Technical Appendices

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E

Activity Levels

This appendix provides detailed tables in support of *Chapter 2, Activity Levels*:

- Table E-1 Logan Airport Historic Air Passenger and Operations Data
- Table E-2 Logan Airport Changes in Domestic Passenger Operations by Carrier
- Table E-3 Logan Airport Changes in International Passenger Operations by Carrier
- Table E-4 Logan Airport Scheduled Passenger Departures by Destination

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Table E-1	Logan Airport Historic Air Passenger and Operations Data				
Year	**Operations**	**Air Passengers**	**Year**	**Operations**	**Air Passengers**
1980	258,167	14,722,363	1997	482,542	25,567,888
1981	251,961	14,827,684	1998	507,449	26,526,708
1982	244,468	15,867,722	1999	494,816	27,052,078
1983	288,956	17,848,797	2000	487,996	27,726,833
1984	318,959	19,417,971	2001	463,125	24,474,930
1985	349,518	20,448,424	2002	392,079	22,696,141
1986	363,995	21,862,718	2003	373,304	22,791,169
1987	414,968	23,369,002	2004	405,258	26,142,516
1988	407,479	23,732,959	2005	409,066	27,087,905
1989	388,797	22,272,860	2006	406,119	27,725,443
1990	424,568	22,878,191	2007	399,537	28,102,455
1991	430,403	21,450,143	2008	371,604	26,102,651
1992	474,378	22,723,138	2009	345,306	25,512,086
1993	493,093	23,579,726	2010	352,643	27,428,962
1994	458,623	24,468,178	2011	368,987	28,909,267
1995	466,327	24,192,095	**2012**	**354,869**	**29,236,087**
1996	456,226	25,134,826	**2013**	**361,339**	**30,218,970**

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Table E-2 Logan Airport Changes in Domestic Passenger Operations by Carrier

Airline	2000	2005	2010	2011	2012	2013	2011-2012 Change	2011-2012 Percent Change	2012-2013 Change	2012-2013 Percent Change
Scheduled Jet Carriers	233,993	190,991	203,081	207,369	203,376	211,176	-3,993	-1.9%	7,800	3.8%
AirTran Airlines	3,090	14,580	13,672	12,869	10,883	7,764	-1,986	-15.4%	-3,119	-28.7%
Alaska Airlines		1,088	1,733	1,757	1,873	2,661	116	6.6%	788	42.1%
America West Airlines	5,116	4,467								
American Airlines	30,821	27,712	21,313	18,943	20,962	22,535	2,019	10.7%	1,573	7.5%
American Trans Air	1,448	2,294								
Continental Airlines	16,894	13,546	10,869	11,074	1,546		-9,528	-86.0%	-1,546	-100.0%
Delta Subtotal	52,954	36,388	28,980	25,429	23,270	21,139	-2,159	-8.5%	-2,131	-9.2%
Delta Air Lines Mainline	*22,031*	*14,317*	*21,926*	*19,633*	*23,270*	*21,139*	3,637	18.5%	*-2,131*	*-9.2%*
Delta Express	*13,746*									
Delta Shuttle	*17,177*	*9,588*	*7,054*	*5,796*			-5,796	-100.0%		
Delta Song		*12,483*								
Frontier Airlines	1,052		1,094		275		275	100.0%	-275	-100.0%
Independence Air		4,676								
JetBlue		15,069	49,981	58,737	63,210	73,374	4,473	7.6%	10,164	16.1%
Midway Airlines	4,096									
Midwest Airlines	3,726	3,570	1,961	2,786			-2,786	-100.0%		
Northwest Airlines	13,147	9,685								
Southwest Airlines			13,727	17,413	12,784	15,937	-4,629	-26.6%	3,153	24.7%
Spirit Airlines			3,023	3,054	3,365	2,721	311	10.2%	-644	-19.1%
Sun Country Airlines	723		313	509	596	926	87	17.1%	330	55.4%
Trans World Airlines	6,280									
United Airlines	28,092	18,304	16,314	15,351	24,090	25,214	8,739	56.9%	1,124	4.7%
US Airways	66,554	39,612	36,678	36,421	36,633	35,613	212	0.6%	-1,020	-2.8%
Virgin America			3,394	3,026	3,889	3,292	863	28.5%	-597	-15.4%
Regional/Commuter Carriers	160,041	137,203	94,535	89,586	83,814	83,948	-5,772	-6.4%	134	0.2%
America West Express	1,267									
American Airlines Subtotal										
Chautauqua Airlines (American Airlines)										
American Eagle Airlines	62,140	37,394	15,291	6,669	4	4	-6,665	-99.9%	0	0.0%
Cape Air	31,026	25,018	35,899	35,940	37,184	37,194	1,244	3.5%	10	0.0%

Table E-2 Logan Airport Changes in Domestic Passenger Operations by Carrier (Continued)

Airline	2000	2005	2010	2011	2012	2013	2011-2012 Change	2011-2012 Percent Change	2012-2013 Change	2012-2013 Percent Change
Continental Connection Subtotal			1,809	1,199	131		-1,068	-89.1%	-131	-100.0%
Colgan Air (Continental Connection)			*1,809*	*1,199*	*131*		-1,068	-89.1%	*-131*	*-100.0%*
Continental Express Subtotal		12,544	529	902	385		-517	-57.3%	-385	-100.0%
Atlantic SE (Continental Express)				*134*			-134	-100.0%		
Chautauqua Airlines (Continental Express)			*529*	*719*	*185*		-534	-74.3%	*-185*	*-100.0%*
Commutair (Continental Express)		*12,544*								
Express Jet (Continental Express?)					*86*		86	100.0%	*-86*	*-100.0%*
Trans States Airlines (Continental Express)				*49*	*114*		65	132.7%	*-114*	*-100.0%*
Delta Connection Subtotal	15,438	26,557	18,445	23,243	20,925	20,848	-2,318	-10.0%	-77	-0.4%
ACJet (Delta Connection)	*2,258*									
Atlantic SE (Delta Connection)			*943*	*4,948*			-4,948	-100.0%		
Big Sky Airlines (Delta Connection)										
Chautauqua Airlines (Delta Connection)		*1,938*	*1,794*	*2,230*	*1,926*	*1,860*	-304	-13.6%	*-66*	*-3.4%*
Comair Airlines (Delta Connection)	*520*	*24,619*	*10,255*	*7,857*	*5,824*		-2,033	-25.9%	*-5,824*	*-100.0%*
Compass Airlines (Delta Connection)			*1,053*	*1,577*	*574*	*14*	-1,003	-63.6%	*-560*	*-97.6%*
Express Jet (Delta Connection?)					*1,648*	*3,771*	1,648	100.0%	*2,123*	*128.8%*
Freedom Airlines (Delta Connection)										
Go Jet (Delta Connection?)					*88*	*6*	88	100.0%	*-82*	*-93.2%*
Mesaba Airlines (Delta Connection)			*1,078*	*3,117*	*21*		-3,096	-99.3%	*-21*	*-100.0%*
Pinnacle Airlines (Delta Connection)			*1,278*	*1,507*	*3,689*	*4,747*	2,182	144.8%	*1,058*	*28.7%*
Shuttle America (Delta Connection)			*2,044*	*2,007*	*7,155*	*10,450*	5,148	256.5%	*3,295*	*46.1%*
Trans States Airlines (Delta Connection)	*12,660*									
MidAtlantic Express										
Midwest/Republic			258							
Northwest Airlink Subtotal		5,034								
Compass Airlines (Northwest Airlink)										
Pinnacle Airlines (Northwest Airlink)		*5,034*								
PenAir					2,268	4,384	2,268	100.0%	2,116	93.3%
United Express Subtotal		3,178	2,802	2,763	4,342	5,633	1,579	57.1%	1,291	29.7%
ACJet (United Express)										
Air Wisconsin (United Express)		*1,699*								
Atlantic SE (United Express)			*574*	*6*			-6	-100.0%		

Table E-2 Logan Airport Changes in Domestic Passenger Operations by Carrier (Continued)

Airline	2000	2005	2010	2011	2012	2013	2011-2012 Change	2011-2012 Percent Change	2012-2013 Change	2012-2013 Percent Change
Chautauqua Airlines (United Express)		*103*			*976*	*1,527*	976	100.0%	*551*	*56.5%*
Colgan Air (United Express)					*334*		334	100.0%	*-334*	*-100.0%*
Express Jet (United Express)					*1,089*	*973*	1,089	100.0%	*-116*	*-10.7%*
Mesa Airlines (United Express)		*1,376*	*434*	*258*	*18*	*886*	-240	-93.0%	*868*	*4822.2%*
Shuttle America (United Express)			*1,561*	*1,941*	*1,023*	*1,597*	-918	-47.3%	*574*	*56.1%*
SkyWest Airlines (United Express)						*469*			*469*	*100.0%*
Trans States Airlines (United Express)			*233*	*558*	*902*	*181*	344	61.6%	*-721*	*-79.9%*
US Airways Express Subtotal	50,170	27,478	19,502	18,870	14,551	11,859	-4,319	-22.9%	-2,692	-18.5%
Air Wisconsin (US Airways Express)		*174*	*6,266*	*6,499*	*6,664*	*6,440*	165	2.5%	*-224*	*-3.4%*
Allegheny (US Airways Express)	*9,537*									
Chautauqua Airlines (US Airways Express)	*0*	*7,852*	*3*							
Colgan Air (US Airways Express)	*11,390*	*12,583*	*9,256*	*8,302*	*2,114*		-6,188	-74.5%	*-2,114*	*-100.0%*
Commutair (US Airways Express)	*25,774*									
Mesa Airlines (US Airways Express)	*3,469*	*4*								
MidAtlantic Express (US Airways Express)		*150*								
Piedmont Airlines (US Airways Express)		*3,165*	*963*	*1,325*	*2,428*	*1,951*	1,103	83.2%	*-477*	*-19.6%*
PSA (US Airways Express)		*526*	*2*	*5*			-5	-100.0%		
Republic (US Airways Express)		*46*	*3,012*	*2,739*	*3,345*	*3,468*	606	22.1%	*123*	*3.7%*
Trans States Airlines (US Airways Express)		*2,978*								
Non-Scheduled Operations (Incl. Charter)	1,008	325	501	106	-3,843	-3,826	-3,949	-3725.5%	17	-0.4%
Total Domestic Operations	395,042	328,519	298,117	297,061	283,347	291,298	-13,714	-4.6%	7,951	2.8%

Note: Excludes general aviation and all-cargo operations.
Source: Massport

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Table E-3 Logan Airport Changes in International Passenger Operations by Carrier

Airline	2000	2005	2010	2011	2012	2013	2011-2012 Change	2011-2012 Percent Change	2012-2013 Change	2012-2013 Percent Change
Scheduled Jet Carriers	27,427	24,550	20,771	26,984	27,645	25,314	661	2.4%	-2,331	-8.4%
Aer Lingus	1,160	1,016	1,097	1,130	1,273	1,513	143	12.7%	240	18.9%
Aeromexico		534								
Air Canada	10,047	5,782	3,895	4,125	4,517	1,747	392	9.5%	-2,770	-61.3%
Air France	1,046	1,334	995	1,013	974	955	-39	-3.8%	-19	-2.0%
Air Jamaica		349								
Air One										
Alitalia	729	986	624	604	530	542	-74	-12.3%	12	2.3%
American Airlines	4,657	4,672	2,422	2,149	1,901	447	-248	-11.5%	-1,454	-76.5%
Astraeus				100			-100	-100.0%		
British Airways	2,159	2,151	2,082	2,161	2,149	2,573	-12	-0.6%	424	19.7%
Canadian Airlines	417									
Copa Airlines						347			347	100.0%
Delta Air Lines	733	749	1,614	3,280	2,531	2,851	-749	-22.8%	320	12.6%
Finnair		44								
FlyGlobespan										
Frontier Airlines										
Iberia Airlines			435	445	441	404	-4	-0.9%	-37	-8.4%
Icelandair	726	811	816	928	938	1,120	10	1.1%	182	19.4%
Japan Airlines					474	646	474	100.0%	172	36.3%
JetBlue			2,262	5,173	5,902	6,138	729	14.1%	236	4.0%
Korean Air Lines	314									
LACSA Airlines										
Lufthansa	1,140	1,564	1,657	1,734	1,784	1,723	50	2.9%	-61	-3.4%
Northwest Airlines	744	727	61							
Olympic Airways	256									
Sabena	724									
SATA International Airlines		315	403	400	412	466	12	3.0%	54	13.1%
SWISS International	926	704	720	725	716	720	-9	-1.2%	4	0.6%
TACA		327								
TACV - Cabo Verde		154	240	236	234	214	-2	-0.8%	-20	-8.5%
TAP - Air Portugal	200									
Trans World Airlines										

Table E-3 Logan Airport Changes in International Passenger Operations by Carrier (Continued)

Airline	2000	2005	2010	2011	2012	2013	2011-2012 Change	2011-2012 Percent Change	2012-2013 Change	2012-2013 Percent Change
United Airlines	728									
US Airways		1,607	667	49	146	186	97	198.0%	40	27.4%
VG Airlines										
Virgin Atlantic Airways	721	724	707	721	711	709	-10	-1.4%	-2	-0.3%
Regional/Commuter Carriers	15,594	13,112	12,494	12,153	12,270	14,378	117	1.0%	2,108	17.2%
Air Canada Regional	4,088	5,120	7,065	6,803	7,058	9,563	255	3.7%	2,505	35.5%
American Eagle Airlines	8,975	4,637	2,480	2,206			-2,206	-100.0%		
Delta Connection Subtotal	2,531	3,355	81	1	1,489	1,082	1,488	148800.0%	-407	-27.3%
ACJet (Delta Connection)										
Big Sky Airlines (Delta Connection)										
Comair Airlines (Delta Connec	*2,531*	*3,355*	*81*	*1*			-1	-100.0%		
Pinnacle Airlines (Delta Connection)					*1,489*	*1,082*	1,489	100.0%	*-407*	*-27.3%*
Porter Airlines			2,868	3,143	3,723	3,733	580	18.5%	10	0.3%
Non-Scheduled Operations	2,141	1,068	305	300	268	277	-32	-10.7%	9	3.4%
Total International Operations	45,162	38,643	33,570	39,437	40,183	39,969	746	1.9%	-214	-0.5%

Note: Excludes general aviation and all-cargo operations.
Source: Massport

Table E-4 Logan Airport Scheduled Passenger Departures by Destination

Destination Airport	Code	2000	2005	2010	2011	2012	2013	2011-2012 Change	2011-2012 Percent Change	2012-2013 Change	2012-2013 Percent Change
Domestic		210,068	163,684	149,962	152,303	147,895	151,104	-4,409	-2.9%	3,210	2.2%
New York La Guardia	LGA	11,872	13,350	11,705	11,489	9,564	9,255	-1,925	-16.8%	-309	-3.2%
Washington National	DCA	8,474	10,680	9,419	9,793	8,543	8,360	-1,250	-12.8%	-183	-2.1%
Chicago O'Hare	ORD	10,063	7,412	7,403	7,635	7,461	7,733	-174	-2.3%	272	3.6%
Philadelphia	PHL	11,785	7,014	6,548	7,985	6,301	7,305	-1,684	-21.1%	1,004	15.9%
New York J F Kennedy	JFK	9,899	4,985	7,054	5,969	5,428	5,919	-541	-9.1%	491	9.1%
Baltimore	BWI	1,773	5,029	7,053	6,755	5,910	5,737	-845	-12.5%	-173	-2.9%
New York Newark	EWR	5,206	5,626	3,666	4,608	5,228	5,702	620	13.5%	474	9.1%
Atlanta	ATL	7,110	6,003	5,548	5,569	5,574	5,501	5	0.1%	-72	-1.3%
Dallas/Fort Worth	DFW	5,002	3,544	2,938	2,781	3,790	4,147	1,009	36.3%	357	9.4%
San Francisco	SFO	3,526	2,591	3,711	3,884	4,198	4,038	314	8.1%	-160	-3.8%
Charlotte	CLT	2,758	3,288	4,180	3,976	3,991	3,911	15	0.4%	-80	-2.0%
Los Angeles	LAX	3,647	2,655	3,382	3,164	3,544	3,603	380	12.0%	59	1.7%
Nantucket	ACK	5,022	3,452	3,884	3,382	3,469	3,601	88	2.6%	132	3.8%
Orlando	MCO	4,914	3,517	3,179	3,580	3,496	3,399	-84	-2.3%	-97	-2.8%
Raleigh/Durham	RDU	3,775	4,110	3,259	2,867	3,059	3,313	192	6.7%	254	8.3%
Washington Dulles	IAD	8,625	6,139	4,625	3,910	3,014	2,974	-896	-22.9%	-40	-1.3%
Martha's Vineyard	MVY	3,863	2,231	3,218	2,829	2,774	2,740	-55	-2.0%	-33	-1.2%
Pittsburgh	PIT	3,086	2,021	2,312	3,179	2,498	2,641	-681	-21.4%	143	5.7%
Miami	MIA	2,068	2,072	2,238	2,555	2,610	2,555	55	2.2%	-55	-2.1%
Buffalo	BUF	950	1,226	2,181	2,183	2,264	2,468	82	3.7%	204	9.0%
Denver	DEN	2,628	1,990	2,812	2,640	2,518	2,433	-122	-4.6%	-85	-3.4%
Fort Lauderdale/Hollywood	FLL	3,327	3,065	2,370	2,517	2,371	2,379	-146	-5.8%	8	0.4%
Detroit	DTW	2,937	2,827	2,353	2,437	2,314	2,340	-123	-5.0%	25	1.1%
Minneapolis	MSP	3,078	1,791	1,927	2,031	2,062	2,200	30	1.5%	138	6.7%
Provincetown	PVC	2,023	1,659	2,410	2,086	2,054	1,982	-31	-1.5%	-73	-3.5%
Fort Myers	RSW	949	1,525	1,587	1,620	1,738	1,806	118	7.3%	68	3.9%
Houston Intercontinental	IAH	1,995	1,752	1,717	1,697	1,704	1,789	7	0.4%	86	5.0%
Richmond	RIC	1,537	1,404	1,431	1,525	1,481	1,723	-44	-2.9%	242	16.3%
Chicago Midway	MDW	868	1,339	1,756	1,751	1,690	1,617	-61	-3.5%	-73	-4.3%
Cleveland	CLE	2,797	1,260	1,369	1,326	1,455	1,501	130	9.8%	46	3.1%
Lebanon	LEB			1,734	1,460	1,464	1,460	4	0.3%	-4	-0.3%
Phoenix	PHX	1,386	944	1,348	1,895	1,773	1,413	-123	-6.5%	-360	-20.3%
Seattle/Tacoma	SEA	458	610	1,001	993	1,051	1,378	58	5.9%	327	31.1%

Table E-4 Logan Airport Scheduled Passenger Departures by Destination (Continued)

Destination Airport	Code	2000	2005	2010	2011	2012	2013	2011-2012 Change	2011-2012 Percent Change	2012-2013 Change	2012-2013 Percent Change
Bar Harbor	BHB	1,196	1,154	815	1,030	1,213	1,283	183	17.8%	70	5.7%
Rockland	RKD	1,152	1,374	1,301	1,279	1,282	1,279	3	0.2%	-3	-0.2%
Cincinnati	CVG	2,235	2,637	1,364	1,308	1,272	1,269	-36	-2.7%	-3	-0.3%
Augusta	AUG	584	621	1,000	1,187	1,091	1,248	-96	-8.1%	157	14.4%
West Palm Beach	PBI	1,674	1,126	1,450	1,380	1,161	1,235	-219	-15.9%	74	6.4%
Tampa	TPA	2,502	1,946	1,246	1,255	1,266	1,195	11	0.9%	-71	-5.6%
Albany	ALB	3,433	1,073	647	2,180	1,523	1,183	-657	-30.1%	-340	-22.3%
Saranac Lake	SLK		800	1,174	1,157	1,222	1,157	65	5.6%	-65	-5.3%
Rutland	RUT	1,259	643	1,095	1,148	1,160	1,095	12	1.0%	-65	-5.6%
Presque Isle	PQI	1,835	1,017	991	991	993	991	3	0.3%	-3	-0.3%
Indianapolis	IND	765	2,076	1,121	977	936	895	-41	-4.2%	-41	-4.4%
Milwaukee	MKE	1,189	2,182	2,213	1,941	1,069	880	-872	-44.9%	-189	-17.6%
Rochester	ROC	3,644	1,181	908	886	889	878	2	0.3%	-11	-1.2%
Columbus	CMH	2,708	2,114	972	1,048	972	871	-76	-7.3%	-100	-10.3%
San Diego	SAN	366	365	571	535	476	859	-60	-11.2%	383	80.6%
Las Vegas	LAS	1,098	1,679	756	904	737	813	-167	-18.5%	76	10.4%
St. Louis	STL	2,187	1,461	934	713	815	748	102	14.3%	-67	-8.2%
Hyannis	HYA	2,274	1,059	1,165	1,047	1,028	705	-19	-1.8%	-324	-31.5%
Houston Hobby	HOU						664			664	100.0%
Plattsburgh International	PBG			1,025	899	623	639	-276	-30.7%	16	2.5%
Syracuse	SYR	3,876	1,762	991	964	784	626	-180	-18.7%	-159	-20.2%
Portland	PDX			352	440	528	615	88	19.9%	87	16.5%
Norfolk	ORF	838	1,032		511	667	613	156	30.6%	-54	-8.1%
Jacksonville	JAX		428	365	544	619	593	75	13.8%	-26	-4.2%
Nashville	BNA	642				153	588	153	100.0%	435	284.4%
Salt Lake City	SLC	1,094	730	669	438	370	584	-68	-15.5%	214	57.7%
Akron/Canton	CAK		730	475	488	497	557	9	1.8%	60	12.1%
Kansas City	MCI	597	241	313	536	571	515	35	6.5%	-56	-9.7%
Harrisburg	MDT	1,307	886	551	574	540	469	-33	-5.8%	-71	-13.1%
Charleston	CHS		61				398			398	100.0%
Myrtle Beach	MYR	105	265	365	365	366	378	1	0.3%	12	3.3%
Austin	AUS			365	365	366	352	1	0.3%	-14	-3.7%
Sarasota/Bradenton	SRQ		30	82	242	248	348	6	2.5%	99	40.1%
New Orleans	MSY		191	348	304	335	339	31	10.2%	4	1.1%

