MTOW) on Runway 25R, and the weight penalties incurred when operating with stronger tailwinds.[7]

Exhibit 16: Aircraft Performance with Tailwinds on Runway 25R

Aircraft	Max Tailwind @ MTOW (knots)	Penalty per Knot (lbs.)
747-400	2 to 7	6,600 to 8,800
777-200ER	0 to 1	2,500 to 4,400
777-300ER	5 to 8	5,400
A330-300	10	-
A380-800	9	4,700

Source LAX airline interviews

Depending on different airframe/engine combinations, 747-400s can take off from Runway 25R with tailwinds from 2 to 7 knots before incurring a weight penalty. There is a weight penalty of 6,600 to 8,800 pounds per knot for each knot of tailwind above that. Some 777-200ER aircraft cannot take-off from 25R at maximum take-off weight with any tailwind and incur a weight penalty of 2,500 to 4,400 pounds for each knot of tailwind. The 777-300ER and A380 aircraft are more tolerant of tailwinds, and can operate at maximum take-off weight with tailwinds from 5 to 9 knots.

The weight penalty that airlines would incur if the proposed regulation is enacted will depend not only on these performance factors but also on the actual weights at which the aircraft operate. For example, if a 777-200ER planned to take-off at 8,800 pounds below maximum take-off weight, it could operate with a two knot tailwind without any further payload penalty.

Because it is not possible to forecast the payload of each flight that would perform a non-conforming departure in the future, the exact amount of the payload penalty that airlines would face under the proposed restriction cannot

[7] A380 data are based on Runway 25L because A380s are not currently authorized to operate on 25R.

be calculated. Based on the historical pattern of Runway 25R tailwinds and the range of aircraft performance characteristics, two representative planning scenarios have been developed to provide reasonable estimates of the costs that the restriction could impose on airlines at LAX, one where airlines face an average payload penalty of 10,000 pounds per flight, and a second where they face an average penalty of 20,000 pounds per flight. Under the first scenario, airlines achieve the needed weight reduction by off-loading cargo and excess bags. Under the second scenario, passenger flights reduce weight by reducing passenger loads as well as cargo, while all-cargo flights off-load additional cargo.[8]

[8] The combined weight of one passenger and bags for planning purposes is 105 kg or approximately 230 pounds, following the EASA planning standard.

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4.0 Potential Costs of the Proposed Restriction

Airlines would be able to maintain their current schedules and meet the requirements of the proposed restriction by reducing payload and aircraft take-off weight to compensate for mild tailwinds, but will lose cargo and passenger revenue as a result. Cargo revenue currently has three main components: the base cargo rate, fuel surcharge, and security surcharge. Exhibit 17 shows representative rates and surcharges to the three market areas that potentially affected flights serve. Air cargo rates are highly competitive and fluctuate substantially depending on market conditions, volume discounts, seasonality and other factors.

Exhibit 17: Representative Air Cargo Rates and Surcharges: $ per Kg, Winter 2011-2012

Market Area	Base Rate	Fuel Surcharge	Security Surcharge	Total
Asia	$0.95	$1.00	$0.15	$2.10
Australia Pacific	$2.75	$1.00	$0.15	$3.90
Latin America	$1.35	$1.00	$0.15	$2.50

Source: SH&E analysis

The base rate to many Asian markets is under $1.00 per kilo because of ample westbound air cargo capacity, and typical airline fuel and security surcharges contribute over half of the westbound cargo revenue to many of these markets. Rates are higher to Australia/Pacific markets because of a better balance of air cargo demand and supply, while rates to Latin America are higher than many Asian rates despite being much closer. Air cargo is expected to remain highly competitive in most markets, and airline cargo rates are not expected to show any substantial growth in constant dollars between 2012 and. 2018.

Exhibit 18 shows the airline cargo revenue potentially lost per year when airlines off-load cargo pounds in order to comply with the proposed restriction. It should be emphasized that this is a planning estimate, and it is possible that airlines might choose to reduce aircraft take-off weight by a greater or lesser amount to operate safely with tailwind conditions.