Table E-4 Logan Airport Scheduled Passenger Departures by Destination (Continued)

Destination Airport	Code	2000	2005	2010	2011	2012	2013	2011-2012 Change	2011-2012 Percent Change	2012-2013 Change	2012-2013 Percent Change
Memphis	MEM	972	1,034	1,048	1,029	688	313	-341	-33.1%	-375	-54.5%
Islip	ISP	4,222	1,581				293			293	100.0%
Long Beach	LGB		853	459	296	292	274	-4	-1.3%	-18	-6.2%
San Jose	SJC	842	245	232	292	227	205	-65	-22.2%	-21	-9.4%
Atlantic City Pomona Field	ACY			536	326	355	123	29	8.8%	-232	-65.3%
Oakland	OAK		853	195	105	83	83	-22	-20.8%	0	0.0%
Newport News	PHF		671	549	549	60		-489	-89.1%	-60	-100.0%
Bangor	BGR	6,644	2,946								
Westchester County	HPN	6,065	2,256								
Greensboro	GSO	415	1,120								
Trenton	TTN										
Watertown	ART										
Savannah	SAV		78								
Burlington	BTV	5,913	1,632								
Allentown/Bethlehem	ABE	780	626								
Louisville	SDF										
Manchester	MHT										
Massena	MSS										
Dayton	DAY										
Plattsburgh	PLB										
Portland (ME)	PWM	6,267	1,394								
Wilkes-Barre Scranton	AVP	584	420								
Columbia	CAE										
Ithaca	ITH	872									
Elmira/Corning	ELM	441									
Hartford	BDL										
Binghamton	BGM										
Providence	PVD	91									
International		23,711	19,837	18,764	19,641	23,564	23,119	3,923	20.0%	-446	-1.9%
Toronto	YYZ	3,691	3,876	3,603	3,737	3,529	3,306	-208	-5.6%	-223	-6.3%
London Heathrow	LHR	2,187	2,133	2,331	2,833	2,642	2,134	-191	-6.7%	-508	-19.2%
Toronto Island Apt	YTZ			1,535	1,687	2,009	2,009	322	19.1%	0	0.0%
Montreal-Trudeau	YUL	3,401	2,578	2,008	2,021	2,009	1,833	-12	-0.6%	-176	-8.8%

Table E-4 Logan Airport Scheduled Passenger Departures by Destination (Continued)

Destination Airport	Code	2000	2005	2010	2011	2012	2013	2011-2012 Change	2011-2012 Percent Change	2012-2013 Change	2012-2013 Percent Change
San Juan	SJU	1,750	1,237	1,294	1,130	1,031	1,038	-99	-8.7%	7	0.7%
Paris De Gaulle	CDG	898	853	710	946	619	784	-327	-34.6%	165	26.7%
Halifax	YHZ	3,210	1,891	852	744	745	704	2	0.2%	-41	-5.6%
Ottawa	YOW	2,575	864	744	696	623	652	-73	-10.5%	29	4.6%
Dublin	DUB	223		348	457	480	605	23	5.0%	126	26.2%
Amsterdam	AMS	366	365	457	553	558	575	5	1.0%	16	2.9%
Reykjavik Keflavik Apt	KEF	393	361	404	531	467	561	-65	-12.2%	95	20.3%
Frankfurt	FRA	580	575	548	544	572	545	28	5.1%	-27	-4.7%
Bermuda	BDA	550	518	532	540	511	501	-29	-5.4%	-10	-1.9%
Aruba	AUA	9	338	407	426	405	408	-21	-4.9%	3	0.7%
Zurich	ZRH	523	356	365	365	366	365	1	0.3%	-1	-0.3%
Tokyo Narita	NRT					236	352	236	100.0%	116	49.0%
Munich	MUC		210	313	335	357	348	22	6.6%	-9	-2.6%
Santo Domingo	SDQ		174	305	275	358	339	83	30.3%	-19	-5.3%
Rome Leonardo Da Vinci-Fiumicino	FCO		135	313	314	266	271	-47	-15.1%	5	1.8%
Cancun	CUN		207	307	270	217	225	-53	-19.5%	8	3.6%
Santiago	STI				92	201	214	109	119.2%	13	6.3%
Madrid	MAD			218	231	222	209	-8	-3.7%	-13	-6.0%
Ponta Delgada	PDL	30	39	165	170	148	179	-21	-12.6%	30	20.4%
Saint Thomas	STT	78	108	125	117	156	173	39	33.7%	17	10.7%
Shannon	SNN	366	737	213	118	144	166	26	22.2%	22	15.4%
Punta Cana	PUJ			95	92	139	134	48	52.1%	-5	-3.6%
Nassau	NAS		100	180	134	142	108	9	6.4%	-34	-24.2%
Praia	RAI		9	121	122	109	104	-12	-10.2%	-5	-4.4%
Saint Maarten	SXM			39	43	61	61	17	39.8%	0	-0.2%
Montego Bay	MBJ		238	126	52	69	56	17	33.3%	-13	-19.0%
Providenciales	PLS	4	43	39	26	69	52	43	163.0%	-17	-25.2%
Lisbon	LIS	44		26	26	48	39	22	83.7%	-9	-18.3%
Grand Cayman	GCM		31	17		9	26	9	100.0%	17	196.7%
Terceira	TER	44		17	17	17	17	0	0.0%	0	0.0%
Sao Vicente	VXE			4		4		4	100.0%	-4	-100.0%
Charlottetown	YYG										
Helsinki	HEL										
Milan Malpensa	MXP	366	343								

Table E-4 Logan Airport Scheduled Passenger Departures by Destination (Continued)

Destination Airport	Code	2000	2005	2010	2011	2012	2013	2011-2012 Change	2011-2012 Percent Change	2012-2013 Change	2012-2013 Percent Change
Fredericton	YFC		686								
Quebec	YQB	1,229	30								
Manchester	MAN	26	241								
Glasgow	GLA										
Connaught	NOC										
Stockholm Arlanda	ARN										
Mexico City	MEX		234								
Las Palmas	LPA										
San Salvador	SAL		178								
Vancouver	YVR	366	62								
Ilha Do Sal	SID		56								
Nykoping	NYO		31								
Port Au Prince	PAP										
Lerwick Sumburgh Apt	LSI										
Freeport	FPO										
London Gatwick	LGW	362									
Brussels	BRU	362									
Gander	YQX										
Athens	ATH	74									
Puerto Plata	POP	4									
Total Scheduled Carrier Operations		233,779	183,520	168,726	171,945	171,459	174,223	-486	-0.3%	2,764	1.6%

Source: OAG Schedules.

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F

Regional Transportation

This appendix provides detailed tables in support of *Chapter 4, Regional Transportation*:

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Table F-1 Aircraft Operations by Classification for New England's Airports, 2000 to 2013

Airport	Bradley International	T.F. Green	Manchester-Boston Regional	Portland International Jetport	Burlington	Bangor	Tweed-New Haven	Worcester Regional	Portsmouth International	Hanscom Field[2]	Subtotal	Logan[3]	Total
2000													
Commercial	132,062	103,750	61,506	47,609	45,745	21,446	5,260	4,029	6,104	6,572	434,083	452,763	886,846
General Aviation[1]	31,863	52,184	45,740	56,571	59,377	34,831	56,200	46,518	31,601	204,512	619,397	35,233	654,630
Military & Other	5,811	2,764	586	2,072	10,241	26,507	328	495	9,973	1,287	60,064	0	60,064
Total	169,736	158,698	107,832	106,252	115,363	82,784	61,788	51,042	47,678	212,371	1,113,544	487,996	1,601,540
2001													
Commercial	128,638	100,606	61,669	47,770	47,261	18,286	4,581	5,631	4,485	6,414	425,341	434,386	859,727
General Aviation[1]	30,478	45,095	44,358	62,014	61,986	35,230	56,092	45,464	30,148	197,770	608,635	28,739	637,374
Military & Other	5,913	2,635	607	2,259	11,821	26,623	437	917	8,221	1,252	60,685	0	60,685
Total	165,029	148,336	106,634	112,043	121,068	80,139	61,110	52,012	42,854	205,436	1,094,661	463,125	1,557,786
2002													
Commercial	113,194	96,595	62,346	45,899	38,929	24,412	3,827	4,062	5,059	6,603	400,926	366,476	767,402
General Aviation[1]	27,838	45,473	29,549	57,720	59,679	35,711	62,163	52,277	28,333	210,221	608,964	25,596	634,560
Military & Other	6,085	2,587	376	2,162	12,167	27,297	593	418	8,220	1,424	61,329	0	61,329
Total	147,117	144,655	92,271	105,781	110,775	87,420	66,583	56,757	41,612	218,248	1,071,219	392,072	1,463,291
2003													
Commercial	103,917	84,301	68,184	42,658	38,293	25,626	3,705	868	4,552	2,956	375,060	344,644	719,704
General Aviation[1]	27,115	42,878	29,552	44,036	50,461	36,706	54,224	55,972	24,866	190,789	556,599	28,660	585,259
Military & Other	4,214	2,496	324	1,449	11,466	32,938	776	378	7,720	1,142	62,903	0	62,903
Total	135,246	129,675	98,060	88,143	100,220	95,270	58,705	57,218	37,138	194,887	994,562	373,304	1,367,866
2004													
Commercial	108,823	83,496	75,360	46,474	41,719	24,970	4,501	0	3,981	4,308	393,632	374,022	767,654
General Aviation[1]	32,269	34,878	27,438	41,547	54,709	29,884	58,881	61,343	25,962	175,301	542,212	31,236	573,448
Military & Other	4,100	346	749	1,338	12,404	29,676	1,010	530	7,797	1,195	59,145	0	59,145
Total	145,192	118,720	103,547	89,359	108,832	84,530	64,392	61,873	37,740	180,804	994,989	405,258	1,400,247
2005													
Commercial	119,048	88,374	76,342	42,661	43,987	25,976	6,137	2,727	3,197	3,627	412,076	377,830	789,906
General Aviation[1]	33,341	28,138	26,369	36,191	49,888	30,016	60,893	62,743	25,446	165,424	518,449	31,236	549,685
Military & Other	3,701	241	479	1,405	11,468	24,154	1,063	519	7,669	904	51,603	0	51,603
Total	156,090	116,753	103,190	80,257	105,343	80,146	68,093	65,989	36,312	169,955	982,128	409,066	1,391,194

Table F-1 Aircraft Operations by Classification for New England's Airports, 2000 to 2013 (Continued)

Airport	Bradley International	T.F. Green	Manchester-Boston Regional	Portland International Jetport	Burlington	Bangor	Tweed-New Haven	Worcester Regional	Portsmouth International	Hanscom Field[2]	Subtotal	Logan[3]	Total
2006													
Commercial	111,341	81,282	67,326	38,663	41,342	23,466	5,177	3,793	3,981	3,057	379,428	374,675	754,103
General Aviation[1]	34,548	25,510	25,074	35,572	44,471	29,848	51,702	56,770	25,962	167,560	497,017	31,444	528,461
Military & Other	4,348	229	738	1,536	9,299	22,359	1,157	609	7,797	1,433	49,505	0	49,505
Total	150,237	107,021	93,138	75,771	95,112	75,673	58,036	61,172	37,740	172,050	925,950	406,119	1,332,069
2007													
Commercial	107,097	80,525	69,134	41,450	39,928	22,571	4,594	3,162	4,270	3,477	376,208	370,905	747,113
General Aviation[1]	29,308	22,984	23,959	31,724	47,521	25,542	51,200	61,296	27,000	160,992	481,526	28,632	510,158
Military & Other	5,097	242	644	1,384	9,528	20,949	944	879	8,017	1,438	49,122	0	49,122
Total	141,502	103,751	93,737	74,558	96,977	69,062	56,738	65,337	39,287	165,907	906,856	399,537	1,306,393
2008													
Commercial	98,194	73,096	63,505	40,834	37,832	19,282	4,013	2,553	1,347	104	340,760	347,784	688,544
General Aviation[1]	22,908	19,470	16,198	31,869	46,391	27,143	44,642	43,763	31,051	164,195	447,630	23,820	471,450
Military & Other	3,637	187	840	974	9,688	20,449	243	886	7,993	1,590	46,487	0	46,487
Total	124,739	92,753	80,543	73,677	93,911	66,874	48,898	47,202	40,391	165,889	834,877	371,604	1,206,481
2009													
Commercial	82,021	62,233	54,336	35,909	31,153	16,485	3,096	2,527	422	0	288,182	333,064	621,246
General Aviation[1]	19,586	19,438	14,354	25,473	32,872	19,558	37,722	41,700	25,161	148,696	384,560	12,242	396,802
Military & Other	2,726	260	1,163	778	8,628	16,267	486	17	6,851	1,215	38,391	0	38,391
Total	104,333	81,931	69,853	62,160	72,653	52,310	41,304	44,244	32,434	149,911	711,133	345,306	1,056,439
2010													
Commercial	80,418	60,128	53,971	35,035	29,538	16,190	3,201	1,629	1,516	0	281,626	337,961	619,587
General Aviation[1]	18,759	21,096	13,636	24,776	36,106	20,142	31,884	41,843	25,674	161,942	395,858	14,682	410,540
Military & Other	3,028	347	933	446	4,776	15,525	381	572	7,707	1,795	35,510	0	35,510
Total	102,205	81,571	68,540	60,257	70,420	51,857	35,466	44,044	34,897	163,737	712,994	352,643	1,065,637
2011													
Commercial	86,838	57,194	51,379	35,157	29,166	16,177	3,367	2,017	1,717	750	283,762	340,757	624,519
General Aviation[1]	16,483	21,774	12,497	21,453	42,562	19,503	33,919	44,050	27,056	160,840	400,137	28,230	428,367
Military & Other	3,630	369	874	533	5,890	13,220	310	634	8,158	1,409	35,027	0	35,027
Total	106,951	79,337	64,750	57,143	77,618	48,900	37,596	46,701	36,931	162,999	718,926	368,987	1,087,913

Table F-1 Aircraft Operations by Classification for New England's Airports, 2000 to 2013 (Continued)

Airport	Bradley International	T.F. Green	Manchester-Boston Regional	Portland International Jetport	Burlington	Bangor	Tweed-New Haven	Worcester Regional	Portsmouth International	Hanscom Field[2]	Subtotal	Logan[3]	Total
2012													
Commercial	79,704	50,301	45,379	33,118	27,067	14,826	3,936	1,639	502	635	257,107	326,755	583,862
General Aviation[1]	15,589	24,781	12,504	20,864	42,352	18,069	34,775	42,655	30,186	164,841	406,616	28,114	434,730
Military & Other	3,726	434	1,073	584	7,079	11,503	416	740	7,917	738	34,210	0	34,210
Total	99,019	75,516	58,956	54,566	76,498	44,398	39,127	45,034	38,605	166,214	697,933	354,869	1,052,802
2013													
Commercial	78,213	48,340	43,572	31,076	26,814	14,707	4,094	173	560	0	247,549	334,657	582,206
General Aviation[1]	15,192	24,729	11,432	20,021	40,413	15,535	28,794	35,064	28,951	153,639	373,770	26,682	400,452
Military & Other	2,558	435	1,224	471	6,972	11,045	423	593	7,573	612	31,906	0	31,906
Total	95,963	73,504	56,228	51,568	74,199	41,287	33,311	35,830	37,084	154,251	653,225	361,339	1,014,564

1 Includes itinerant and local general aviation operations at the regional airports. There are no local (touch-and-go training) operations at Logan Airport.
2 Commercial operations at Hanscom Field include scheduled commercial operations only; other air taxi operations counted as GA.
3 Operations at Logan Airport include international operations.
Source: Massport, Federal Aviation Administration (FAA) Tower Counts, and individual airport records.

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Table F-2 Percentage Change in Aircraft Operations by Classification for New England's Airports, 2000 to 2013

Airport	Bradley International	T.F. Green	Manchester-Boston Regional	Portland International Jetport	Burlington	Bangor	Tweed-New Haven	Worcester Regional	Portsmouth International	Hanscom Field[2]	Subtotal	Logan[3]	Total
2000 to 2001													
Commercial	(2.59%)	(3.03%)	0.27%	0.34%	3.31%	(14.73%)	(12.91%)	39.76%	(26.52%)	(2.40%)	(2.01%)	(4.06%)	(3.06%)
General Aviation[1]	(4.35%)	(13.58%)	(3.02%)	9.62%	4.39%	1.15%	(0.19%)	(2.27%)	(4.60%)	(3.30%)	(1.74%)	(18.43%)	(2.64%)
Military & Other	1.76%	(4.67%)	3.58%	9.03%	15.43%	0.44%	33.23%	85.25%	(17.57%)	(2.72%)	1.03%	-	1.03%
Total	(2.77%)	(6.53%)	(1.11%)	5.45%	4.95%	(3.20%)	(1.10%)	1.90%	(10.12%)	(3.27%)	(1.70%)	(5.10%)	(2.73%)
2001 Percent of Total	10.59%	9.52%	6.85%	7.19%	7.77%	5.14%	3.92%	3.34%	2.75%	13.19%	70.27%	29.73%	100.00%
2001 to 2002													
Commercial	(12.01%)	(3.99%)	1.10%	(3.92%)	(17.63%)	33.50%	(16.46%)	(27.86%)	12.80%	2.95%	(5.74%)	(15.63%)	(10.74%)
General Aviation[1]	(8.66%)	0.84%	(33.39%)	(6.92%)	(3.72%)	1.37%	10.82%	14.99%	(6.02%)	6.30%	0.05%	(10.94%)	(0.44%)
Military & Other	2.91%	(1.82%)	(38.06%)	(4.29%)	2.93%	2.53%	35.70%	(54.42%)	(0.01%)	13.74%	1.06%	-	1.06%
Total	(10.85%)	(2.48%)	(13.47%)	(5.59%)	(8.50%)	9.09%	8.96%	9.12%	(2.90%)	6.24%	(2.14%)	(15.34%)	(6.07%)
2002 Percent of Total	10.05%	9.89%	6.31%	7.23%	7.57%	5.97%	4.55%	3.88%	2.84%	14.91%	73.21%	26.79%	100.00%
2002 to 2003													
Commercial	(8.20%)	(12.73%)	9.36%	(7.06%)	(1.63%)	4.97%	(3.19%)	(78.63%)	(10.02%)	(55.23%)	(6.45%)	(5.96%)	(6.22%)
General Aviation[1]	(2.60%)	(5.71%)	0.01%	(23.71%)	(15.45%)	2.79%	(12.77%)	7.07%	(12.24%)	(9.24%)	(8.60%)	11.97%	(7.77%)
Military & Other	(30.75%)	(3.52%)	(13.83%)	(32.98%)	(5.76%)	20.67%	30.86%	(9.57%)	(6.08%)	(19.80%)	2.57%	-	2.57%
Total	(8.07%)	(10.36%)	6.27%	(16.67%)	(9.53%)	8.98%	(11.83%)	0.81%	(10.75%)	(10.70%)	(7.16%)	(4.79%)	(6.52%)
2003 Percent of Total	9.89%	9.48%	7.17%	6.44%	7.33%	6.96%	4.29%	4.18%	2.72%	14.25%	72.71%	27.29%	100.00%
2003 to 2004													
Commercial	4.72%	(0.95%)	10.52%	8.95%	8.95%	(2.56%)	21.48%	(100.00%)	(12.54%)	45.74%	4.95%	8.52%	6.66%
General Aviation[1]	19.01%	(18.66%)	(7.15%)	(5.65%)	8.42%	(18.59%)	8.59%	9.60%	4.41%	(8.12%)	(2.58%)	8.99%	(2.02%)
Military & Other	(2.71%)	(86.14%)	131.17%	(7.66%)	8.18%	(9.90%)	30.15%	40.21%	1.00%	4.64%	(5.97%)	-	(5.97%)
Total	7.35%	(8.45%)	5.60%	1.38%	8.59%	(11.27%)	9.69%	8.14%	1.62%	(7.23%)	0.04%	8.56%	2.37%
2004 Percent of Total	10.37%	8.48%	7.39%	6.38%	7.77%	6.04%	4.60%	4.42%	2.70%	12.91%	71.06%	28.94%	100.00%
2004 to 2005													
Commercial	9.40%	5.84%	1.30%	(8.20%)	5.44%	4.03%	36.35%	-	(19.69%)	(15.81%)	4.69%	1.02%	2.90%
General Aviation[1]	3.32%	(19.32%)	(3.90%)	(12.89%)	(8.81%)	0.44%	3.42%	2.28%	(1.99%)	(5.63%)	(4.38%)	0.00%	(4.14%)
Military & Other	(9.73%)	(30.35%)	(36.05%)	5.01%	(7.55%)	(18.61%)	5.25%	(2.08%)	(1.64%)	(24.35%)	(12.75%)	-	(12.75%)
Total	7.51%	(1.66%)	(0.34%)	(10.19%)	(3.21%)	(5.19%)	5.75%	6.65%	(3.78%)	(6.00%)	(1.29%)	0.94%	(0.65%)
2005 Percent of Total	11.22%	8.39%	7.42%	5.77%	7.57%	5.76%	4.89%	4.74%	2.61%	12.22%	70.60%	29.40%	100.00%

Table F-2 Percentage Change in Aircraft Operations by Classification for New England's Airports, 2000 to 2013 (Continued)

Airport	Bradley International	T.F. Green	Manchester-Boston Regional	Portland International Jetport	Burlington	Bangor	Tweed-New Haven	Worcester Regional	Portsmouth International	Hanscom Field[2]	Subtotal	Logan[3]	Total
2005 to 2006													
Commercial	(6.47%)	(8.02%)	(11.81%)	(9.37%)	(6.01%)	(9.66%)	(15.64%)	39.09%	24.52%	(15.72%)	(7.92%)	(0.84%)	(4.53%)
General Aviation[1]	3.62%	(9.34%)	(4.91%)	(1.71%)	(10.86%)	(0.56%)	(15.09%)	(9.52%)	2.03%	1.29%	(4.13%)	0.67%	(3.86%)
Military & Other	17.48%	(4.98%)	54.07%	9.32%	(18.91%)	(7.43%)	8.84%	17.34%	1.67%	58.52%	(4.07%)	-	(4.07%)
Total	(3.75%)	(8.34%)	(9.74%)	(5.59%)	(9.71%)	(5.58%)	(14.77%)	(7.30%)	3.93%	1.23%	(5.72%)	(0.72%)	(4.25%)
2006 Percent of Total	11.28%	8.03%	6.99%	5.69%	7.14%	5.68%	4.36%	4.59%	2.83%	12.92%	69.51%	30.49%	100.00%
2006 to 2007													
Commercial	(3.81%)	(0.93%)	2.69%	7.21%	(3.42%)	(3.81%)	(11.26%)	(16.64%)	7.26%	13.74%	(0.85%)	(1.01%)	(0.93%)
General Aviation[1]	(15.17%)	(9.90%)	(4.45%)	(10.82%)	6.86%	(14.43%)	(0.97%)	7.97%	4.00%	(3.92%)	(3.12%)	(8.94%)	(3.46%)
Military & Other	17.23%	5.68%	(12.74%)	(9.90%)	2.46%	(6.31%)	(18.41%)	44.33%	2.82%	0.35%	(0.77%)	-	(0.77%)
Total	(5.81%)	(3.06%)	0.64%	(1.60%)	1.96%	(8.74%)	(2.24%)	6.81%	4.10%	(3.57%)	(2.06%)	(1.62%)	(1.93%)
2007 Percent of Total	10.83%	7.94%	7.18%	5.71%	7.42%	5.29%	4.34%	5.00%	3.01%	12.70%	69.42%	30.58%	100.00%
2007 to 2008													
Commercial	(8.31%)	(9.23%)	(8.14%)	(1.49%)	(5.25%)	(14.57%)	(12.65%)	(19.26%)	(68.45%)	(97.01%)	(9.42%)	(6.23%)	(7.84%)
General Aviation[1]	(21.84%)	(15.29%)	(32.39%)	0.46%	(2.38%)	6.27%	(12.81%)	(28.60%)	15.00%	1.99%	(7.04%)	(16.81%)	(7.59%)
Military & Other	(28.64%)	(22.73%)	30.43%	(29.62%)	1.68%	(2.39%)	(74.26%)	0.80%	(0.30%)	10.57%	(5.36%)	-	(5.36%)
Total	(11.85%)	(10.60%)	(14.08%)	(1.18%)	(3.16%)	(3.17%)	(13.82%)	(27.76%)	2.81%	(0.01%)	(7.94%)	(6.99%)	(7.65%)
2008 Percent of Total	10.34%	7.69%	6.68%	6.11%	7.78%	5.54%	4.05%	3.91%	3.35%	13.75%	69.20%	30.80%	100.00%
2008 to 2009													
Commercial	(16.47%)	(14.86%)	(14.44%)	(12.06%)	(17.65%)	(14.51%)	(22.85%)	(1.02%)	(68.67%)	(100.00%)	(15.43%)	(4.23%)	(9.77%)
General Aviation[1]	(14.50%)	(0.16%)	(11.38%)	(20.07%)	(29.14%)	(27.94%)	(15.50%)	(4.71%)	(18.97%)	(9.44%)	(14.09%)	(48.61%)	(15.83%)
Military & Other	(25.05%)	39.04%	38.45%	(20.12%)	(10.94%)	(20.45%)	100.00%	(98.08%)	(14.29%)	(23.58%)	(17.42%)	-	(17.42%)
Total	(16.36%)	(11.67%)	(13.27%)	(15.63%)	(22.64%)	(21.78%)	(15.53%)	(6.27%)	(19.70%)	(9.63%)	(14.82%)	(7.08%)	(12.44%)
2009 Percent of Total	9.88%	7.76%	6.61%	5.88%	6.88%	4.95%	3.91%	4.19%	3.07%	14.19%	67.31%	32.69%	100.00%
2009 to 2010													
Commercial	(1.95%)	(3.38%)	(0.67%)	(2.43%)	(5.18%)	(1.79%)	3.39%	(35.54%)	259.24%	-	(2.27%)	1.47%	(0.27%)
General Aviation[1]	(4.22%)	8.53%	(5.00%)	(2.74%)	9.84%	2.99%	(15.48%)	0.34%	2.04%	8.91%	2.94%	19.93%	3.46%
Military & Other	11.08%	33.46%	(19.78%)	(42.67%)	(44.65%)	(4.56%)	(21.60%)	3264.71%	12.49%	47.74%	(7.50%)	-	(7.50%)
Total	(2.04%)	(0.44%)	(1.88%)	(3.06%)	(3.07%)	(0.87%)	(14.13%)	(0.45%)	7.59%	9.22%	0.26%	2.12%	0.87%
2010 Percent of Total	9.59%	7.65%	6.43%	5.65%	6.61%	4.87%	3.33%	4.13%	3.27%	15.37%	66.91%	33.09%	100.00%
2010 to 2011													
Commercial	7.98%	(4.88%)	(4.80%)	0.35%	(1.26%)	(0.08%)	5.19%	23.82%	13.26%	-	0.76%	0.83%	0.80%
General Aviation[1]	(12.13%)	3.21%	(8.35%)	(13.41%)	17.88%	(3.17%)	6.38%	5.27%	5.38%	(0.68%)	1.08%	92.28%	4.34%
Military & Other	19.88%	6.34%	(6.32%)	19.51%	23.32%	(14.85%)	(18.64%)	10.84%	5.85%	(21.50%)	(1.36%)	-	(1.36%)
Total	4.64%	(2.74%)	(5.53%)	(5.17%)	10.22%	(5.70%)	6.01%	6.03%	5.83%	(0.45%)	0.83%	4.63%	2.09%
2011 Percent of Total	9.83%	7.29%	5.95%	5.25%	7.13%	4.49%	3.46%	4.29%	3.39%	14.98%	66.08%	33.92%	100.00%

Table F-2 Percentage Change in Aircraft Operations by Classification for New England's Airports, 2000 to 2013 (Continued)

Airport	Bradley International	T.F. Green	Manchester-Boston Regional	Portland International Jetport	Burlington	Bangor	Tweed-New Haven	Worcester Regional	Portsmouth International	Hanscom Field[2]	Subtotal	Logan[3]	Total
2011 to 2012													
Commercial	(8.22%)	(12.05%)	(11.68%)	(5.80%)	(7.20%)	(8.35%)	16.90%	(18.74%)	(70.76%)	-	(9.39%)	(4.11%)	(6.51%)
General Aviation[1]	(5.42%)	13.81%	0.06%	(2.75%)	(0.49%)	(7.35%)	2.52%	(3.17%)	11.57%	2.49%	1.62%	(0.41%)	1.49%
Military & Other	2.64%	17.62%	22.77%	9.57%	20.19%	(12.99%)	34.19%	16.72%	(2.95%)	(47.62%)	(2.33%)	NA	(2.33%)
Total	(7.42%)	(4.82%)	(8.95%)	(4.51%)	(1.44%)	(9.21%)	4.07%	(3.57%)	4.53%	1.97%	(2.92%)	(3.83%)	(3.23%)
2012 Percent of Total	9.41%	7.17%	5.60%	5.18%	7.27%	4.22%	3.72%	4.28%	3.67%	15.79%	66.29%	33.71%	100.00%
2012 to 2013													
Commercial	(1.87%)	(3.90%)	(3.98%)	(6.17%)	(0.93%)	(0.80%)	4.01%	(89.44%)	11.55%	-	(3.72%)	2.42%	(0.28%)
General Aviation[1]	(2.55%)	(0.21%)	(8.57%)	(4.04%)	(4.58%)	(14.02%)	(17.20%)	(17.80%)	(4.09%)	(6.80%)	(8.08%)	(5.09%)	(7.88%)
Military & Other	(31.35%)	0.23%	14.07%	(19.35%)	(1.51%)	(3.98%)	1.68%	(19.86%)	(4.35%)	(17.07%)	(6.73%)	NA	(6.73%)
Total	(3.09%)	(2.66%)	(4.63%)	(5.49%)	(3.01%)	(7.01%)	(14.86%)	(20.44%)	(3.94%)	(7.20%)	(6.41%)	1.82%	(3.63%)
2013 Percent of Total	9.46%	7.24%	5.54%	5.08%	7.31%	4.07%	3.28%	3.53%	3.66%	15.20%	64.38%	35.62%	100.00%

1 Includes itinerant and local general aviation operations at the regional airports. There are no local (touch-and-go training) operations at Logan Airport.
2 Commercial operations at Hanscom Field include scheduled commercial operations only; other air taxi operations counted as GA.
3 Operations at Logan Airport include international operations.
Source: Massport, Federal Aviation Administration (FAA) Tower Counts, and individual airport records.

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Table F-3 Scheduled Passenger Operations by Market and Carrier for Bradley International Airport, Connecticut

Departures

Carrier	Code	Market	Code	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	'11-'13 Change	'11-'13 Pct. Change
Jet Carriers																			
Alaska	AS	Chicago O'Hare	ORD	30														0	-
America West	HP	Columbus	CMH	149														0	-
America West	HP	Las Vegas	LAS	210	204	65												0	-
America West	HP	Phoenix	PHX	275	304	275	361	366	365	365	61							0	-
American	AA	Chicago O'Hare	ORD	2,139	2,147	2,112	1,756	2,001	1,570	959								0	-
American	AA	Dallas/Fort Worth	DFW	1,343	1,283	1,421	1,147	1,403	1,052	1,082	1,091	1,068	1,043	1,052	1,078			26	2.5%
American	AA	Los Angeles	LAX	214	304													0	-
American	AA	Miami	MIA	366	365	427	426	487	365	365	365	366	365	413	516			103	24.9%
American	AA	New York J F Kennedy	JFK		214													0	-
American	AA	San Juan	SJU	366	471	604	529	366	365	365	365	366	365	365	365			0	0.0%
American	AA	St. Louis	STL		124	1,267	869											0	-
Boston-Maine Airways	E9	Fort Lauderdale/Hollywood	FLL						13									0	-
Continental	CO	Cleveland	CLE	582	387	380	74	127	131	92	131	105	75					0	-
Continental	CO	Houston Intercontinental	IAH	366	295		214	222	313	227	232	119						0	-
Continental	CO	New York Newark	EWR	331	186						4							0	-
Delta	DL	Atlanta	ATL	2,192	2,194	2,331	2,164	2,558	3,098	2,406	2,158	2,152	2,103	2,099	2,094			(4)	(0.2%)
Delta	DL	Boston	BOS	4														0	-
Delta	DL	Cancun	CUN									31	30	35	35			0	0.0%
Delta	DL	Cincinnati	CVG	1,464	1,460	1,447	1,447	1,438	1,373	768	562	663	250					0	-
Delta	DL	Detroit	DTW											1,003	658			(346)	(34.4%)
Delta	DL	Fort Lauderdale/Hollywood	FLL	732	945	1,095	885	702	673	717	669	479	281	237	210			(27)	(11.4%)
Delta	DL	Fort Myers	RSW							31	142	121	121	99	90			(9)	(9.0%)
Delta	DL	Las Vegas	LAS							109				9				(9)	(100.0%)
Delta	DL	Los Angeles	LAX						100	291	287	135		83				(83)	(100.0%)
Delta	DL	Minneapolis	MSP											758	576			(182)	(24.0%)
Delta	DL	New York J F Kennedy	JFK	183														0	-
Delta	DL	Orlando	MCO	1,838	1,702	1,460	1,172	1,023	1,095	890	824	692	558	704	608			(96)	(13.7%)
Delta	DL	Salt Lake City	SLC						27	208								0	-
Delta	DL	Tampa	TPA		582	822	886	662	678	682	660	470	180	252	120			(132)	(52.4%)
Delta	DL	West Palm Beach	PBI	732	945	1,003	556	537	516	365	356	370	160	283	120			(163)	(57.5%)
Frontier Airlines	F9	Denver	DEN								306	209						0	-
jetBlue	B6	Fort Lauderdale/Hollywood	FLL											101	599			499	495.7%
jetBlue	B6	Orlando	MCO											101	730			629	625.9%
jetBlue	B6	San Juan	SJU															0	-
jetBlue	B6	West Palm Beach	PBI															0	-
Laker Airways (Bahamas)	7Z	Freeport	FPO	39	78	43	43	26										0	-
Midway Airlines	JI	Raleigh/Durham	RDU	683	391													0	-
Midwest/Republic	YX	Milwaukee	MKE	619	504	420												0	-
Northwest	NW	Amsterdam	AMS								184	274						0	-
Northwest	NW	Detroit	DTW	1,699	1,638	1,487	1,597	1,504	1,451	1,399	1,374	1,189	960					0	-
Northwest	NW	Fort Myers	RSW															0	-
Northwest	NW	Minneapolis	MSP	1,177	1,148	1,099	1,116	1,098	1,042	1,060	1,060	1,002	654					0	-
Northwest	NW	Orlando	MCO										115					0	-
Northwest	NW	Tampa	TPA										261					0	-
Northwest	NW	West Palm Beach	PBI										205					0	-
Southwest	WN	Baltimore	BWI	2,841	2,755	2,689	3,072	3,059	3,094	3,116	3,137	2,883	2,713	2,700	2,708			8	0.3%
Southwest	WN	Chicago Midway	MDW	723	700	708	687	710	953	1,034	1,061	1,033	940	923	979			57	6.1%
Southwest	WN	Denver	DEN											306	365			59	19.3%
Southwest	WN	Fort Lauderdale/Hollywood	FLL				35							70	365			295	423.6%
Southwest	WN	Fort Myers	RSW															0	-
Southwest	WN	Las Vegas	LAS	52	52	22	122	375	365	365	365	366	365	361	365			4	1.2%
Southwest	WN	Nashville	BNA	672	730	674	586	366	365	365	365	366	365	361	304			(57)	(15.7%)
Southwest	WN	Orlando	MCO	375	448	726	730	833	1,108	1,108	1,091	1,081	1,047	1,016	1,003			(13)	(1.3%)
Southwest	WN	Philadelphia	PHL					296	1,590	1,078	169							0	-
Southwest	WN	Tampa	TPA		78	365	365	383	695	730	730	736	426	570	656			86	15.0%
Southwest	WN	West Palm Beach	PBI												61			61	-
Sunworld International	SM	Philadelphia	PHL			153												0	-
Trans World Airlines	TW	Portland (ME)	PWM	305														0	-
Trans World Airlines	TW	St. Louis	STL	1,460	1,336													0	-
United	UA	Chicago O'Hare	ORD	2,034	1,751	2,122	2,185	2,065	1,812	1,816	1,800	1,643	1,364	1,296	1,077			(219)	(16.9%)
United	UA	Denver	DEN	366	304	13												0	-
United	UA	San Francisco	SFO	366	243													0	-
United	UA	Washington Dulles	IAD	1,455	1,155	365	365	492	726	944	1,112	1,076	1,008	1,192	812			(380)	(31.9%)
US Airways	US	Baltimore	BWI	488	1,305													0	-
US Airways	US	Charlotte	CLT	1,464	1,521	1,681	1,349	1,574	2,188	1,660	1,525	1,412	1,104	1,588	1,664			76	4.8%
US Airways	US	Fort Lauderdale/Hollywood	FLL	366	239			9	123									0	-
US Airways	US	Orlando	MCO	1,098	663			48	30	30								0	-
US Airways	US	Philadelphia	PHL	2,148	2,107	1,825	1,781	1,913	2,102	930	665	518	583	361	317			(43)	(12.0%)
US Airways	US	Phoenix	PHX								241	335						0	-
US Airways	US	Pittsburgh	PIT	1,800	1,825	1,729	1,399	1,198	27									0	-
US Airways	US	Washington Dulles	IAD	732														0	-
US Airways	US	Washington National	DCA	1,329	1,142	1,091	1,077	1,081	1,064	947	1,092	1,203	755	361	365			4	1.2%
US Airways	US	West Palm Beach	PBI	366	225													0	-
USA 3000 Airlines	U5	Cancun	CUN						26	30	21							0	-
USA 3000 Airlines	U5	Punta Cana	PUJ						13	22	17							0	-
Subtotal				38,171	36,450	31,921	28,996	28,921	30,507	26,558	24,223	22,463	18,396	18,695	18,841			146	0.8%

Departing Seats

Carrier	Code	Market	Code	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2013	2013	'11-'13 Change	'11-'13 Pct. Change
Jet Carriers																			
Alaska	AS	Chicago O'Hare	ORD	4,050														0	-
America West	HP	Columbus	CMH	18,441														0	-
America West	HP	Las Vegas	LAS	27,469	30,255	9,683												0	-
America West	HP	Phoenix	PHX	37,772	44,992	40,700	53,365	51,960	54,570	54,750	7,564							0	-
American	AA	Chicago O'Hare	ORD	304,855	291,219	279,895	232,333	265,113	203,929	123,729								0	-
American	AA	Dallas/Fort Worth	DFW	185,922	165,562	183,272	148,000	180,987	136,897	144,171	154,505	158,001	154,343	160,983	172,457			11,474	7.1%
American	AA	Los Angeles	LAX	31,244	44,384													0	-
American	AA	Miami	MIA	51,427	53,290	62,342	62,196	71,102	49,990	52,732	51,720	54,168	54,020	63,559	82,560			19,001	29.9%
American	AA	New York J F Kennedy	JFK		31,244													0	-
American	AA	San Juan	SJU	69,348	79,653	103,144	90,017	92,171	84,425	81,776	70,856	65,880	56,900	55,856	58,400			2,544	4.6%
American	AA	St. Louis	STL		17,608	163,480	112,046											0	-
Boston-Maine Airways	E9	Fort Lauderdale/Hollywood	FLL						1,993									0	-
Continental	CO	Cleveland	CLE	68,974	45,629	47,331	11,417	15,985	16,262	9,875	16,262	12,807	9,203					0	-
Continental	CO	Houston Intercontinental	IAH	45,790	37,089		24,483	25,341	34,072	26,618	26,393	13,650						0	-
Continental	CO	New York Newark	EWR	38,916	21,712						446							0	-
Delta	DL	Atlanta	ATL	392,835	400,879	452,378	395,332	450,671	479,098	347,090	326,949	328,814	300,052	300,185	310,149			9,965	3.3%
Delta	DL	Boston	BOS	634														0	-
Delta	DL	Cancun	CUN									5,136	4,543	5,470	5,397			(73)	(1.3%)
Delta	DL	Cincinnati	CVG	244,837	250,529	246,514	264,450	257,177	196,741	102,635	82,000	97,102	37,709					0	-
Delta	DL	Detroit	DTW											129,228	91,657			(37,572)	(29.1%)
Delta	DL	Fort Lauderdale/Hollywood	FLL	87,108	112,455	130,305	122,463	139,613	133,927	127,218	97,327	70,389	39,902	33,674	29,280			(4,394)	(13.0%)
Delta	DL	Fort Myers	RSW							4,402	20,184	17,182	17,369	13,104	12,780			(324)	(2.5%)
Delta	DL	Las Vegas	LAS							16,329				1,394				(1,394)	(100.0%)
Delta	DL	Los Angeles	LAX						19,928	48,428	43,093	20,601		13,257				(13,257)	(100.0%)
Delta	DL	Minneapolis	MSP											99,431	79,418			(20,013)	(20.1%)
Delta	DL	New York J F Kennedy	JFK	39,894														0	-
Delta	DL	Orlando	MCO	218,705	202,538	173,740	165,251	203,634	217,905	160,415	118,320	106,599	79,256	99,129	88,041			(11,088)	(11.2%)
Delta	DL	Salt Lake City	SLC						3,986	31,243								0	-
Delta	DL	Tampa	TPA		69,258	97,818	123,897	131,795	134,894	117,960	93,781	66,811	25,828	33,625	15,420			(18,205)	(54.1%)
Delta	DL	West Palm Beach	PBI	87,108	112,455	119,357	75,907	106,806	102,684	62,395	51,099	53,971	22,659	37,536	16,500			(21,036)	(56.0%)
Frontier Airlines	F9	Denver	DEN								40,392	27,645						0	-
jetBlue	B6	Fort Lauderdale/Hollywood	FLL											15,086	90,231			75,146	498.1%
jetBlue	B6	Orlando	MCO											15,086	109,860			94,774	628.2%
jetBlue	B6	San Juan	SJU															0	-
jetBlue	B6	West Palm Beach	PBI															0	-
Laker Airways (Bahamas)	7Z	Freeport	FPO	5,850	11,700	6,471	6,471	3,900										0	-
Midway Airlines	JI	Raleigh/Durham	RDU	69,213	45,802													0	-
Midwest/Republic	YX	Milwaukee	MKE	44,455	36,082	29,366												0	-
Northwest	NW	Amsterdam	AMS								29,440	43,840						0	-
Northwest	NW	Detroit	DTW	215,750	199,154	190,874	193,856	204,604	192,679	181,501	178,364	152,492	113,746					0	-
Northwest	NW	Fort Myers	RSW															0	-
Northwest	NW	Minneapolis	MSP	135,570	137,404	134,201	144,001	149,646	140,194	147,350	142,982	130,019	84,739					0	-
Northwest	NW	Orlando	MCO										14,278					0	-
Northwest	NW	Tampa	TPA										32,382					0	-
Northwest	NW	West Palm Beach	PBI										25,473					0	-
Southwest	WN	Baltimore	BWI	389,158	377,285	367,798	420,903	419,083	423,878	426,399	429,393	394,440	371,357	367,534	367,414			(120)	(0.0%)
Southwest	WN	Chicago Midway	MDW	99,090	95,861	97,016	93,838	97,309	130,541	141,717	145,318	140,567	128,780	126,412	133,267			6,855	5.4%
Southwest	WN	Denver	DEN											41,922	50,005			8,083	19.3%
Southwest	WN	Fort Lauderdale/Hollywood	FLL				4,756							9,551	50,005			40,454	423.6%
Southwest	WN	Fort Myers	RSW															0	-
Southwest	WN	Las Vegas	LAS	7,163	7,144	2,955	16,714	51,336	50,005	50,005	50,005	50,142	50,005	49,398	50,005			607	1.2%
Southwest	WN	Nashville	BNA	92,064	100,010	92,299	80,341	50,142	50,005	50,005	50,005	49,810	50,005	49,398	41,648			(7,750)	(15.7%)
Southwest	WN	Orlando	MCO	51,336	61,317	99,403	100,010	114,082	151,816	151,816	148,887	148,058	143,459	139,212	137,411			(1,801)	(1.3%)
Southwest	WN	Philadelphia	PHL					40,591	217,850	147,666	23,094							0	-
Southwest	WN	Tampa	TPA		10,706	50,005	50,005	52,530	95,156	100,010	99,366	100,871	58,362	78,129	89,852			11,723	15.0%
Southwest	WN	West Palm Beach	PBI												8,357			8,357	-
Sunworld International	SM	Philadelphia	PHL			22,886												0	-
Trans World Airlines	TW	Portland (ME)	PWM	43,310														0	-
Trans World Airlines	TW	St. Louis	STL	206,109	185,855													0	-
United	UA	Chicago O'Hare	ORD	299,522	262,838	302,260	310,554	317,682	259,437	254,198	259,509	237,995	200,920	198,709	159,738			(38,971)	(19.6%)
United	UA	Denver	DEN	46,901	39,381	1,630												0	-
United	UA	San Francisco	SFO	45,384	33,018													0	-
United	UA	Washington Dulles	IAD	173,869	143,374	46,815	44,087	63,854	81,631	111,596	133,741	131,169	131,883	155,750	108,500			(47,250)	(30.3%)
US Airways	US	Baltimore	BWI	41,760	149,554													0	-
US Airways	US	Charlotte	CLT	214,719	235,997	260,958	191,931	229,826	350,776	227,845	219,915	192,821	146,512	228,119	238,508			10,389	4.6%
US Airways	US	Fort Lauderdale/Hollywood	FLL	39,232	26,818			1,272	15,161									0	-
US Airways	US	Orlando	MCO	117,696	74,184			5,986	3,842	3,737								0	-
US Airways	US	Philadelphia	PHL	310,118	318,428	277,118	253,658	267,741	301,242	139,939	84,575	61,974	58,153	49,914	44,595			(5,319)	(10.7%)
US Airways	US	Phoenix	PHX								28,869	40,200						0	-
US Airways	US	Pittsburgh	PIT	278,575	270,919	255,327	205,951	157,633	3,189									0	-
US Airways	US	Washington Dulles	IAD	86,376														0	-
US Airways	US	Washington National	DCA	171,891	146,558	139,812	138,468	141,901	141,068	130,161	143,281	141,492	84,917	51,434	52,210			776	1.5%
US Airways	US	West Palm Beach	PBI	39,232	25,268													0	-
USA 3000 Airlines	U5	Cancun	CUN						4,336	5,088	3,600							0	-
USA 3000 Airlines	U5	Punta Cana	PUJ						2,128	3,624	2,880							0	-
Subtotal				5,179,671	5,005,409	4,487,153	4,136,700	4,361,471	4,486,236	3,784,422	3,374,113	3,114,646	2,496,754	2,622,086	2,693,666			71,580	2.7%