Exhibit 18: Potential Airline Cargo Revenue Lost per Year under the Proposed Restriction

Market Area	Affected Flights		Revenue per Kg	Scenario 1 10,000 lb	Scenario 2 20,000 lb
	Passenger	All-Cargo			
Asia	30	13	$2.10	$409,594	$533,425
Australia Pacific	21		$3.90	$371,492	$371,492
Latin America		1	$2.50	$11,340	$22,680
Total	51	14		$792,426	$927,597

Source: SH&E analysis

Of the 65 potentially affected flights, 43 are to Asian destinations, 21 to Australian or Pacific destinations, and one to Latin America. Under Scenario 1, passenger and all-cargo flights comply with the proposed restriction by off-loading 10,000 pounds of cargo. Under Scenario 2, the 14 all-cargo flights off-load an additional 10,000 pounds. The cargo revenue associated with the payload reduction is $792,000 per year under Scenario 1 and $928,000 per year under Scenario 2. The affected airlines are not likely to lose all this cargo revenue, since these airlines operate daily or double-daily service to most of the affected markets, and most or all of the off-loaded cargo can probably be accommodated on later flights. For this reason the estimate of revenue lost represents an upper bound of the potential impact on airline cargo revenues.

Exhibit 19 describes the potential impact on airline passenger revenues.

Exhibit 19: Potential Airline Passenger Revenue Lost per Year under the Proposed Restriction

Market Area	Affected Flights		Revenue per Pax	Scenario 1 10,000 lb	Scenario 2 20,000 lb
	Passenger	All-Cargo			
Asia	30	13	$500	$0	$660,000
Australia Pacific	21		$800	$0	$739,200
Latin America		1		$0	$0
Total	51	14		$0	$1,399,200

Source: SH&E analysis

Under Scenario 1 there is no impact on passenger revenue, since the required take-off weight reduction is accomplished by off-loading cargo. Under Scenario 2, 44 seats are blocked on each of the 51 affected passenger flights. The estimated revenue per seat is $500 to Asian markets and $800 per seat to Australia Pacific markets. The total potential reduction is airline passenger revenue is estimated to be $1.4 million per year.

Exhibit 20 shows the net present value of the potential reduction in airline cargo revenue for five year (2013-2017), ten year (2013-2022), and twenty year (2013-2032) periods under the two planning scenarios. Under the first scenario, passenger and cargo rates in constant dollars remain flat as competition balances the increase in demand associated with future economic growth. Under the second scenario, airlines achieve an average 3.0% annual growth in rates. The standard Office of Management and Budget discount rate of 7% is used for both scenarios.[9]

[9] OMB Circular No. A-94 Revised

Exhibit 20: Net Present Value of Potential Reduction in Airline Revenue

	Scenario 1 Off-load 10,000 lbs.	Scenario 2 Off-load 20,000 lbs.
No Increase In Airline Yields		
NPV 5 years	$3,249,000	$9,591,000
NPV 10 years	$5,566,000	$16,430,000
NPV 20 years	$8,395,000	$24,782,000
3% Annual Increase In Airline Yields		
NPV 5 years	$3,539,000	$10,448,000
NPV 10 years	$6,465,000	$19,084,000
NPV 20 years	$10,881,000	$32,122,000

Source: SH&E analysis

Looking at a 20 year period with no increase in constant dollar airline rates, the net present value of the potential reduction in airline revenue ranges from $8.4 to $24.8 million, depending on the airline decision to reduce payload by an average of 10,000 or 20,000 pounds per departure. If airlines succeed in achieving 3.0% annual growth in real passenger and cargo rates, the net present value of the potential revenue loss increases to between $10.9 and $32.1 million for the 20 year period. Another way to view the potential costs to airlines is in the context of the economic benefits that international air service at LAX generates. A 2007 study prepared by the Los Angeles County Economic Development Corporation (LAEDC) found the average daily overseas round trip in 2006 generated $623 million in economic output and supported 3,120 direct and indirect jobs with $156 million in wages.[10] Compared to the dollar value of economic benefits the potential costs of complying with the proposed restriction are small, but they will still be noticeable to airlines who continue to struggle with high fuel prices.