Table F-3 Scheduled Passenger Operations by Market and Carrier for Bradley International Airport, Connecticut

Departures

Carrier	Code	Market	Code	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	'11-'13 Change	'11-'13 Pct. Change
Regional/Commuter Carriers																			
Air Canada Express	AC	Montreal Dorval	YUL	1,385	1,360	1,343	1,437	1,037	1,038	1,021	1,043	1,024	1,008	1,021	986			(35)	(3.4%)
Air Canada Express	AC	Toronto	YYZ	1,589	1,574	1,446	1,444	1,338	1,342	1,282	1,277	1,241	1,286	1,287	1,308			21	1.6%
America West Express	HP	Columbus	CMH	450	1,104	1,356	500											0	-
American Connection	AA	St. Louis	STL				113	880	947	896	958	827	210					0	-
American Eagle	AA	Chicago O'Hare	ORD					9		701	1,825	1,297	1,034	1,501	1,630			129	8.6%
American Eagle	AA	New York J F Kennedy	JFK	1,460	1,185	1,005	240											0	-
American Eagle	AA	Raleigh/Durham	RDU		197	1,128	1,038	1,233	1,364	1,370	1,185	1,155	1,043	257				(257)	(100.0%)
American Eagle	AA	St. Louis	STL										92					0	-
Continental Connection	CO	Albany	ALB			148	626	860	51									0	-
Continental Connection	CO	Binghamton	BGM		156													0	-
Continental Connection	CO	Boston	BOS		434													0	-
Continental Connection	CO	Buffalo	BUF	89	582													0	-
Continental Connection	CO	Burlington	BTV	4	154													0	-
Continental Connection	CO	New York J F Kennedy	JFK		235													0	-
Continental Connection	CO	New York Newark	EWR									672	375	608	901			294	48.3%
Continental Connection	CO	Philadelphia	PHL		566													0	-
Continental Connection	CO	Rochester	ROC	93	569													0	-
Continental Connection	CO	Syracuse	SYR	97	445													0	-
Continental Express	CO	Cleveland	CLE	803	1,064	971	1,121	1,124	1,102	1,159	1,151	1,145	1,164	1,208	1,200			(8)	(0.7%)
Continental Express	CO	New York Newark	EWR	1,747	1,685	1,591	1,382	1,368	1,351	1,364	1,386	696	841	465	258			(208)	(44.6%)
Delta Connection	DL	Atlanta	ATL							83		4			48			48	-
Delta Connection	DL	Cincinnati	CVG							623	798	714	1,088	1,218	1,251			33	2.7%
Delta Connection	DL	Columbus	CMH					93	994	621	595	191						0	-
Delta Connection	DL	Detroit	DTW											1,004	1,323			319	31.8%
Delta Connection	DL	Fort Lauderdale/Hollywood	FLL									53						0	-
Delta Connection	DL	Fort Myers	RSW						612	359		4						0	-
Delta Connection	DL	Minneapolis	MSP											481	814			333	69.2%
Delta Connection	DL	Myrtle Beach	MYR	61														0	-
Delta Connection	DL	New York J F Kennedy	JFK							546	1,177	1,050	795	365	304			(61)	(16.7%)
Delta Connection	DL	Orlando	MCO							88								0	-
Delta Connection	DL	Raleigh/Durham	RDU											100	569			469	467.9%
Delta Connection	DL	Tampa	TPA									79						0	-
Delta Connection	DL	Washington National	DCA											166	929			764	461.3%
Delta Connection	DL	West Palm Beach	PBI									8						0	-
Frontier Express	F9	Milwaukee	MKE											140	417			276	196.9%
Independence Air	DH	Washington Dulles	IAD					1,154	1,966	93								0	-
Midway Airlines	JI	Raleigh/Durham	RDU	1,348	1,065													0	-
Midwest Connect	YX	Milwaukee	MKE	4	144	271	896	941	965	943	831	532						0	-
Northwest Airlink	NW	Detroit	DTW							95	330	523	804					0	-
Northwest Airlink	NW	Indianapolis	IND					113	638	625	608	610	77					0	-
Northwest Airlink	NW	Memphis	MEM									53						0	-
Northwest Airlink	NW	Minneapolis	MSP						31			57	459					0	-
Shuttle America	S5	Albany	ALB	66														0	-
Shuttle America	S5	Bedford	BED	233	34													0	-
Shuttle America	S5	Buffalo	BUF	337														0	-
Shuttle America	S5	Islip	ISP	27														0	-
Shuttle America	S5	Wilmington	ILG	159														0	-
Swissair	SR	New York J F Kennedy	JFK	31														0	-
Trans World Airlines	TW	New York J F Kennedy	JFK	1,098														0	-
United Express	UA	Chicago O'Hare	ORD		336	547	184	475	691	691	689	501	382	548	685			137	25.0%
United Express	UA	Cleveland	CLE															0	-
United Express	UA	New York Newark	EWR															0	-
United Express	UA	Washington Dulles	IAD		335	1,095	1,095	1,676	1,519	1,014	794	692	708	494	889			394	79.8%
US Airways Express	US	Baltimore	BWI	1,185														0	-
US Airways Express	US	Buffalo	BUF	1,032	986	909	865	889	839	830	812	94						0	-
US Airways Express	US	Charlotte	CLT					13	4	104	278	658	1,035	537	452			(86)	(15.9%)
US Airways Express	US	New York La Guardia	LGA											139	1,057			917	657.9%
US Airways Express	US	New York Newark	EWR		350													0	-
US Airways Express	US	Philadelphia	PHL		273	188	9	206	439	1,943	2,250	2,227	2,015	2,404	2,430			26	1.1%
US Airways Express	US	Pittsburgh	PIT					183	1,646	1,634	1,581	976	939	939	939			0	0.0%
US Airways Express	US	Rochester	ROC	937	1,225	641	552	575	574	569	613	530	574	478				(478)	(100.0%)
US Airways Express	US	Syracuse	SYR	732	878	481	574	584	478									0	-
US Airways Express	US	Washington National	DCA			236	313	392	551	899	863	683	904	1,334	1,411			77	5.8%
Subtotal				14,968	16,935	13,356	12,388	15,144	19,143	19,553	21,046	18,299	16,833	16,694	19,799			3,105	18.6%
Total				53,139	53,384	45,277	41,384	44,064	49,651	46,111	45,269	40,761	35,229	35,389	38,640			3,251	9.2%

Departing Seats

Carrier	Code	Market	Code	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2013	2013	'11-'13 Change	'11-'13 Pct. Change
Regional/Commuter Carriers																			
Air Canada Express	AC	Montreal Dorval	YUL	19,392	25,894	25,474	27,025	21,557	19,475	19,402	19,814	19,453	19,157	19,399	18,739			(660)	(3.4%)
Air Canada Express	AC	Toronto	YYZ	61,991	58,254	53,518	46,094	35,666	38,242	42,200	41,623	40,366	38,410	36,960	38,342			1,381	3.7%
America West Express	HP	Columbus	CMH	22,493	55,179	67,786	24,993											0	-
American Connection	AA	St. Louis	STL				4,192	32,571	44,356	44,821	43,414	36,407	9,240					0	-
American Eagle	AA	Chicago O'Hare	ORD					416		34,094	80,300	57,606	50,374	79,594	95,985			16,391	20.6%
American Eagle	AA	New York J F Kennedy	JFK	48,166	39,105	33,165	8,880											0	-
American Eagle	AA	Raleigh/Durham	RDU		7,273	41,752	38,422	46,535	54,521	52,371	44,685	44,275	45,154	10,774				(10,774)	(100.0%)
American Eagle	AA	St. Louis	STL										4,600					0	-
Continental Connection	CO	Albany	ALB			2,815	11,889	16,337	961									0	-
Continental Connection	CO	Binghamton	BGM		2,964													0	-
Continental Connection	CO	Boston	BOS		8,238													0	-
Continental Connection	CO	Buffalo	BUF	1,683	11,050													0	-
Continental Connection	CO	Burlington	BTV	84	2,934													0	-
Continental Connection	CO	New York J F Kennedy	JFK		4,470													0	-
Continental Connection	CO	New York Newark	EWR									46,520	13,859	22,485	33,353			10,867	48.3%
Continental Connection	CO	Philadelphia	PHL		10,749													0	-
Continental Connection	CO	Rochester	ROC	1,767	10,806													0	-
Continental Connection	CO	Syracuse	SYR	1,851	8,447													0	-
Continental Express	CO	Cleveland	CLE	39,357	52,441	48,374	55,469	56,179	54,951	57,971	57,507	57,045	58,179	60,400	59,979			(421)	(0.7%)
Continental Express	CO	New York Newark	EWR	82,365	80,263	78,540	69,030	68,285	67,455	68,221	66,703	34,171	42,029	23,264	12,879			(10,386)	(44.6%)
Delta Connection	DL	Atlanta	ATL							5,820		310			3,396			3,396	-
Delta Connection	DL	Cincinnati	CVG							40,956	49,854	40,876	60,954	61,642	66,559			4,916	8.0%
Delta Connection	DL	Columbus	CMH					4,650	49,196	27,671	29,707	9,543						0	-
Delta Connection	DL	Detroit	DTW											54,265	82,915			28,649	52.8%
Delta Connection	DL	Fort Lauderdale/Hollywood	FLL									3,680						0	-
Delta Connection	DL	Fort Myers	RSW						42,840	25,100		290						0	-
Delta Connection	DL	Minneapolis	MSP											36,567	61,731			25,164	68.8%
Delta Connection	DL	Myrtle Beach	MYR	3,057														0	-
Delta Connection	DL	New York J F Kennedy	JFK							20,207	48,637	52,493	39,736	18,250	15,200			(3,050)	(16.7%)
Delta Connection	DL	Orlando	MCO							6,130								0	-
Delta Connection	DL	Raleigh/Durham	RDU											6,136	28,436			22,299	363.4%
Delta Connection	DL	Tampa	TPA									5,520						0	-
Delta Connection	DL	Washington National	DCA											11,324	51,524			40,200	355.0%
Delta Connection	DL	West Palm Beach	PBI									580						0	-
Frontier Express	F9	Milwaukee	MKE											6,313	18,746			12,433	196.9%
Independence Air	DH	Washington Dulles	IAD					57,714	98,307	4,650								0	-
Midway Airlines	JI	Raleigh/Durham	RDU	67,393	53,243													0	-
Midwest Connect	YX	Milwaukee	MKE	142	4,594	8,999	28,686	30,117	30,871	30,171	35,492	26,600						0	-
Northwest Airlink	NW	Detroit	DTW							4,771	16,493	30,948	53,556					0	-
Northwest Airlink	NW	Indianapolis	IND					5,664	31,907	31,257	30,400	30,500	3,857					0	-
Northwest Airlink	NW	Memphis	MEM									2,657						0	-
Northwest Airlink	NW	Minneapolis	MSP						1,550			4,299	34,895					0	-
Shuttle America	S5	Albany	ALB	3,286														0	-
Shuttle America	S5	Bedford	BED	11,671	1,714													0	-
Shuttle America	S5	Buffalo	BUF	16,857														0	-
Shuttle America	S5	Islip	ISP	1,329														0	-
Shuttle America	S5	Wilmington	ILG	7,936														0	-
Swissair	SR	New York J F Kennedy	JFK	1,023														0	-
Trans World Airlines	TW	New York J F Kennedy	JFK	31,842														0	-
United Express	UA	Chicago O'Hare	ORD		16,800	27,350	9,200	24,456	48,370	48,261	47,315	34,216	26,387	36,797	43,701			6,903	18.8%
United Express	UA	Cleveland	CLE															0	-
United Express	UA	New York Newark	EWR															0	-
United Express	UA	Washington Dulles	IAD		16,750	54,750	54,660	84,513	84,484	63,290	49,069	47,354	46,746	30,270	54,707			24,437	80.7%
US Airways Express	US	Baltimore	BWI	43,850														0	-
US Airways Express	US	Buffalo	BUF	38,200	36,493	33,638	32,000	32,121	28,607	28,215	27,623	3,206						0	-
US Airways Express	US	Charlotte	CLT					650	221	6,700	23,658	55,459	86,653	45,043	37,510			(7,533)	(16.7%)
US Airways Express	US	New York La Guardia	LGA											5,159	39,098			33,940	657.9%
US Airways Express	US	New York Newark	EWR		10,146													0	-
US Airways Express	US	Philadelphia	PHL		10,101	6,951	322	9,500	27,685	119,743	156,739	167,459	148,400	183,838	163,675			(20,163)	(11.0%)
US Airways Express	US	Pittsburgh	PIT					9,247	84,598	88,694	80,184	48,800	46,929	46,929	46,929			0	0.0%
US Airways Express	US	Rochester	ROC	34,658	45,325	23,733	20,429	21,280	19,555	19,351	20,832	18,005	19,501	16,242				(16,242)	(100.0%)
US Airways Express	US	Syracuse	SYR	27,084	32,470	14,421	10,898	11,093	9,077									0	-
US Airways Express	US	Washington National	DCA			7,071	13,054	19,813	34,454	59,076	51,252	42,356	60,107	89,629	89,940			311	0.3%
Subtotal				567,477	605,702	528,336	455,243	588,364	871,682	949,146	1,021,302	960,993	908,722	901,282	1,063,342			162,060	18.0%
Total				5,747,148	5,611,111	5,015,489	4,591,943	4,949,835	5,357,918	4,733,569	4,395,415	4,075,639	3,405,476	3,523,368	3,757,008			233,640	6.6%

Source: OAG Schedules.
Note: All Northwest operations included in Delta from 2010 onwards

Table F-4 Scheduled Passenger Operations by Market and Carrier for T.F. Green Airport, Rhode Island

Departures

Carrier	Code	Market	Code	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	'11-'13 Change	'11-'13 Pct. Change
Jet Carriers																			
American	AA	Chicago O'Hare	ORD	1,464	1,460	1,452	1,421	1,609	1,113	257								0	-
American	AA	Dallas/Fort Worth	DFW				61	366	365	90								0	-
Continental	CO	Cleveland	CLE	569	167	208	13	131	13	4								0	-
Continental	CO	Houston Intercontinental	IAH	366	243													0	-
Continental	CO	New York Newark	EWR	738	1,170	869	450	331	282	282	248	38						0	-
Delta	DL	Atlanta	ATL	1,464	1,460	1,678	1,825	1,830	1,976	827	256	25	43	510	1,043			533	104.4%
Delta	DL	Cincinnati	CVG	732	730	730	730	732	695	237								0	-
Delta	DL	Detroit	DTW											414	58			(356)	(86.1%)
Delta	DL	Fort Lauderdale/Hollywood	FLL		306													0	-
Delta	DL	Minneapolis	MSP											74				(74)	(100.0%)
Delta	DL	Orlando	MCO	732	730	730	424											0	-
Laker Airways (Bahamas)	7Z	Freeport	FPO					9										0	-
Northwest	NW	Detroit	DTW	1,682	1,631	1,534	1,513	1,512	1,550	1,395	1,278	1,120	1,006					0	-
Northwest	NW	Minneapolis	MSP			668	726	641	539	303	282							0	-
Sata Internacional	S4	Ponta Delgada	PDL					17		18	13	13						0	-
Southwest	WN	Baltimore	BWI	3,913	3,877	3,789	4,043	4,222	4,180	4,249	4,259	3,995	3,427	3,260	3,043			(217)	(6.7%)
Southwest	WN	Chicago Midway	MDW	1,072	1,022	1,013	1,056	1,089	1,349	1,373	1,400	1,390	1,231	1,135	1,095			(40)	(3.5%)
Southwest	WN	Fort Lauderdale/Hollywood	FLL	9	30			26			222	427	656	594	590			(4)	(0.7%)
Southwest	WN	Houston	HOU	152														0	-
Southwest	WN	Islip	ISP	608	1,369	1,351												0	-
Southwest	WN	Kansas City	MCI	366	365	361	365	366	365	31								0	-
Southwest	WN	Las Vegas	LAS					9	31	365	365	366	365	365	365			0	0.0%
Southwest	WN	Nashville	BNA	706	700	726	708	706	721	396	365	366	365	296	123			(173)	(58.4%)
Southwest	WN	Orlando	MCO	955	1,095	1,183	1,460	1,586	1,821	1,838	2,030	2,161	1,842	1,799	1,659			(139)	(7.8%)
Southwest	WN	Philadelphia	PHL					1,199	1,773	1,918	1,986	1,721	1,669	1,402	1,298			(104)	(7.4%)
Southwest	WN	Phoenix	PHX	366	703	730	730	732	726	730	638	366	365	361	365			4	1.2%
Southwest	WN	Tampa	TPA	745	730	818	1,095	1,085	1,086	1,091	1,095	993	826	813	808			(4)	(0.5%)
Spirit Airlines	NK	Detroit	DTW					61	120									0	-
Spirit Airlines	NK	Fort Lauderdale/Hollywood	FLL					131	568	400	151							0	-
Spirit Airlines	NK	Fort Myers	RSW					70	365	181	184							0	-
United	UA	Chicago O'Hare	ORD	1,477	1,491	1,670	1,666	1,555	1,460	1,491	1,491	1,003	730	644	626			(18)	(2.9%)
US Airways	US	Baltimore	BWI	2,462	2,101													0	-
US Airways	US	Charlotte	CLT	977	1,309	1,438	1,513	1,582	1,858	1,435	1,256	1,425	1,655	1,643	1,599			(44)	(2.7%)
US Airways	US	Fort Lauderdale/Hollywood	FLL					31	17									0	-
US Airways	US	Orlando	MCO	52	48			48	43	13	13	9						0	-
US Airways	US	Philadelphia	PHL	1,830	1,794	1,766	1,738	2,416	2,182	1,131	1,429	862	928	1,299	1,012			(287)	(22.1%)
US Airways	US	Pittsburgh	PIT	1,339	1,460	1,460	1,165	1,290	31									0	-
US Airways	US	Washington National	DCA	1,333	1,147	1,407	1,390	1,107	1,270	1,334	761	684	463	365	313			(52)	(14.3%)
Subtotal				26,108	27,136	25,580	24,093	26,488	26,499	21,387	19,720	16,965	15,571	14,974	13,998			(976)	(6.5%)
Regional/Commuter Carriers																			
Air Canada Express	AC	Toronto	YYZ	989	991	835	906	798	734	699	700	658	639	625	591			(34)	(5.5%)
American Eagle	AA2	Chicago O'Hare	ORD							842	1,095	784						0	-
American Eagle	AA2	New York J F Kennedy	JFK	1,291	1,404	731	330											0	-
American Eagle	AA2	New York La Guardia	LGA	2,756	1,788	961												0	-
American Eagle	AA2	Raleigh/Durham	RDU					643	343									0	-
Cape Air	9K	Hyannis	HYA							26								0	-
Cape Air	9K	Martha's Vineyard	MVY	1,762	1,871	1,948	1,502	1,960	1,015	1,045	1,014	967	795	747	672			(75)	(10.0%)
Cape Air	9K	Nantucket	ACK	2,453	2,653	2,592	1,975	2,765	1,199	1,285	1,183	879	733	681	668			(13)	(1.9%)
Continental Connection	CO	Albany	ALB		944	1,116	863	702	51									0	-
Continental Connection	CO	Boston	BOS		51													0	-
Continental Connection	CO	New York Newark	EWR									625	1,043	427	171			(257)	(60.1%)
Continental Connection	CO	Plattsburgh	PLB		22													0	-
Continental Express	CO	Cleveland	CLE	699	1,190	1,186	1,200	1,119	1,238	1,286	1,326	1,290	1,264	1,217	1,079			(138)	(11.3%)
Continental Express	CO	New York Newark	EWR	1,482	465	650	1,019	1,395	1,455	1,438	1,481	1,080	417	1,028	1,268			240	23.3%
Delta Connection	DL	Atlanta	ATL						31	705	1,291	1,373	1,136	724	9			(715)	(98.8%)
Delta Connection	DL	Cincinnati	CVG		275	365	334	335	373	749	978	993	816	43				(43)	(100.0%)
Delta Connection	DL	Detroit	DTW											1,324	1,995			671	50.6%
Delta Connection	DL	Minneapolis	MSP											347	392			44	12.7%
Delta Connection	DL	New York J F Kennedy	JFK							542	1,238	671	90					0	-
Delta Connection	DL	New York La Guardia	LGA	610	155													0	-
Delta Connection	DL	Raleigh/Durham	RDU												131			131	-
Delta Connection	DL	Washington National	DCA												685			685	-
Independence Air	DH	Washington Dulles	IAD					875	1,509	93								0	-
Midway Airlines	JI	Raleigh/Durham	RDU		510													0	-
Northwest Airlink	NW	Detroit	DTW									113	373					0	-
Northwest Airlink	NW	Minneapolis	MSP		302	93	40	79	31			271	262					0	-
Swissair	SR	New York J F Kennedy	JFK	31														0	-
United Express	UA	Chicago O'Hare	ORD					214	262	334	217	213	370	455	375			(80)	(17.5%)
United Express	UA	Washington Dulles	IAD	1,468	1,507	1,460	1,460	1,876	1,716	1,656	1,589	1,464	1,460	1,569	1,421			(148)	(9.4%)
US Airways Express	US	Albany	ALB	679														0	-
US Airways Express	US	Boston	BOS	48														0	-
US Airways Express	US	Charlotte	CLT					13	18	338	491	348	92	126	147			22	17.1%
US Airways Express	US	Hyannis	HYA			183	17											0	-
US Airways Express	US	Nantucket	ACK				9											0	-
US Airways Express	US	New York La Guardia	LGA	2,298	2,233	1,930	1,876	1,808	1,669	1,816	1,855	1,589	1,705	1,222	957			(266)	(21.7%)
US Airways Express	US	New York Newark	EWR	1,569	1,507	80												0	-
US Airways Express	US	Philadelphia	PHL	366	365	365	9	22	716	1,685	1,356	1,800	1,788	1,526	1,713			187	12.3%
US Airways Express	US	Pittsburgh	PIT					183	1,360	1,395	978	303						0	-
US Airways Express	US	Plattsburgh	PLB	26														0	-
US Airways Express	US	Washington National	DCA					143	482	625	1,254	1,373	1,256	1,373	1,304			(70)	(5.1%)
Subtotal				18,527	18,233	14,496	11,538	14,930	14,200	16,560	18,046	16,795	14,239	13,436	13,577			142	1.1%
Total				44,635	45,369	40,076	35,631	41,419	40,699	37,946	37,766	33,760	29,809	28,409	27,575			(834)	(2.9%)

Departing Seats

Carrier	Code	Market	Code	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	'11-'13 Change	'11-'13 Pct. Change
Jet Carriers																			
American	AA	Chicago O'Hare	ORD	203,104	188,340	187,253	183,309	207,543	143,522	33,171								0	-
American	AA	Dallas/Fort Worth	DFW				7,869	47,214	47,085	11,610								0	-
Continental	CO	Cleveland	CLE	69,771	20,446	24,382	1,629	15,622	1,630	446								0	-
Continental	CO	Houston Intercontinental	IAH	45,946	28,062													0	-
Continental	CO	New York Newark	EWR	96,448	148,092	105,448	53,213	38,535	34,808	29,298	27,309	4,348						0	-
Delta	DL	Atlanta	ATL	207,888	232,070	283,761	294,173	289,611	290,915	108,427	36,556	3,570	6,147	72,461	150,526			78,065	107.7%
Delta	DL	Cincinnati	CVG	103,944	105,055	129,715	129,625	103,944	89,235	23,714								0	-
Delta	DL	Detroit	DTW											50,065	7,139			(42,927)	(85.7%)
Delta	DL	Fort Lauderdale/Hollywood	FLL		36,414													0	-
Delta	DL	Minneapolis	MSP											9,211				(9,211)	(100.0%)
Delta	DL	Orlando	MCO	87,108	86,870	86,870	50,456											0	-
Laker Airways (Bahamas)	7Z	Freeport	FPO					1,329										0	-
Northwest	NW	Detroit	DTW	200,509	201,221	185,628	187,255	203,837	202,255	191,678	163,119	144,120	104,662					0	-
Northwest	NW	Minneapolis	MSP			82,832	95,305	85,995	68,977	41,988	34,986							0	-
Sata Internacional	S4	Ponta Delgada	PDL					3,486		3,514	2,629	2,629						0	-
Southwest	WN	Baltimore	BWI	535,911	531,110	519,132	553,911	578,063	572,699	582,133	581,240	547,223	468,695	442,637	415,554			(27,083)	(6.1%)
Southwest	WN	Chicago Midway	MDW	146,844	139,975	138,399	144,672	149,232	184,813	188,160	191,469	190,410	167,712	153,121	149,877			(3,244)	(2.1%)
Southwest	WN	Fort Lauderdale/Hollywood	FLL	1,194	4,149			3,562			30,473	58,499	89,852	81,378	80,791			(587)	(0.7%)
Southwest	WN	Houston	HOU	20,824														0	-
Southwest	WN	Islip	ISP	83,237	187,494	185,126												0	-
Southwest	WN	Kansas City	MCI	50,142	50,005	49,398	50,005	50,142	50,005	4,247								0	-
Southwest	WN	Las Vegas	LAS					1,194	4,247	50,005	50,005	50,142	50,005	50,005	50,005			0	0.0%
Southwest	WN	Nashville	BNA	96,702	95,861	99,403	97,055	96,722	98,816	54,252	50,005	50,142	49,154	39,578	16,067			(23,512)	(59.4%)
Southwest	WN	Orlando	MCO	130,855	150,015	162,012	200,020	217,302	249,418	251,806	278,130	296,077	252,021	245,156	225,244			(19,912)	(8.1%)
Southwest	WN	Philadelphia	PHL					164,224	238,366	262,328	272,023	230,076	228,594	192,054	177,001			(15,053)	(7.8%)
Southwest	WN	Phoenix	PHX	50,142	96,370	100,010	100,010	100,284	99,403	100,010	87,406	50,142	50,005	49,398	50,005			607	1.2%
Southwest	WN	Tampa	TPA	102,065	100,010	112,007	150,015	148,625	148,821	149,408	150,015	136,100	112,247	111,231	109,572			(1,659)	(1.5%)
Spirit Airlines	NK	Detroit	DTW					9,150	18,000									0	-
Spirit Airlines	NK	Fort Lauderdale/Hollywood	FLL					19,586	84,117	57,411	21,095							0	-
Spirit Airlines	NK	Fort Myers	RSW					10,436	54,750	29,706	32,533							0	-
United	UA	Chicago O'Hare	ORD	239,076	239,727	245,812	242,105	234,843	200,677	189,260	179,413	124,349	98,155	82,802	78,487			(4,315)	(5.2%)
US Airways	US	Baltimore	BWI	263,921	239,659													0	-
US Airways	US	Charlotte	CLT	128,984	181,656	216,134	218,364	223,314	274,039	224,384	181,130	187,163	208,090	233,886	226,854			(7,032)	(3.0%)
US Airways	US	Fort Lauderdale/Hollywood	FLL					3,941	2,186									0	-
US Airways	US	Orlando	MCO	5,605	5,440			6,126	5,831	1,831	1,831	1,080						0	-
US Airways	US	Philadelphia	PHL	253,015	257,340	265,192	254,348	345,461	312,890	149,514	170,237	90,225	97,365	130,008	101,987			(28,021)	(21.6%)
US Airways	US	Pittsburgh	PIT	185,109	184,748	219,611	161,979	174,598	4,446									0	-
US Airways	US	Washington National	DCA	167,278	145,960	175,855	178,061	149,503	170,009	176,649	96,999	81,540	58,046	49,501	44,006			(5,495)	(11.1%)
Subtotal				3,475,622	3,656,088	3,573,982	3,353,377	3,683,422	3,651,961	2,914,952	2,638,603	2,247,835	2,040,751	1,992,492	1,883,114			(109,378)	(5.5%)
Regional/Commuter Carriers																			
Air Canada Express	AC	Toronto	YYZ	37,482	36,656	29,701	17,478	14,364	13,783	13,286	13,292	12,494	12,136	11,880	11,232			(649)	(5.5%)
American Eagle	AA2	Chicago O'Hare	ORD							37,107	48,386	34,490						0	-
American Eagle	AA2	New York J F Kennedy	JFK	42,589	46,341	24,979	12,210											0	-
American Eagle	AA2	New York La Guardia	LGA	90,957	63,908	35,568												0	-
American Eagle	AA2	Raleigh/Durham	RDU					25,643	13,081									0	-
Cape Air	9K	Hyannis	HYA							231								0	-
Cape Air	9K	Martha's Vineyard	MVY	15,861	16,839	17,535	13,515	17,640	9,132	9,408	9,129	8,707	7,154	6,722	6,048			(674)	(10.0%)
Cape Air	9K	Nantucket	ACK	22,073	23,874	23,332	17,775	24,885	10,787	11,569	10,650	7,912	6,593	6,128	6,012			(116)	(1.9%)
Continental Connection	CO	Albany	ALB		17,941	21,212	16,397	13,335	961									0	-
Continental Connection	CO	Boston	BOS		961													0	-
Continental Connection	CO	New York Newark	EWR									46,261	77,150	31,630	6,316			(25,313)	(80.0%)
Continental Connection	CO	Plattsburgh	PLB		415													0	-
Continental Express	CO	Cleveland	CLE	34,936	59,234	59,266	59,930	55,900	61,900	64,307	66,250	64,500	63,214	60,836	53,943			(6,893)	(11.3%)
Continental Express	CO	New York Newark	EWR	86,552	23,216	32,493	50,770	67,702	71,185	70,697	72,165	53,297	20,871	51,407	63,407			12,000	23.3%
Delta Connection	DL	Atlanta	ATL						1,550	37,276	70,664	84,816	78,920	52,959	662			(52,297)	(98.7%)
Delta Connection	DL	Cincinnati	CVG		13,750	18,250	16,700	16,750	19,109	43,523	53,217	51,691	41,597	2,150				(2,150)	(100.0%)
Delta Connection	DL	Detroit	DTW											78,701	111,901			33,199	42.2%
Delta Connection	DL	Minneapolis	MSP											26,192	29,553			3,361	12.8%
Delta Connection	DL	New York J F Kennedy	JFK							20,043	50,095	33,550	4,500					0	-
Delta Connection	DL	New York La Guardia	LGA	19,520	4,960													0	-
Delta Connection	DL	Raleigh/Durham	RDU												6,557			6,557	-
Delta Connection	DL	Washington National	DCA												34,243			34,243	-
Independence Air	DH	Washington Dulles	IAD					43,764	75,429	4,650								0	-
Midway Airlines	JI	Raleigh/Durham	RDU		25,507													0	-
Northwest Airlink	NW	Detroit	DTW									8,610	25,817					0	-
Northwest Airlink	NW	Minneapolis	MSP		15,079	4,650	1,986	3,943	1,550			20,563	19,912					0	-
Swissair	SR	New York J F Kennedy	JFK	1,023														0	-
United Express	UA	Chicago O'Hare	ORD					10,700	18,330	23,380	14,847	14,077	24,401	29,820	24,079			(5,741)	(19.3%)
United Express	UA	Washington Dulles	IAD	52,832	74,367	73,000	73,000	93,779	85,821	85,133	90,282	88,930	90,648	99,719	89,593			(10,126)	(10.2%)
US Airways Express	US	Albany	ALB	12,898														0	-
US Airways Express	US	Boston	BOS	909														0	-
US Airways Express	US	Charlotte	CLT					657	879	26,581	38,945	28,677	5,998	10,047	12,035			1,988	19.8%
US Airways Express	US	Hyannis	HYA			3,480	326											0	-
US Airways Express	US	Nantucket	ACK				292											0	-
US Airways Express	US	New York La Guardia	LGA	84,116	81,795	57,349	48,101	50,163	55,077	59,675	57,420	53,702	63,090	45,225	33,141			(12,084)	(26.7%)
US Airways Express	US	New York Newark	EWR	31,176	43,707	2,312												0	-
US Airways Express	US	Philadelphia	PHL	13,542	13,505	13,505	322	1,324	45,199	105,463	88,590	135,360	123,761	107,790	122,386			14,596	13.5%
US Airways Express	US	Pittsburgh	PIT					9,157	72,808	76,891	51,251	15,136						0	-
US Airways Express	US	Plattsburgh	PLB	497														0	-
US Airways Express	US	Washington National	DCA					7,171	30,996	31,326	78,780	84,215	79,539	92,151	95,527			3,376	3.7%
Subtotal				546,963	562,057	416,630	328,803	456,879	587,576	720,547	813,962	846,987	745,302	713,356	706,634			(6,721)	(0.9%)
Total				4,022,585	4,218,145	3,990,612	3,682,181	4,140,301	4,239,537	3,635,498	3,452,565	3,094,822	2,786,053	2,705,848	2,589,748			(116,100)	(4.3%)

Source: OAG Schedules.
Note: All Northwest operations included in Delta from 2010 onwards

Table F-5 Scheduled Passenger Operations by Market and Carrier for Manchester-Boston Regional Airport, New Hampshire

Departures

Carrier	Code	Market	Code	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	'11-'13 Change	'11-'13 Pct. Change
Jet Carriers																			
Boston-Maine Airways	PN	Myrtle Beach	MYR				26	83										0	-
Boston-Maine Airways	PN	Portsmouth	PSM				26	183										0	-
Boston-Maine Airways	PN	Sanford	SFB				13	87										0	-
Continental	CO	Cleveland	CLE	130	91								9					0	-
Continental	CO	New York Newark	EWR	462	874	694	326	314	286	260	4							0	-
Delta	DL	Atlanta	ATL	244	730	944	881	732	668			13		275	565			290	105.6%
Delta	DL	Cincinnati	CVG		214	579	730	710	664									0	-
Delta	DL	Detroit	DTW											796				(796)	(100.0%)
Northwest	NW	Detroit	DTW	1,609	1,613	1,534	1,429	1,460	1,399	1,301	1,199	832	778					0	-
Northwest	NW	Minneapolis	MSP				214	362	365	241	153							0	-
Southwest	WN	Baltimore	BWI	2,828	2,812	3,128	3,625	3,874	3,850	3,859	3,898	3,638	3,312	2,891	2,761			(130)	(4.5%)
Southwest	WN	Chicago Midway	MDW	706	708	704	669	693	1,355	1,399	1,631	1,651	1,253	1,144	1,244			100	8.8%
Southwest	WN	Denver	DEN												92			92	-
Southwest	WN	Fort Lauderdale/Hollywood	FLL		9		22	9				254	120	9	9			0	0.0%
Southwest	WN	Kansas City	MCI	366	365	365	365	305										0	-
Southwest	WN	Las Vegas	LAS				122	375	365	365	365	366	365	365	365			0	0.0%
Southwest	WN	Nashville	BNA	397	721	730	730	715	730	62								0	-
Southwest	WN	Orlando	MCO	410	697	818	1,095	1,129	1,468	1,456	1,774	1,602	1,201	1,125	977			(148)	(13.2%)
Southwest	WN	Philadelphia	PHL					788	1,786	1,756	2,005	2,026	1,894	1,411	1,325			(86)	(6.1%)
Southwest	WN	Phoenix	PHX								122	366	365	322	273			(49)	(15.2%)
Southwest	WN	Tampa	TPA		306	453	730	845	1,099	1,095	1,030	741	673	782	629			(153)	(19.6%)
United	UA	Chicago O'Hare	ORD	1,403	1,431	1,694	1,460	1,464	1,339	1,096	1,067	824	608					0	-
United	UA	Portland (ME)	PWM	57	90													0	-
US Airways	US	Baltimore	BWI	1,782	1,444													0	-
US Airways	US	Charlotte	CLT		62	730	901	1,276	1,308	660	623	689	378	365	51			(314)	(85.9%)
US Airways	US	Orlando	MCO	52	48													0	-
US Airways	US	Philadelphia	PHL	1,821	1,821	1,812	1,602	1,806	2,021	683	634	366	395	365	313			(52)	(14.3%)
US Airways	US	Pittsburgh	PIT	1,085	1,095	1,086	820	553										0	-
US Airways	US	Washington National	DCA	675	599			113	575	539	304	296						0	-
Subtotal				14,026	15,731	15,270	15,787	17,876	19,279	14,771	14,810	13,664	11,352	9,850	8,604			(1,246)	(12.6%)
Regional/Commuter Carriers																			
Air Canada Express	AC	Montreal Dorval	YUL		423													0	-
Air Canada Express	AC	Toronto	YYZ	339	1,299	1,295	1,391	1,024	930	908	917	910	908	707	403			(305)	(43.1%)
American Eagle	AA	New York La Guardia	LGA	1,833	810													0	-
Boston-Maine Airways	E9	Bangor	BGR				192	4										0	-
Boston-Maine Airways	E9	Martha's Vineyard	MVY				105											0	-
Boston-Maine Airways	E9	Nantucket	ACK				214											0	-
Boston-Maine Airways	E9	New London/Groton	GON				118	22										0	-
Boston-Maine Airways	E9	Portsmouth	PSM				148	4										0	-
Boston-Maine Airways	E9	Saint John	YSJ				139											0	-
Continental Connection	CO	Albany	ALB	80	1,131	1,116	1,130	1,007	313									0	-
Continental Connection	CO	New York J F Kennedy	JFK		349													0	-
Continental Connection	CO	New York Newark	EWR									62	337	141	175			34	23.9%
Continental Connection	CO	Plattsburgh	PLB		39													0	-
Continental Connection	CO	Rochester	ROC	44	129													0	-
Continental Connection	CO	Syracuse	SYR	22	64													0	-
Continental Connection	CO	Westchester County	HPN		328													0	-
Continental Express	CO	Cleveland	CLE	593	914	1,343	1,173	1,198	1,186	1,213	1,236	1,212	1,178	1,178	935			(244)	(20.7%)
Continental Express	CO	New York Newark	EWR	1,028	603	762	1,125	1,150	1,165	1,196	1,451	1,380	1,072	1,267	1,215			(51)	(4.1%)
Delta Connection	DL	Atlanta	ATL	488			214	366	485	1,621	1,176	692	365	90				(90)	(100.0%)
Delta Connection	DL	Bangor	BGR	244														0	-
Delta Connection	DL	Cincinnati	CVG	1,673	1,246	881	726	750	735	986	982	775						0	-
Delta Connection	DL	Detroit	DTW											499	1,858			1,359	272.2%
Delta Connection	DL	New York J F Kennedy	JFK							453	1,059							0	-
Delta Connection	DL	New York La Guardia	LGA	727	124		825	1,067	486									0	-
Independence Air	DH	Washington Dulles	IAD					1,439	1,568	93								0	-
Northwest Airlink	NW	Detroit	DTW					13		89	49	397	359					0	-
Northwest Airlink	NW	Minneapolis	MSP				214	324	233	89	153	271	92					0	-
United Express	UA	Chicago O'Hare	ORD				83	213	31	333	363	322	388	1,040	983			(57)	(5.5%)
United Express	UA	Washington Dulles	IAD		124	1,460	1,460	1,678	1,760	1,316	1,429	1,098	1,161	1,104	658			(446)	(40.4%)
US Airways Express	US	Boston	BOS									73						0	-
US Airways Express	US	Charlotte	CLT						307	396	416	196	227	153	318			165	107.9%
US Airways Express	US	New York La Guardia	LGA	2,583	2,095	2,109	2,335	2,632	2,499	2,454	2,454	2,157	1,464	1,381	1,269			(112)	(8.1%)
US Airways Express	US	Philadelphia	PHL				275	370	562	2,120	1,720	1,878	1,929	2,116	2,068			(48)	(2.3%)
US Airways Express	US	Pittsburgh	PIT				214	567	1,022									0	-
US Airways Express	US	Washington National	DCA			844	1,017	976	508	547	782	845	1,008	1,039	1,043			4	0.4%
Subtotal				9,655	9,677	9,809	13,098	14,804	13,788	13,815	14,186	12,269	10,486	10,716	10,925			209	1.9%
Total				23,681	25,408	25,079	28,885	32,680	33,067	28,586	28,996	25,933	21,839	20,566	19,529			(1,037)	(5.0%)