[10] The Economic Activity Dependent on Overseas Flights at LAX, prepared by LAEDC with HR&A and SH&E, August 2007

5.0 Potential Fuel and Emissions Savings from the Proposed Restriction

Enacting the proposed restriction would lead to a reduction in airline fuel consumption and carbon dioxide emissions. Exhibit 21 shows the projected non-conforming departures by aircraft type and market. Flights to Asian and Australia/Pacific markets account for most non-conforming departures.

Exhibit 21: Projected Non-Conforming Departures by Aircraft Type and Market Region

	Asia	Australia Pacific	Latin America	Total
Passenger Aircraft				
777-200/300	30	5		35
747-400		14		14
A380		2		2
All Cargo Aircraft				
747-400F	13			13
767F			1	1
Total	43	21	1	65

Source: SH&E analysis

Flight track analysis shows that departing to the east and circling back over the Pacific Ocean adds an average of 3.5 minutes to these flights, increasing the amount of fuel consumed and also adding to the carbon dioxide that these aircraft emit

Exhibit 22 shows the average fuel consumption per hour for the aircraft types projected to make non-conforming departures and the total fuel per year that would be saved by eliminating the additional miles flown due to non-conforming departures.

Exhibit 22: Additional Gallons of Jet Fuel Consumed per Year due to Additional Miles Flown

	Average Gallons per Hour	Non Conforming Departures	Extra Fuel Consumed
Passenger Aircraft			
A380	3,800	2	443
747-400	3,480	14	2,842
777-200/300	2,360	35	4,818
All Cargo Aircraft			
747-400F	3,480	13	2,639
767F	1,750	1	102
Total		65	10,845

Source: USDOT Form 41, Schedule P5.2, SH&E analysis

Aircraft fuel consumption per hour can vary substantially based on the weight of the aircraft, flight speed, the part of the flight cycle (e.g. climb, cruise, and descent), engine condition, and other factors. The values shown in Exhibit 22 represent averages based on US airline fuel consumption and flight hour data filed with the USDOT plus analysis of other industry sources. .

With an extra 3.5 minutes of flight time for each non-conforming departure to Asian and Australia/Pacific markets, the additional fuel consumption from non-conforming departures totals 10,845 gallons per year.

The price of jet fuel has been volatile in recent years and is expected to remain volatile for the foreseeable future. After accounting for data outliers, analysis of USDOT Form 41 data indicates that the US airlines serving Pacific region markets paid an average of $3.06 per gallon during the first nine months of 2011.

Exhibit 23 shows the 5, 10, and 20 year net present value of the airline fuel savings that could be achieved if non-conforming departures were prohibited. The exhibit also shows the net present value if the price of fuel increases by 50% to $4.59 per gallon. The net present value of potential savings at average 2011 fuel prices would equal $136,000 over the first 5 years. At $4.59 a gallon, no longer an unrealistic figure, the net present value for a 20 year period would equal $527,000.

Exhibit 23: Net Present Value of Potential Reduction in Airline Fuel Consumption

	Fuel at 2011 Price	50% Fuel Price Increase
NPV 5 years	$136,000	$204,000
NPV 10 years	$233,000	$350,000
NPV 20 years	$352,000	$527,000

Source: USDOT Form 41, Schedule P5.2, SH&E analysis

Prohibiting non-conforming departures would also reduce airline carbon dioxide emissions. Each gallon of jet fuel burned produces an average of 9.57 kilograms or 21.1 pounds of carbon dioxide.[11] By reducing airline fuel consumption by 10,845 gallons per year, prohibiting non-conforming departures would also reduce carbon dioxide emissions by approximately 229,000 pounds or 114 tons per year.

[11] Direct Emissions from Mobile Combustion Sources, US EPA, May 2008, Table B-2

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