Departing Seats

Carrier	Code	Market	Code	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	'11-'13 Change	'11-'13 Pct. Change
Jet Carriers																			
Boston-Maine Airways	PN	Myrtle Beach	MYR				3,943	12,429										0	-
Boston-Maine Airways	PN	Portsmouth	PSM				3,921	27,471										0	-
Boston-Maine Airways	PN	Sanford	SFB				1,971	13,114										0	-
Continental	CO	Cleveland	CLE	16,151	10,857								1,038					0	-
Continental	CO	New York Newark	EWR	62,358	105,765	80,049	37,310	36,123	30,953	27,025	446							0	-
Delta	DL	Atlanta	ATL	34,648	103,660	134,048	125,102	103,944	94,856			1,826		39,050	81,600			42,550	109.0%
Delta	DL	Cincinnati	CVG		30,388	82,218	103,660	100,840	86,583									0	-
Delta	DL	Detroit	DTW											89,289				(89,289)	(100.0%)
Northwest	NW	Detroit	DTW	194,058	214,073	205,234	193,043	202,623	180,879	181,073	149,221	101,760	93,450					0	-
Northwest	NW	Minneapolis	MSP				26,536	44,835	46,933	30,575	18,972							0	-
Southwest	WN	Baltimore	BWI	387,397	385,205	428,516	496,645	530,588	527,405	525,342	530,545	496,372	450,616	393,093	376,945			(16,148)	(4.1%)
Southwest	WN	Chicago Midway	MDW	96,702	97,055	96,448	91,712	94,744	185,481	191,722	222,957	226,101	169,754	155,466	169,440			13,975	9.0%
Southwest	WN	Denver	DEN												12,604			12,604	-
Southwest	WN	Fort Lauderdale/Hollywood	FLL		1,194		2,955	1,194				34,692	16,440	1,194	1,194			0	0.0%
Southwest	WN	Kansas City	MCI	50,142	50,005	50,005	50,005	41,785										0	-
Southwest	WN	Las Vegas	LAS				16,714	51,336	50,005	50,005	50,005	50,142	50,005	50,005	50,005			0	0.0%
Southwest	WN	Nashville	BNA	54,389	98,816	99,682	99,686	97,896	99,879	8,494								0	-
Southwest	WN	Orlando	MCO	56,111	95,469	112,007	150,015	154,673	201,175	199,413	243,032	219,402	164,332	154,145	133,829			(20,315)	(13.2%)
Southwest	WN	Philadelphia	PHL					107,995	244,356	240,533	274,328	269,953	259,275	192,456	180,871			(11,585)	(6.0%)
Southwest	WN	Phoenix	PHX								16,714	50,142	50,005	44,114	37,401			(6,713)	(15.2%)
Southwest	WN	Tampa	TPA		41,922	62,002	100,010	115,693	150,165	150,015	141,071	101,283	92,240	107,173	86,212			(20,961)	(19.6%)
United	UA	Chicago O'Hare	ORD	221,523	231,477	248,062	219,888	209,179	179,151	138,080	129,086	106,943	85,929					0	-
United	UA	Portland (ME)	PWM	7,241	13,230													0	-
US Airways	US	Baltimore	BWI	191,078	163,901													0	-
US Airways	US	Charlotte	CLT		8,122	98,076	118,445	167,699	178,836	91,141	85,232	86,775	53,676	52,560	7,406			(45,154)	(85.9%)
US Airways	US	Orlando	MCO	5,605	5,440													0	-
US Airways	US	Philadelphia	PHL	222,331	226,973	245,108	212,916	244,129	274,215	95,260	73,396	48,403	56,219	33,132	30,973			(2,159)	(6.5%)
US Airways	US	Pittsburgh	PIT	139,837	142,409	150,124	103,168	77,259										0	-
US Airways	US	Washington National	DCA	82,085	77,187			14,323	77,461	77,575	43,717	40,724						0	-
Subtotal				1,821,657	2,103,146	2,091,581	2,157,645	2,449,873	2,608,335	2,006,253	1,978,722	1,834,518	1,542,979	1,311,677	1,168,481			(143,196)	(10.9%)
Regional/Commuter Carriers																			
Air Canada Express	AC	Montreal Dorval	YUL		7,606													0	-
Air Canada Express	AC	Toronto	YYZ	5,616	23,385	23,305	25,863	18,758	17,439	17,260	17,415	17,295	17,252	13,441	7,652			(5,790)	(43.1%)
American Eagle	AA	New York La Guardia	LGA	60,480	26,735													0	-
Boston-Maine Airways	E9	Bangor	BGR				3,453	80										0	-
Boston-Maine Airways	E9	Martha's Vineyard	MVY				1,885											0	-
Boston-Maine Airways	E9	Nantucket	ACK				3,844											0	-
Boston-Maine Airways	E9	New London/Groton	GON				2,124	399										0	-
Boston-Maine Airways	E9	Portsmouth	PSM				2,667	80										0	-
Boston-Maine Airways	E9	Saint John	YSJ				2,510											0	-
Continental Connection	CO	Albany	ALB	1,515	21,486	21,212	21,470	19,130	5,944									0	-
Continental Connection	CO	New York J F Kennedy	JFK		6,623													0	-
Continental Connection	CO	New York Newark	EWR									4,588	24,906	9,483	6,486			(2,997)	(31.6%)
Continental Connection	CO	Plattsburgh	PLB		746													0	-
Continental Connection	CO	Rochester	ROC	841	2,443													0	-
Continental Connection	CO	Syracuse	SYR	421	1,221													0	-
Continental Connection	CO	Westchester County	HPN		6,224													0	-
Continental Express	CO	Cleveland	CLE	29,614	45,371	66,906	58,053	59,729	58,991	60,240	60,374	60,487	58,893	58,921	46,736			(12,186)	(20.7%)
Continental Express	CO	New York Newark	EWR	64,944	29,821	38,107	55,935	57,169	58,140	59,779	72,054	68,613	53,579	63,336	60,764			(2,571)	(4.1%)
Delta Connection	DL	Atlanta	ATL	24,400			10,700	18,300	26,620	107,251	82,310	48,440	25,550	6,300				(6,300)	(100.0%)
Delta Connection	DL	Bangor	BGR	12,200														0	-
Delta Connection	DL	Cincinnati	CVG	83,657	62,300	44,050	40,657	39,299	38,426	54,667	55,601	39,633						0	-
Delta Connection	DL	Detroit	DTW											32,795	95,802			63,007	192.1%
Delta Connection	DL	New York J F Kennedy	JFK							16,766	41,783							0	-
Delta Connection	DL	New York La Guardia	LGA	36,357	6,200		41,250	53,350	24,300									0	-
Independence Air	DH	Washington Dulles	IAD					71,971	78,379	4,650								0	-
Northwest Airlink	NW	Detroit	DTW					664		4,450	3,011	30,242	25,524					0	-
Northwest Airlink	NW	Minneapolis	MSP				10,700	16,179	11,664	4,450	9,358	20,563	6,992					0	-
United Express	UA	Chicago O'Hare	ORD				4,157	10,650	2,170	23,310	24,922	21,200	25,402	67,675	62,096			(5,579)	(8.2%)
United Express	UA	Washington Dulles	IAD		6,200	73,000	73,000	83,900	90,419	65,881	75,866	61,533	62,534	55,951	33,514			(22,437)	(40.1%)
US Airways Express	US	Boston	BOS									1,384						0	-
US Airways Express	US	Charlotte	CLT						21,863	29,701	33,671	16,039	19,547	13,146	27,181			14,036	106.8%
US Airways Express	US	New York La Guardia	LGA	96,936	77,531	77,425	81,678	90,511	86,492	84,057	83,265	73,334	49,761	49,420	43,737			(5,683)	(11.5%)
US Airways Express	US	Philadelphia	PHL				12,957	19,654	30,239	115,950	107,421	127,396	118,750	140,277	135,156			(5,120)	(3.7%)
US Airways Express	US	Pittsburgh	PIT				10,700	28,935	51,107									0	-
US Airways Express	US	Washington National	DCA			29,377	38,697	48,684	25,379	35,327	55,456	58,271	76,259	81,095	81,683			588	0.7%
Subtotal				416,980	323,892	373,382	502,301	637,439	627,572	683,739	722,508	649,020	564,949	591,840	600,808			8,967	1.5%
Total				2,238,636	2,427,038	2,464,963	2,659,946	3,087,313	3,235,907	2,689,992	2,701,229	2,483,538	2,107,928	1,903,517	1,769,288			(134,229)	(7.1%)

Source: OAG Schedules.
Note: All Northwest operations included in Delta from 2010 onwards

Table F-6 Scheduled Passenger Operations by Market and Carrier for Portland International Jetport, Maine

Departures

Carrier	Code	Market	Code	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	'11-'13 Change	'11-'13 Pct. Change
Jet Carriers																			
AirTran	FL	Atlanta	ATL										153	92	167			75	81.4%
AirTran	FL	Baltimore	BWI								589.714	1,012	948	944	927			(17)	(1.8%)
AirTran	FL	Orlando	MCO								91.5714	156	91	52	52			0	0.8%
Continental	CO	Cleveland	CLE										9					0	-
Continental	CO	New York Newark	EWR		62		66											0	-
Delta	DL	Atlanta	ATL	732	730	730	730	732	486			118	114	424	793			370	87.2%
Delta	DL	Cincinnati	CVG	1,089	853	730	730	732	486	92								0	-
Independence Air	DH	Washington Dulles	IAD						307									0	-
jetBlue	B6	New York J F Kennedy	JFK							856	1504.29	1,571	1,527	1,201	1,323			122	10.1%
jetBlue	B6	Orlando	MCO									296	286	212	181			(31)	(14.6%)
Northwest	NW	Detroit	DTW	523	744	458	368	368	427	612	307							0	-
Trans World Airlines	TW	Hartford	BDL	305														0	-
United	UA	Chicago O'Hare	ORD	728	608													0	-
United	UA	Manchester	MHT	366	243													0	-
US Airways	US	Charlotte	CLT										122	395	352			(43)	(11.0%)
US Airways	US	Philadelphia	PHL	1,312	1,460	1,124	1,399	294	154						217			217	-
US Airways	US	Pittsburgh	PIT	1,081	1,095	1,031	184											0	-
US Airways	US	Washington National	DCA					62	52									0	-
Subtotal				6,135	5,795	4,073	3,477	2,188	1,912	1,560	2,493	3,153	3,251	3,320	4,013			693	20.9%
Regional/Commuter Carriers																			
Air Canada Express	AC	Montreal Dorval	YUL	344	348													0	-
Air Canada Express	AC	Toronto	YYZ											481	783			302	62.7%
America West	HP	New York Newark	EWR	52														0	-
American Eagle	AA	Boston	BOS	3,804	2,273	1,570	334	105										0	-
American Eagle	AA	Chicago O'Hare	ORD		381	726	761	702										0	-
American Eagle	AA	New York La Guardia	LGA	2,033	1,617	960	819	690										0	-
Continental Connection	CO	Albany	ALB		507	1,116	1,199	1,268	291									0	-
Continental Connection	CO	Boston	BOS	204	1,493				241									0	-
Continental Connection	CO	New York Newark	EWR									718	1,412	1,426	1,343			(83)	(5.8%)
Continental Connection	CO	Presque Isle	PQI		30													0	-
Continental Express	CO	Cleveland	CLE	425	569	197	135	135	223	210	236	324	276	188	188			0	0.0%
Continental Express	CO	New York Newark	EWR	1,429	1,355	1,443	1,355	1,425	1,394	1,420	1,438	746	13	4	83			79	1975.0%
Delta Connection	DL	Atlanta	ATL						700	1,369	1,055	784	742	350				(350)	(100.0%)
Delta Connection	DL	Boston	BOS		642	1,672	1,582	1,464	1,153									0	-
Delta Connection	DL	Cincinnati	CVG		61	120		184	600	942	1,013	706						0	-
Delta Connection	DL	Detroit	DTW											1,217	1,314			96	7.9%
Delta Connection	DL	New York J F Kennedy	JFK							436	1,391	1,273	1,286	270				(270)	(100.0%)
Delta Connection	DL	New York La Guardia	LGA	475	766	1,095	1,095	1,098	1,095	1,000	585			786	1,034			249	31.6%
Independence Air	DH	Washington Dulles	IAD					1,197	1,384	93								0	-
Lufthansa German Airlines	LH	Washington Dulles	IAD	31														0	-
Northwest Airlink	NW	Detroit	DTW	484	78	334	772	1,027	915	329	585	845	997					0	-
Northwest Airlink	NW	Minneapolis	MSP			22	141	441	404	91	122	122	30					0	-
Starlink Aviation	Q4	Yarmouth	YQI										393	521	521			0	0.0%
Swissair	SR	Boston	BOS	31														0	-
United Express	UA	Chicago O'Hare	ORD		244	1,095	1,340	1,464	1,095	1,252	1,265	1,255	1,257	1,249	1,176			(72)	(5.8%)
United Express	UA	Washington Dulles	IAD	996	975	1,309	1,117	1,342	1,456	1,408	1,112	1,072	1,099	1,078	1,066			(13)	(1.2%)
US Airways Express	US	Bangor	BGR	231	252	13												0	-
US Airways Express	US	Boston	BOS	2,229	1,748	698	204											0	-
US Airways Express	US	Charlotte	CLT					193	365	431	365	541	384	88	18			(70)	(79.8%)
US Airways Express	US	New York La Guardia	LGA	1,218	1,231	1,404	1,356	1,364	1,665	1,843	1,767	1,940	1,874	1,647	1,526			(121)	(7.3%)
US Airways Express	US	Philadelphia	PHL				61	1,222	1,913	2,148	2,042	2,000	1,891	1,947	1,987			39	2.0%
US Airways Express	US	Pittsburgh	PIT				484	799	219									0	-
US Airways Express	US	Plattsburgh	PLB	48														0	-
US Airways Express	US	Presque Isle	PQI				131	130										0	-
US Airways Express	US	Washington National	DCA	1,089	890	865	1,022	984	1,149	1,173	1,377	1,574	1,113	1,043	1,043			0	0.0%
US Airways Express	US	Westchester County	HPN	65														0	-
Subtotal				15,187	15,460	14,639	13,909	17,235	16,261	14,145	14,355	13,898	12,766	12,296	12,081			(215)	(1.7%)
Total				21,322	21,255	18,712	17,386	19,423	18,174	15,705	16,848	17,051	16,017	15,615	16,094			478	3.1%

Departing Seats

Carrier	Code	Market	Code	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	'11-'13 Change	'11-'13 Pct. Change
Jet Carriers																			
AirTran	FL	Atlanta	ATL										18,189	10,764	19,522			8,758	81.4%
AirTran	FL	Baltimore	BWI								68,997	118,437	111,024	112,951	109,024			(3,928)	(3.5%)
AirTran	FL	Orlando	MCO								10,714	18,367	11,117	6,503	6,355			(148)	(2.3%)
Continental	CO	Cleveland	CLE										1,373					0	-
Continental	CO	New York Newark	EWR		7,068		7,675											0	-
Delta	DL	Atlanta	ATL	103,944	103,660	103,660	103,660	103,944	61,229			16,715	16,208	60,167	114,597			54,429	90.5%
Delta	DL	Cincinnati	CVG	154,658	121,126	103,660	103,660	103,944	69,012	9,200								0	-
Independence Air	DH	Washington Dulles	IAD						40,524									0	-
jetBlue	B6	New York J F Kennedy	JFK							119,872	178,914	179,850	178,129	128,936	135,379			6,443	5.0%
jetBlue	B6	Orlando	MCO									29,614	28,629	21,214	21,344			130	0.6%
Northwest	NW	Detroit	DTW	52,105	70,929	45,800	36,800	36,800	42,700	61,157	30,700							0	-
Trans World Airlines	TW	Hartford	BDL	43,310														0	-
United	UA	Chicago O'Hare	ORD	88,996	77,723													0	-
United	UA	Manchester	MHT	53,802	35,721													0	-
US Airways	US	Charlotte	CLT										10,736	48,688	47,130			(1,558)	(3.2%)
US Airways	US	Philadelphia	PHL	163,051	181,329	149,318	179,229	37,687	19,404						21,525			21,525	-
US Airways	US	Pittsburgh	PIT	137,472	141,080	133,590	23,552											0	-
US Airways	US	Washington National	DCA					7,936	6,668									0	-
Subtotal				797,338	738,636	536,028	454,576	290,311	239,537	190,229	289,325	362,984	375,404	389,224	474,876			85,651	22.0%
Regional/Commuter Carriers																			
Air Canada Express	AC	Montreal Dorval	YUL	4,734	6,269													0	-
Air Canada Express	AC	Toronto	YYZ											9,142	14,872			5,730	62.7%
America West	HP	New York Newark	EWR	2,457														0	-
American Eagle	AA	Boston	BOS	125,518	75,204	55,457	12,580	3,932										0	-
American Eagle	AA	Chicago O'Hare	ORD		17,289	33,557	33,792	40,456										0	-
American Eagle	AA	New York La Guardia	LGA	67,084	65,442	35,525	30,746	25,672										0	-
Continental Connection	CO	Albany	ALB		9,636	21,212	22,786	24,097	5,537									0	-
Continental Connection	CO	Boston	BOS	3,871	28,372				4,576									0	-
Continental Connection	CO	New York Newark	EWR									53,164	104,509	105,503	99,361			(6,142)	(5.8%)
Continental Connection	CO	Presque Isle	PQI		570													0	-
Continental Express	CO	Cleveland	CLE	20,378	25,606	9,176	6,700	6,757	11,021	10,493	11,197	16,193	13,786	9,400	9,400			0	0.0%
Continental Express	CO	New York Newark	EWR	70,393	63,715	70,587	67,610	70,061	69,605	71,007	71,921	36,831	657	200	4,150			3,950	1975.0%
Delta Connection	DL	Atlanta	ATL						48,440	95,820	73,880	54,724	51,970	25,532				(25,532)	(100.0%)
Delta Connection	DL	Boston	BOS		20,544	56,798	70,334	69,924	57,650									0	-
Delta Connection	DL	Cincinnati	CVG		3,050	6,000		9,200	31,166	47,966	47,813	35,463						0	-
Delta Connection	DL	Detroit	DTW											62,320	65,686			3,366	5.4%
Delta Connection	DL	New York J F Kennedy	JFK							16,143	64,967	65,560	64,286	13,500				(13,500)	(100.0%)
Delta Connection	DL	New York La Guardia	LGA	15,191	24,512	38,334	54,750	54,900	54,750	50,014	29,243			41,440	57,437			15,996	38.6%
Independence Air	DH	Washington Dulles	IAD					59,864	69,186	4,650								0	-
Lufthansa German Airlines	LH	Washington Dulles	IAD	1,550														0	-
Northwest Airlink	NW	Detroit	DTW	33,366	5,392	19,550	43,832	57,748	53,132	17,039	30,613	61,181	61,251					0	-
Northwest Airlink	NW	Minneapolis	MSP			1,093	7,064	22,057	20,186	4,550	6,100	6,100	1,500					0	-
Starlink Aviation	Q4	Yarmouth	YQI										7,071	9,386	9,386			0	0.0%
Swissair	SR	Boston	BOS	1,023														0	-
United Express	UA	Chicago O'Hare	ORD		12,200	54,750	67,000	73,200	67,590	87,660	85,347	82,719	82,662	82,273	72,457			(9,816)	(11.9%)
United Express	UA	Washington Dulles	IAD	49,779	48,750	65,450	55,850	67,100	83,730	92,899	70,940	68,020	67,831	64,767	62,493			(2,274)	(3.5%)
US Airways Express	US	Bangor	BGR	8,558	9,238	424												0	-
US Airways Express	US	Boston	BOS	42,359	40,311	14,362	4,615											0	-
US Airways Express	US	Charlotte	CLT					9,643	23,710	30,942	31,390	46,129	32,987	5,323	1,364			(3,959)	(74.4%)
US Airways Express	US	New York La Guardia	LGA	43,901	44,651	42,640	44,009	45,007	77,909	89,773	84,304	94,419	93,079	78,477	68,755			(9,722)	(12.4%)
US Airways Express	US	Philadelphia	PHL				3,050	68,684	100,307	113,072	121,427	124,630	134,837	133,521	129,133			(4,389)	(3.3%)
US Airways Express	US	Pittsburgh	PIT				24,200	43,103	10,971									0	-
US Airways Express	US	Plattsburgh	PLB	909														0	-
US Airways Express	US	Presque Isle	PQI				2,497	2,470										0	-
US Airways Express	US	Washington National	DCA	33,976	35,453	25,954	44,564	49,207	75,568	77,587	85,732	95,623	78,421	83,302	87,190			3,888	4.7%
US Airways Express	US	Westchester County	HPN	1,235														0	-
Subtotal				526,282	536,204	550,870	595,979	803,084	865,033	809,613	814,876	840,756	794,848	724,086	681,682			(42,404)	(5.9%)
Total				1,323,619	1,274,840	1,086,898	1,050,555	1,093,395	1,104,570	999,842	1,104,200	1,203,740	1,170,251	1,113,310	1,156,558			43,248	3.9%

Source: OAG Schedules.
Note: All Northwest operations included in Delta from 2010 onwards

Table F-7 Scheduled Passenger Operations by Market and Carrier for Burlington International Airport, Vermont

Departures

Carrier	Code	Market	Code	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	'11-'13 Change	'11-'13 Pct. Change
Jet Carriers																			
AirTran	FL	Baltimore	BWI									512	609					0	-
Continental	CO	New York Newark	EWR					4										0	-
jetBlue	B6	New York J F Kennedy	JFK	244	730	730	782	1,094	1,126	1,460	1,495	1,477	1,500	1,434	1,405			(29)	(2.0%)
jetBlue	B6	Orlando	MCO									361	317	330	339			9	2.6%
Northwest	NW	Detroit	DTW					214	174									0	-
United	UA	Chicago O'Hare	ORD	815	862	730	454	401	365	426	652	632	90					0	-
United	UA	Portland (ME)	PWM		61													0	-
US Airways	US	Philadelphia	PHL	1,098	1,095	1,126	338	366	365	365	181							0	-
US Airways	US	Pittsburgh	PIT	732	730	699												0	-
US Airways	US	Washington National	DCA						4									0	-
Subtotal				2,889	3,478	3,285	1,574	2,079	2,035	2,251	2,328	2,982	2,516	1,764	1,744			(20)	(1.2%)
Regional/Commuter Carriers																			
America West	HP	New York Newark	EWR	166														0	-
American Eagle	AA	Boston	BOS	3,094	1,855													0	-
American Eagle	AA	Chicago O'Hare	ORD			490	180											0	-
Continental Connection	CO	Albany	ALB		287	970	652	541										0	-
Continental Connection	CO	Boston	BOS	244	1,714	44			634	982	208							0	-
Continental Connection	CO	Buffalo	BUF	4	26													0	-
Continental Connection	CO	Hartford	BDL		129													0	-
Continental Connection	CO	New York Newark	EWR									573	973	405	975			570	140.5%
Continental Connection	CO	Plattsburgh	PLB	213	2,127	617	521	423	367	582	177							0	-
Continental Connection	CO	Plattsburgh International	PBG								31							0	-
Continental Connection	CO	Poughkeepsie	POU	66	521													0	-
Continental Connection	CO	Westchester County	HPN		26			17										0	-
Continental Express	CO	Cleveland	CLE	322	352	330	422	493	509	540	614	615	370	366	348			(17)	(4.7%)
Continental Express	CO	New York Newark	EWR	1,458	1,643	1,369	1,360	1,407	1,455	1,447	1,451	882	457	1,020	450			(570)	(55.9%)
Continental Express	CO	Westchester County	HPN				9											0	-
Delta Connection	DL	Atlanta	ATL						62	699	616	506	304					0	-
Delta Connection	DL	Boston	BOS		1,548	1,460	1,582	1,098	1,002		244	120						0	-
Delta Connection	DL	Cincinnati	CVG		552	1,095	1,095	1,098	1,060	651	365	152						0	-
Delta Connection	DL	Detroit	DTW											1,227	1,309			82	6.7%
Delta Connection	DL	New York J F Kennedy	JFK							582	1,364	1,251	1,182	1,336	1,338			2	0.2%
Delta Connection	DL	New York La Guardia	LGA	355	124													0	-
Independence Air	DH	Washington Dulles	IAD					977	1,903	93								0	-
Lufthansa German Airlines	LH	Washington Dulles	IAD	31														0	-
Northwest Airlink	NW	Detroit	DTW		722	1,087	1,353	1,173	1,159	1,086	866	824	883					0	-
Northwest Airlink	NW	Minneapolis	MSP					13	61	62	92	92						0	-
Porter Airlines	PD	Toronto Island Apt	YTZ												9			9	-
Swissair	SR	Boston	BOS	31														0	-
United Express	UA	Chicago O'Hare	ORD				698	966	1,003	964	730	618	1,097	1,353	1,565			212	15.7%
United Express	UA	Washington Dulles	IAD	1,477	1,460	1,460	1,399	1,464	1,456	1,456	1,403	1,312	1,196	1,130	1,112			(17)	(1.5%)
US Airways Express	US	Boston	BOS	2,404	1,616	637												0	-
US Airways Express	US	Charlotte	CLT							4		13						0	-
US Airways Express	US	New York La Guardia	LGA	2,074	1,673	1,687	1,812	2,200	2,175	2,382	2,275	2,184	2,154	1,680	1,487			(193)	(11.5%)
US Airways Express	US	Philadelphia	PHL				1,314	1,224	1,980	1,686	1,749	2,087	1,894	1,903	1,956			53	2.8%
US Airways Express	US	Pittsburgh	PIT		205	304	668	675										0	-
US Airways Express	US	Plattsburgh	PLB	2,427														0	-
US Airways Express	US	Poughkeepsie	POU	718														0	-
US Airways Express	US	Saranac Lake	SLK	44														0	-
US Airways Express	US	Washington National	DCA	988	812	865	1,047	1,024	990	999	1,095	1,224	1,078	1,043	1,043			0	0.0%
US Airways Express	US	Wilkes-Barre Scranton	AVP	22														0	-
Subtotal				16,138	17,390	12,414	14,113	14,794	15,816	14,215	13,280	12,453	11,587	11,461	11,593			132	1.1%
Total				19,028	20,868	15,699	15,686	16,873	17,851	16,466	15,607	15,435	14,103	13,225	13,336			111	0.8%

Departing Seats

Carrier	Code	Market	Code	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	'11-'13 Change	'11-'13 Pct. Change
Jet Carriers																			
AirTran	FL	Baltimore	BWI									59,887	71,253					0	-
Continental	CO	New York Newark	EWR					531										0	-
jetBlue	B6	New York J F Kennedy	JFK	39,528	118,260	118,260	126,730	170,597	173,920	221,784	224,759	217,650	219,750	180,286	163,839			(16,447)	(9.1%)
jetBlue	B6	Orlando	MCO									41,121	37,700	33,014	33,871			857	2.6%
Northwest	NW	Detroit	DTW					21,400	17,429									0	-
United	UA	Chicago O'Hare	ORD	105,509	113,504	96,537	59,145	51,286	42,379	54,754	79,331	77,707	11,031					0	-
United	UA	Portland (ME)	PWM		7,808													0	-
US Airways	US	Philadelphia	PHL	150,338	145,596	144,205	43,264	46,848	46,170	44,089	21,720							0	-
US Airways	US	Pittsburgh	PIT	103,568	102,444	91,825												0	-
US Airways	US	Washington National	DCA						558									0	-
Subtotal				398,943	487,612	450,827	229,139	290,663	280,456	320,627	325,810	396,366	339,734	213,300	197,710			(15,590)	(7.3%)
Regional/Commuter Carriers																			
America West	HP	New York Newark	EWR	7,889														0	-
American Eagle	AA	Boston	BOS	102,111	61,215													0	-
American Eagle	AA	Chicago O'Hare	ORD			21,901	7,920											0	-
Continental Connection	CO	Albany	ALB		5,456	18,425	12,396	10,284										0	-
Continental Connection	CO	Boston	BOS	4,628	32,571	828			12,054	18,658	3,947							0	-
Continental Connection	CO	Buffalo	BUF	84	491													0	-
Continental Connection	CO	Hartford	BDL		2,443													0	-
Continental Connection	CO	New York Newark	EWR									42,423	71,981	30,002	72,161			42,159	140.5%
Continental Connection	CO	Plattsburgh	PLB	4,039	40,405	11,726	9,904	8,037	6,970	11,061	3,358							0	-
Continental Connection	CO	Plattsburgh International	PBG								589							0	-
Continental Connection	CO	Poughkeepsie	POU	1,262	9,894													0	-
Continental Connection	CO	Westchester County	HPN		494			331										0	-
Continental Express	CO	Cleveland	CLE	16,064	17,086	16,288	20,990	24,145	25,351	26,993	28,485	29,662	18,493	18,286	17,421			(864)	(4.7%)
Continental Express	CO	New York Newark	EWR	70,203	78,296	67,410	67,189	70,028	72,707	72,343	71,370	43,593	22,857	51,000	22,514			(28,486)	(55.9%)
Continental Express	CO	Westchester County	HPN				322											0	-
Delta Connection	DL	Atlanta	ATL						3,100	34,971	33,597	35,430	21,280					0	-
Delta Connection	DL	Boston	BOS		49,536	46,720	50,624	45,072	50,100		4,636	2,280						0	-
Delta Connection	DL	Cincinnati	CVG		17,664	48,270	54,750	54,900	52,979	31,567	18,250	7,600						0	-
Delta Connection	DL	Detroit	DTW											61,417	65,443			4,026	6.6%
Delta Connection	DL	New York J F Kennedy	JFK							24,144	62,901	62,536	59,741	67,071	81,259			14,189	21.2%
Delta Connection	DL	New York La Guardia	LGA	11,351	3,968													0	-
Independence Air	DH	Washington Dulles	IAD					48,829	95,136	4,650								0	-
Lufthansa German Airlines	LH	Washington Dulles	IAD	1,550														0	-
Northwest Airlink	NW	Detroit	DTW		36,093	54,329	72,303	62,125	61,983	63,533	43,279	41,200	44,150					0	-
Northwest Airlink	NW	Minneapolis	MSP					657	3,050	3,100	4,600	4,600						0	-
Porter Airlines	PD	Toronto Island Apt	YTZ												620			620	-
Swissair	SR	Boston	BOS	1,023														0	-
United Express	UA	Chicago O'Hare	ORD				34,900	48,314	59,930	67,500	49,266	40,519	70,569	84,431	88,435			4,004	4.7%
United Express	UA	Washington Dulles	IAD	73,843	71,110	73,000	69,950	73,200	72,786	72,779	71,925	67,065	63,217	61,988	69,793			7,805	12.6%
US Airways Express	US	Boston	BOS	48,139	59,797	23,580												0	-
US Airways Express	US	Charlotte	CLT							221		657						0	-
US Airways Express	US	New York La Guardia	LGA	76,749	61,896	62,403	67,060	81,400	80,491	88,123	84,175	80,792	79,703	62,144	55,008			(7,136)	(11.5%)
US Airways Express	US	Philadelphia	PHL				65,107	60,830	97,288	88,078	95,885	122,571	117,257	128,140	131,727			3,587	2.8%
US Airways Express	US	Pittsburgh	PIT		6,163	9,120	33,400	33,771										0	-
US Airways Express	US	Plattsburgh	PLB	46,116														0	-
US Airways Express	US	Poughkeepsie	POU	13,639														0	-
US Airways Express	US	Saranac Lake	SLK	841														0	-
US Airways Express	US	Washington National	DCA	31,574	33,714	25,954	44,681	51,200	61,458	58,184	70,278	80,423	65,756	77,625	82,974			5,349	6.9%
US Airways Express	US	Wilkes-Barre Scranton	AVP	415														0	-
Subtotal				511,521	588,291	479,952	611,497	673,123	755,382	665,906	646,539	661,351	635,004	642,104	687,357			45,253	7.0%
Total				910,464	1,075,903	930,779	840,636	963,785	1,035,838	986,532	972,349	1,057,717	974,739	855,404	885,067			29,663	3.5%

Source: OAG Schedules.
Note: All Northwest operations included in Delta from 2010 onwards

Table F-8 Scheduled Passenger Operations by Market and Carrier for Bangor International Airport, Maine

Departures

Carrier	Code	Market	Code	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	'11-'13 Change	'11-'13 Pct. Change
Jet Carriers																			
Allegiant Air	G4	Sanford	SFB								17	109	160	181	150			(31)	(17.1%)
Allegiant Air	G4	St. Petersburg/Clearwater	PIE										12	107	93			(14)	(13.1%)
Pan American Airways	PN	Allentown/Bethlehem	ABE		298													0	-
Pan American Airways	PN	Baltimore	BWI		31	303												0	-
Pan American Airways	PN	Pittsburgh	PIT	285	140													0	-
Pan American Airways	PN	Portsmouth	PSM	389	247	303	178											0	-
Pan American Airways	PN	Sanford	SFB				17											0	-
Subtotal				674	716	607	195	0	0	0	17	109	172	288	243			(45)	(15.6%)
Regional/Commuter Carriers																			
American Eagle	AA	Boston	BOS	4,670	3,461	2,731	2,242	1,722	1,530	1,491	1,046							0	-
American Eagle	AA	New York La Guardia	LGA	382	396	457	427	428	518	409	339							0	-
Boston-Maine Airways	E9	Halifax	YHZ				340	4										0	-
Boston-Maine Airways	E9	Manchester	MHT				258	22										0	-
Boston-Maine Airways	E9	Portsmouth	PSM				295											0	-
Boston-Maine Airways	E9	Saint John	YSJ				90											0	-
Continental Connection	CO	Albany	ALB			401	652	575	189									0	-
Continental Express	CO	New York Newark	EWR						481	563	440	549	407					0	-
Delta Connection	DL	Atlanta	ATL							214	509	274						0	-
Delta Connection	DL	Boston	BOS		704	1,884	1,464	1,473	1,416	1,038	1,401	1,092	555					0	-
Delta Connection	DL	Cincinnati	CVG	1,342	1,095	1,095	1,161	1,464	1,394	678	695	125						0	-
Delta Connection	DL	Detroit	DTW											975	871			(104)	(10.7%)
Delta Connection	DL	New York J F Kennedy	JFK									341	942	180				(180)	(100.0%)
Delta Connection	DL	New York La Guardia	LGA											537	844			307	57.2%
Northwest Airlink	NW	Boston	BOS	27														0	-
Northwest Airlink	NW	Detroit	DTW				525	968	1,012	822	822	820	730					0	-
Northwest Airlink	NW	Minneapolis	MSP					13	61	13	13	13	13					0	-
Pan American Airways	PN	Portsmouth	PSM			79	27											0	-
Pan American Airways	PN	Saint John	YSJ			79	27											0	-
US Airways Express	US	Boston	BOS	1,942	1,371	270												0	-
US Airways Express	US	New York La Guardia	LGA	35	13	92	171	92	158	135	126	272	713	1,017	1,230			213	20.9%
US Airways Express	US	Philadelphia	PHL	428	608	511	1,032	1,072	1,179	1,125	1,077	1,085	1,126	1,156	1,405			249	21.5%
US Airways Express	US	Pittsburgh	PIT				153											0	-
US Airways Express	US	Portland (ME)	PWM	231	356	147												0	-
US Airways Express	US	Presque Isle	PQI	299														0	-
US Airways Express	US	Washington National	DCA				13					13	22	31	52			22	70.6%
Subtotal				9,357	8,005	7,745	8,875	7,833	7,937	6,488	6,470	4,583	4,508	3,896	4,402			506	13.0%
Total				10,031	8,720	8,352	9,071	7,833	7,937	6,488	6,487	4,692	4,680	4,184	4,645			461	11.0%

Departing Seats

Carrier	Code	Market	Code	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	'11-'13 Change	'11-'13 Pct. Change
Jet Carriers																			
Allegiant Air	G4	Sanford	SFB								2,614	16,350	24,000	27,150	22,500			(4,650)	(17.1%)
Allegiant Air	G4	St. Petersburg/Clearwater	PIE										1,800	16,050	13,950			(2,100)	(13.1%)
Pan American Airways	PN	Allentown/Bethlehem	ABE		44,636													0	-
Pan American Airways	PN	Baltimore	BWI		4,650	45,514												0	-
Pan American Airways	PN	Pittsburgh	PIT	42,729	21,021													0	-
Pan American Airways	PN	Portsmouth	PSM	58,414	37,029	45,514	26,764											0	-
Pan American Airways	PN	Sanford	SFB				2,550											0	-
Subtotal				101,143	107,336	91,029	29,314	0	0	0	2,614	16,350	25,800	43,200	36,450			(6,750)	(15.6%)
Regional/Commuter Carriers																			
American Eagle	AA	Boston	BOS	154,115	114,559	98,201	86,533	64,063	56,594	56,193	38,697							0	-
American Eagle	AA	New York La Guardia	LGA	12,606	15,754	16,909	15,799	15,836	19,166	15,122	12,538							0	-
Boston-Maine Airways	E9	Halifax	YHZ				6,120	80										0	-
Boston-Maine Airways	E9	Manchester	MHT				4,636	399										0	-
Boston-Maine Airways	E9	Portsmouth	PSM				5,318											0	-
Boston-Maine Airways	E9	Saint John	YSJ				1,628											0	-
Continental Connection	CO	Albany	ALB			7,616	12,383	10,928	3,583									0	-
Continental Express	CO	New York Newark	EWR						22,698	23,928	17,541	25,607	20,343					0	-
Delta Connection	DL	Atlanta	ATL							14,980	35,650	19,160						0	-
Delta Connection	DL	Boston	BOS		22,528	60,288	47,391	60,375	70,800	51,339	34,332	44,102	27,764					0	-
Delta Connection	DL	Cincinnati	CVG	67,100	54,750	55,970	72,189	87,840	82,439	35,299	34,764	6,271						0	-
Delta Connection	DL	Detroit	DTW											50,540	54,640			4,100	8.1%
Delta Connection	DL	New York J F Kennedy	JFK									17,029	47,100	9,000				(9,000)	(100.0%)
Delta Connection	DL	New York La Guardia	LGA											26,958	49,368			22,410	83.1%
Northwest Airlink	NW	Boston	BOS	797														0	-
Northwest Airlink	NW	Detroit	DTW				26,264	54,207	55,222	42,848	41,100	40,979	36,500					0	-
Northwest Airlink	NW	Minneapolis	MSP					657	3,050	657	657	657	887					0	-
Pan American Airways	PN	Portsmouth	PSM			1,419	478											0	-
Pan American Airways	PN	Saint John	YSJ			1,419	478											0	-
US Airways Express	US	Boston	BOS	36,906	42,548	5,130												0	-
US Airways Express	US	New York La Guardia	LGA	1,295	486	3,036	8,529	4,600	7,914	6,757	6,321	13,579	27,763	44,051	53,371			9,321	21.2%
US Airways Express	US	Philadelphia	PHL	15,836	19,283	20,455	32,804	53,593	58,943	56,271	60,830	59,611	58,735	68,510	89,548			21,039	30.7%
US Airways Express	US	Pittsburgh	PIT				7,650											0	-
US Airways Express	US	Portland (ME)	PWM	8,558	12,689	4,842												0	-
US Airways Express	US	Presque Isle	PQI	6,224														0	-
US Airways Express	US	Washington National	DCA				657					657	1,093	1,529	2,607			1,079	70.6%
Subtotal				303,436	282,597	275,286	328,857	352,577	380,408	303,395	282,430	227,651	220,186	200,587	249,535			48,948	24.4%
Total				404,579	389,933	366,315	358,171	352,577	380,408	303,395	285,044	244,001	245,986	243,787	285,985			42,198	17.3%

Source: OAG Schedules; U.S. DOT, T100 Database.

Notes: Finnair scheduled technical stop (to Fort Lauderdale) in 2000 and Flyglobespan scheduled technical stops (on route to Sanford) in 2007 and 2008 not included

Allegiant stopped reporting to the OAG in 2009, so Allegiant 2009-2011 statistics from the T100 database.

All Northwest operations included in Delta from 2010 onwards

Table F-9 Scheduled Passenger Operations by Market and Carrier for Tweed-New Haven Airport, Connecticut

Departures

Carrier	Code	Market	Code	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	'11-'13 Change	'11-'13 Pct. Change
Regional/ Commuter Carriers																			
Delta Connection	DL	Cincinnati	CVG					642	1,025									0	-
Boston-Maine Airways	E9	Baltimore	BWI								279							0	-
Boston-Maine Airways	E9	Bedford	BED								113							0	-
Boston-Maine Airways	E9	Elmira/Corning	ELM								152							0	-
Boston-Maine Airways	E9	Portsmouth	PSM								57							0	-
US Airways Express	US	Philadelphia	PHL	1,773	1,773	1,486	1,452	1,372	1,904	2,051	1,703	1,634	1,586	1,608	1,535			(73)	(4.5%)
US Airways Express	US	Washington National	DCA	937	600													0	-
Total				2,710	2,373	1,486	1,452	2,014	2,929	2,051	2,304	1,634	1,586	1,608	1,535			(73)	(4.5%)

Departing Seats

Carrier	Code	Market	Code	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	'11-'13 Change	'11-'13 Pct. Change
Regional/ Commuter Carriers																			
Delta Connection	DL	Cincinnati	CVG					32,100	51,236									0	-
Boston-Maine Airways	E9	Baltimore	BWI								5,025							0	-
Boston-Maine Airways	E9	Bedford	BED								2,029							0	-
Boston-Maine Airways	E9	Elmira/Corning	ELM								2,739							0	-
Boston-Maine Airways	E9	Portsmouth	PSM								1,021							0	-
US Airways Express	US	Philadelphia	PHL	65,612	65,596	54,977	53,724	50,780	76,208	77,742	63,183	60,726	59,017	59,491	56,806			(2,685)	(4.5%)
US Airways Express	US	Washington National	DCA	34,658	22,200													0	-
Total				100,270	87,796	54,977	53,724	82,880	127,444	77,742	73,996	60,726	59,017	59,491	56,806			(2,685)	(4.5%)

Source: OAG Schedules.

Table F-10 Scheduled Passenger Operations by Market and Carrier for Worcester Regional Airport, Massachusetts

Departures

Carrier	Code	Market	Code	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	'11-'13 Change	'11-'13 Pct. Change
Jet Carriers																			
Allegiant Air	G4	Sanford	SFB							182								-	-
Boston-Maine Airways	PN	Allentown/Bethlehem	ABE			111												-	-
Boston-Maine Airways	PN	Portsmouth	PSM		223	111												-	-
Boston-Maine Airways	PN	Sanford	SFB		284													-	-
Direct Air	D1/VX/	Myrtle Beach	MYR										63	73	96			23	31.5%
Direct Air	D1/VX/	Orlando/Sanford	SFB									17	140	144	148			4	2.8%
Direct Air	D1/VX/	Punta Gorda	PGD									17	67	94	105			11	11.7%
Direct Air	D1/VX/	West Palm Beach	PBI											13	51			38	292.3%
Subtotal				0	507	223	0	0	0	182	0	34	270	324	400			76	23.5%
Regional/Commuter Carriers																			
American Eagle	AA	Chicago O'Hare	ORD		368	333												0	-
American Eagle	AA	New York J F Kennedy	JFK	552	666													0	-
Delta Connection	DL	Atlanta	ATL	670	865	304												0	-
US Airways Express	US	Philadelphia	PHL	1,464	1,382	1,043	257											0	-
Subtotal				2,686	3,281	1,680	257	0	0	0	0	0	0	0	0			0	-
Total				2,686	3,788	1,902	257	0	0	182	0	34	270	324	400			76	23.5%

Departing Seats

Carrier	Code	Market	Code	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	'11-'13 Change	'11-'13 Pct. Change
Jet Carriers																			
Allegiant Air	G4	Sanford	SFB							27,343								-	-
Boston-Maine Airways	PN	Allentown/Bethlehem	ABE			16,693												-	-
Boston-Maine Airways	PN	Portsmouth	PSM		33,471	16,693												-	-
Boston-Maine Airways	PN	Sanford	SFB		42,621													-	-
Direct Air	D1/VX/	Myrtle Beach	MYR										8,743	9,782	14,120			4,338	44.3%
Direct Air	D1/VX/	Orlando/Sanford	SFB									2,533	19,809	21,937	24,339			2,402	10.9%
Direct Air	D1/VX/	Punta Gorda	PGD									2,533	9,569	14,541	17,287			2,746	18.9%
Direct Air	D1/VX/	West Palm Beach	PBI											1,872	7,444			5,572	297.6%
Subtotal				0	76,093	33,386	0	0	0	27,343	0	5,066	38,121	48,132	63,190			15,058	31.3%
Regional/Commuter Carriers																			
American Eagle	AA	Chicago O'Hare	ORD		15,889	15,424												0	-
American Eagle	AA	New York J F Kennedy	JFK	18,216	21,978													0	-
Delta Connection	DL	Atlanta	ATL	33,500	43,271	15,200												0	-
US Airways Express	US	Philadelphia	PHL	54,168	51,118	38,369	9,514											0	-
Subtotal				105,884	132,257	68,993	9,514	0	0	0	0	0	0	0	0			0	-
Total				105,884	208,349	102,379	9,514	0	0	27,343	0	5,066	38,121	48,132	63,190			15,058	31.3%

Sources: OAG Schedules; U.S. DOT, T100 Database.

Note: As Direct Air schedule not published in the OAG, all Direct Air statistics from the T100 database. Direct Air flights operated by Xtra Airways, Vision Airlines, Sky King, Casino Express, USA Jet, Miami Air and Falcon Air Express.

Table F-11 Scheduled Passenger Operations by Market and Carrier for Hanscom Field, Massachusetts

Departures

Carrier	Code	Market	Code	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	'11-'13 Change	'11-'13 Pct. Change
Regional/Commuter Carriers																			
Boston-Maine Airways	E9	Elmira/Corning								131	389							0	-
Boston-Maine Airways	E9	Hyannis	HYA				9											0	-
Boston-Maine Airways	E9	Manchester	MHT				157											0	-
Boston-Maine Airways	E9	Martha's Vineyard	MVY				4											0	-
Boston-Maine Airways	E9	Nantucket	ACK				148											0	-
Boston-Maine Airways	E9	New Haven	HVN								113							0	-
Boston-Maine Airways	E9	New London/Groton	GON					61	9									0	-
Boston-Maine Airways	E9	Portsmouth	PSM				157	336	193	254	221	26						0	-
Boston-Maine Airways	E9	Trenton	TTN					987	867	992	1,047	26						0	-
Pan American Airways	PN	Atlantic City Pomona Field	ACY			9												0	-
Pan American Airways	PN	Martha's Vineyard	MVY			13	4											0	-
Pan American Airways	PN	New York Newark	EWR			92												0	-
Pan American Airways	PN	Portsmouth	PSM			337	97											0	-
Pan American Airways	PN	Westchester County	HPN			224	106											0	-
Shuttle America	S5	Buffalo	BUF	1,119	980													0	-
Shuttle America	S5	Hartford	BDL	173														0	-
Shuttle America	S5	New York La Guardia	LGA	523	854													0	-
Shuttle America	S5	Trenton	TTN	2,062	1,829		196	43										0	-
Streamline	xx	Trenton	TTN												155			155	-
US Airways	US	Martha's Vineyard	MVY			53												0	-
US Airways	US	Nantucket	ACK			35												0	-
US Airways	US	New York La Guardia	LGA			716												0	-
US Airways	US	Philadelphia	PHL		279	1,439												0	-
US Airways	US	Trenton	TTN		340	2,094	1,621	734										0	-
US Airways	US	Westchester County	HPN			337												0	-
Total				3,876	4,282	5,348	2,500	2,161	1,069	1,377	1,769	51	0	0	155			155	-

Departing Seats

Carrier	Code	Market	Code	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	'11-'13 Change	'11-'13 Pct. Change
Regional/Commuter Carriers																			
Boston-Maine Airways	E9	Elmira/Corning								2,366	6,994							-	-
Boston-Maine Airways	E9	Hyannis	HYA				159											-	-
Boston-Maine Airways	E9	Manchester	MHT				2,823											-	-
Boston-Maine Airways	E9	Martha's Vineyard	MVY				72											-	-
Boston-Maine Airways	E9	Nantucket	ACK				2,669											-	-
Boston-Maine Airways	E9	New Haven	HVN								2,029							-	-
Boston-Maine Airways	E9	New London/Groton	GON					1,101	159									-	-
Boston-Maine Airways	E9	Portsmouth	PSM				2,818	6,051	3,482	4,569	3,975	463						-	-
Boston-Maine Airways	E9	Trenton	TTN					17,763	15,606	17,859	18,841	463						-	-
Pan American Airways	PN	Atlantic City Pomona Field	ACY			154												-	-
Pan American Airways	PN	Martha's Vineyard	MVY			234	80											-	-
Pan American Airways	PN	New York Newark	EWR			1,656												-	-
Pan American Airways	PN	Portsmouth	PSM			6,061	1,754											-	-
Pan American Airways	PN	Westchester County	HPN			4,027	1,913											-	-
Shuttle America	S5	Buffalo	BUF	55,950	47,625													-	-
Shuttle America	S5	Hartford	BDL	8,636														-	-
Shuttle America	S5	New York La Guardia	LGA	26,143	42,707													-	-
Shuttle America	S5	Trenton	TTN	103,093	88,737		6,482	1,414										-	-
Streamline	xx	Trenton	TTN												4,650			4,650	-
US Airways	US	Martha's Vineyard	MVY			1,740												-	-
US Airways	US	Nantucket	ACK			1,160												-	-
US Airways	US	New York La Guardia	LGA			23,707												-	-
US Airways	US	Philadelphia	PHL		10,318	48,023												-	-
US Airways	US	Trenton	TTN		12,575	69,691	53,488	24,213										-	-
US Airways	US	Westchester County	HPN			11,135												-	-
Total				193,821	201,962	167,588	72,259	50,541	19,247	24,794	31,839	926	0	0	4,650			4,650	-

Source: OAG Schedules.

Table F-12 Scheduled Passenger Operations by Market and Carrier for Portsmouth International Airport, New Hampshire

Departures

Carrier	Code	Market	Code	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	'11-'13 Change	'11-'13 Pct. Change
Jet Carriers																			
Allegiant Airways	G4	Orlando/Sanford	SFB						35	191	43							-	-
Boston-Maine Airways	E9	Fort Lauderdale/Hollywood	FLL					9	13									-	-
Boston-Maine Airways	E9	Hartford	BDL						13									-	-
Boston-Maine Airways	E9	Newburgh	SWF						48									-	-
Boston-Maine Airways	E9	Sanford	SFB					57	57									-	-
Pan American Airways	PN	Allentown/Bethlehem	ABE	93	215													-	-
Pan American Airways	PN	Bangor	BGR	389	247	303	174											-	-
Pan American Airways	PN	Gary	GYY	51														-	-
Pan American Airways	PN	Manchester	MHT				17	170										-	-
Pan American Airways	PN	New York Newark	EWR			31												-	-
Pan American Airways	PN	Pittsburgh	PIT	261														-	-
Pan American Airways	PN	Sanford	SFB	296	299	286	271	261										-	-
Pan American Airways	PN	Santo Domingo	SDQ			13												-	-
Pan American Airways	PN	St. Petersburg/Clearwater	PIE			65												-	-
Pan American Airways	PN	Worcester	ORH		254	111												-	-
Skybus	SX	Columbus	CMH								409	108						-	-
Skybus	SX	Greensboro	GSO									83						-	-
Skybus	SX	Punta Gorda	PGD								15	59						-	-
Skybus	SX	Saint Augustine	UST								14	56						-	-
Subtotal				1,091	1,015	810	463	497	167	191	481	306	0	0	0			0	-
Regional/Commuter Carriers																			
Boston-Maine Airways	E9	Baltimore	BWI				77											-	-
Boston-Maine Airways	E9	Bangor	BGR				235											-	-
Boston-Maine Airways	E9	Bedford	BED				272	420	171	223	221	9						-	-
Boston-Maine Airways	E9	Hyannis	HYA				96											-	-
Boston-Maine Airways	E9	Manchester	MHT				214	4										-	-
Boston-Maine Airways	E9	Martha's Vineyard	MVY				39	22										-	-
Boston-Maine Airways	E9	Nantucket	ACK				75	82										-	-
Boston-Maine Airways	E9	New Haven	HVN								57							-	-
Boston-Maine Airways	E9	New London/Groton	GON				166	217										-	-
Boston-Maine Airways	E9	Saint John	YSJ				466	173										-	-
Boston-Maine Airways	E9	Trenton	TTN						22									-	-
Boston-Maine Airways	E9	Westchester County	HPN				292	43										-	-
Pan American Airways	PN	Atlantic City Pomona Field	ACY			153												-	-
Pan American Airways	PN	Baltimore	BWI			44	22											-	-
Pan American Airways	PN	Bangor	BGR			79	27											-	-
Pan American Airways	PN	Bedford	BED			315	75											-	-
Pan American Airways	PN	Martha's Vineyard	MVY			153	9											-	-
Pan American Airways	PN	Saint John	YSJ			66	22											-	-
Subtotal				0	0	809	2,087	961	193	223	278	9	0	0	0			0	-
Total				1,091	1,015	1,619	2,550	1,458	360	414	759	315	0	0	0			0	-

Departing Seats

Carrier	Code	Market	Code	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	'11-'13 Change	'11-'13 Pct. Change
Jet Carriers																			
Allegiant Airways	G4	Orlando/Sanford	SFB						5,229	28,671	6,471							-	-
Boston-Maine Airways	E9	Fort Lauderdale/Hollywood	FLL					1,329	1,993									-	-
Boston-Maine Airways	E9	Hartford	BDL						1,993									-	-
Boston-Maine Airways	E9	Newburgh	SWF						7,179									-	-
Boston-Maine Airways	E9	Sanford	SFB					8,507	8,593									-	-
Pan American Airways	PN	Allentown/Bethlehem	ABE	13,950	32,207													-	-
Pan American Airways	PN	Bangor	BGR	58,414	37,029	45,514	26,164											-	-
Pan American Airways	PN	Gary	GYY	7,714														-	-
Pan American Airways	PN	Manchester	MHT				2,614	25,543										-	-
Pan American Airways	PN	New York Newark	EWR			4,650												-	-
Pan American Airways	PN	Pittsburgh	PIT	39,171														-	-
Pan American Airways	PN	Sanford	SFB	44,400	44,914	42,943	40,629	39,107										-	-
Pan American Airways	PN	Santo Domingo	SDQ			1,993												-	-
Pan American Airways	PN	St. Petersburg/Clearwater	PIE			9,707												-	-
Pan American Airways	PN	Worcester	ORH		38,121	16,693												-	-
Skybus	SX	Columbus	CMH								58,896	15,552						-	-
Skybus	SX	Greensboro	GSO									11,952						-	-
Skybus	SX	Punta Gorda	PGD								2,160	8,496						-	-
Skybus	SX	Saint Augustine	UST								2,016	8,064						-	-
Subtotal				163,650	152,271	121,500	69,407	74,486	24,986	28,671	69,543	44,064	0	0	0			0	-
Regional/Commuter Carriers																			
Boston-Maine Airways	E9	Baltimore	BWI				1,391						156					-	-
Boston-Maine Airways	E9	Bangor	BGR				4,222											-	-
Boston-Maine Airways	E9	Bedford	BED				4,904	7,552	3,083	4,014	3,975	154						-	-
Boston-Maine Airways	E9	Hyannis	HYA				1,731											-	-
Boston-Maine Airways	E9	Manchester	MHT				3,847	80										-	-
Boston-Maine Airways	E9	Martha's Vineyard	MVY				705	399										-	-
Boston-Maine Airways	E9	Nantucket	ACK				1,342	1,476										-	-
Boston-Maine Airways	E9	New Haven	HVN								1,021							-	-
Boston-Maine Airways	E9	New London/Groton	GON				2,988	3,901										-	-
Boston-Maine Airways	E9	Saint John	YSJ				8,385	3,111										-	-
Boston-Maine Airways	E9	Trenton	TTN						399									-	-
Boston-Maine Airways	E9	Westchester County	HPN				5,264	782										-	-
Pan American Airways	PN	Atlantic City Pomona Field	ACY			2,754												-	-
Pan American Airways	PN	Baltimore	BWI			784	399											-	-
Pan American Airways	PN	Bangor	BGR			1,419	478											-	-
Pan American Airways	PN	Bedford	BED			5,662	1,355											-	-
Pan American Airways	PN	Martha's Vineyard	MVY			2,754	159											-	-
Pan American Airways	PN	Saint John	YSJ			1,183	399											-	-
Subtotal				0	0	14,557	37,569	17,301	3,482	4,014	4,996	154	156	0	0			0	-
Total				163,650	152,271	136,057	106,976	91,786	28,467	32,685	74,540	44,218	156	0	0			0	-

Sources: OAG Schedules; U.S. DOT, T100 Database.

Note: Skybus did not report to the OAG, so all 2007 and 2008 Skybus statistics from the T100 database.

G

Ground Access

This appendix provides information in support of *Chapter 5, Ground Access to and from Logan Airport*:

- Logan Airport Long-Term Parking Management Plan
- Table G-1 On-Airport Commercial Parking Rates, 2011, 2012, and 2014
- Table G-2 Logan Express Bus Service Ridership (Annual)
- Table G-3 Water Transportation Services Ridership (Annual)
- Table G-4 Massachusetts Bay Transportation Authority (MBTA) Airport Station Passengers
- Table G-5 Annual Taxi Dispatches (Tickets Sold)
- Table G-6 Logan Airport Employee Parking Supply
- Table G-7 Logan Airport Commercial Parking Supply
- Table G-8A 2012 Existing Conditions – Airport-Related Traffic, On-Airport Link Attributes, Traffic Assignment, and Vehicle Miles Traveled (VMT) Summary
- Table G-8B 2013 Existing Conditions – Airport-Related Traffic, On-Airport Link Attributes, Traffic Assignment, and Vehicle Miles Traveled (VMT) Summary
- VISSIM Traffic Roadway Network
- March 2012 Logan Airport Parking Space Inventory, submitted to Massachusetts Department of Environmental Protection (also known as the *Parking Freeze Report*)
- September 2012 Logan Airport Parking Space Inventory, submitted to Massachusetts Department of Environmental Protection (also known as the *Parking Freeze Report*)
- March 2013 Logan Airport Parking Space Inventory, submitted to Massachusetts Department of Environmental Protection (also known as the *Parking Freeze Report*)
- September 2013 Logan Airport Parking Space Inventory, submitted to Massachusetts Department of Environmental Protection (also known as the *Parking Freeze Report*)

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Logan Airport Long-Term Parking Management Plan

Background and Context

As part of its ongoing review of ground access as well as a strategic planning effort that commenced in 2013, Massport has been reviewing recent parking demand trends. That analysis shows that in 2013, Massport diverted or valet-parked passenger vehicles to various on-Airport locations approximately 80 out of 260 work days. While Logan Airport has experienced diversions in the past, the number of days per year has increased over the past several years. As presented in previous Environmental Data Report (EDR)/Environmental Status and Planning Report (ESPR) filings, diverting or valeting cars is inefficient and reduces customer service.

The Massachusetts Port Authority (Massport) is committed to a comprehensive and highly effective program of ground access and parking management designed to achieve a number of inter-related objectives:

- Minimize the traffic and environmental impacts associated with ground access travel to Logan Airport;
- Minimize the environmental impacts associated with the operation of Logan Airport; and
- Provide excellent customer service to air passengers and others traveling to Logan Airport; and
- Operate the Airport, its road system, and its parking supply as efficiently as possible.

The availability of parking at Logan Airport has been capped by the Logan Airport Parking Freeze (310 Code of Massachusetts Regulations 7.30), which is an element of the Massachusetts State Implementation Plan (SIP) under the Federal Clean Air Act[1]. Currently 18,415 commercial parking spaces and 2,673 employee parking spaces (for a total of 21,088) are authorized in the Logan Airport Parking Freeze. The Parking Freeze is a constraint upon, as well as an element of, Massport's multifaceted strategy for improving Logan Airport's connectivity by diversifying ground transportation options (for passengers and employees) and its efforts to reduce reliance on automobile travel to and from Logan Airport. Those efforts are described in detail in *Chapter 5, Ground Access to and from Logan Airport* of this *2012/2013 EDR*. The focus of this Long-Term Parking Management Plan is therefore limited to setting out the efforts that Massport has undertaken (and will continue to implement in the future) to manage the supply, pricing, and operation of parking that it controls both at Logan Airport and at Massport-controlled off-Airport locations to achieve its ground access objectives.

This Parking Management Plan is included as an appendix to this *2012/2013 EDR* to fulfill the requirement, first established as Condition 2 in a *2010 Advisory Opinion* issued by the Massachusetts Environmental Policy Act (MEPA) office in connection with the construction of an Economy Parking Garage in the North Cargo Area (NCA)[2]. The Advisory Opinion requested "an explanation of Massport' short-term and long-range plans for airport parking operations and management, at the NCA and elsewhere, and how these plans relate to Massport's other transportation initiatives and efforts to encourage transit use." Most recently, in its *February 14, 2014 Request for an Advisory Opinion* (with respect to consolidation of parking spaces available under the Logan Airport Parking Freeze in additions to existing parking facilities located in the central terminal area),

1 Clean Air Act of 1990 including amendments.
2 Secretary of the Executive Office of Energy and Environmental Affairs, *Advisory Opinion on Logan Airport Parking Deck*, March 19, 2010; Secretary of the Executive Office of Energy and Environmental Affairs, Request for Clarification on *Advisory Opinion on Logan Airport Parking Deck*, June 23, 2010.

Massport committed to providing the required Parking Management Plan in this *2012/2013 EDR*; this appendix fulfills that commitment.[3]

The Authority is working hard to encourage air passengers to use alternative modes for trips to and from Logan Airport. Key efforts include:

- Encouraging transit use, including subsidizing the entire cost of providing free Silver Line service from the Airport to downtown Boston;
- Investing in expanding its Logan Express bus service (including spending $30 million to build a 1,500 space parking garage in Framingham);
- Using eminent domain power to preserve the capacity of the Braintree Logan Express Facility;
- Adding new options for getting to the Airport, including supporting new shared-ride vans, such as Super Shuttle, and introducing a new Massport-funded Back Bay express shuttle bus service (which began spring 2014) to serve transit riders inconvenienced by the two-year closure of Government Center station;
- Encouraging passengers to consider options other than driving and parking;
- Changing its parking price structure by increasing the cost of on-Airport parking while reducing Logan Express parking rates;
- Massport re-organized the terminal curbs to place HOV/transit services in more central and/or curbside areas; and
- As a result of these and other efforts, Logan Airport is at the top of U.S. airports with regard to shares of air passengers using transit and High Occupancy Vehicle (HOV) modes.

Overview of Long-Term Parking Management Plan

Parking management at Logan Airport needs to be viewed in the broader context of an overall ground access strategy designed to minimize traffic generation and air emissions. In theory, constraining parking supply effectively shifts trips to transit and other shared ride modes because that is the only alternative. As explained in more detail in *Chapter 5, Ground Access to and from Logan Airport* however, air passengers have three major options for getting to Logan Airport:

- Transit and shared-ride: Use the MBTA, Logan Express, or private shared-ride services;
- Drive and Park: Drive to Logan Airport in a private vehicle and park for the duration of the trip; and
- Pick-Up/Drop-Off: Arrive in a taxi, limousine, taxi alternative, or private vehicle that drops off passengers at the terminal curbs but does not remain on Airport (resulting in two vehicle trips per departing passenger).

From an environmental/traffic perspective, there is a hierarchy of modes with the most desirable being transit and shared-ride and the least desirable being pick-up/drop-off. When measured in terms of vehicle trips generated per air passenger, drive-and-park is actually a more desirable alternative than pick-up/drop-off,

3 Secretary of the Executive Office of Energy and Environmental Affairs, *Advisory Opinion on Logan Airport Parking* – East Boston, March 20, 2014.

which generates two vehicle trips for every passenger brought to the Airport. Despite Massport's best efforts, some air passengers respond to parking constraints not by using transit/shared-ride modes, but by using pick-up/drop-off vehicle modes. Indeed, data presented in *Chapter 5, Ground Access to and from Logan Airport* indicates that there is a growing problem with air passengers, faced with severely constrained terminal area parking supply, choosing the least desirable pick-up/drop-off options rather than transit and shared-ride options. Massport's ground access and parking management strategies must therefore prioritize increasing transit/shared-ride modes while simultaneously striving to minimize both driving/parking and pick-up/drop-off access.

This Parking Management Plan therefore lays out a multi-part strategy for efficiently managing parking supply, pricing, and operations – both at Logan Airport and at Massport-controlled off-Airport locations –to maximize transit/shared-ride ground access while minimizing both drive-and-park and pick-up/drop-off modes:

- **Parking Supply**: The supply of parking at Logan Airport is constrained. To address the persistent use of valet parking and vehicle diversions (which, as demonstrated in *Chapter 5, Ground Access to and From Logan Airport*, increases Vehicle Miles Traveled [VMT]), Massport will add revenue-controlled parking spaces in the terminal area to bring supply up to the maximum number of spaces allowed under the Logan Airport Parking Freeze. At the same time, Massport will work to increase the supply of Massport-controlled off-Airport parking at Logan Express sites.
- **Parking Pricing**: Massport pricing policy will be designed to: (1) discourage air passengers from driving and parking at Logan Airport by ensuring that the least expensive Massport-controlled parking will be provided at remote Logan Express sites; and (2) will encourage more efficient use of available on-Airport parking by maintaining a meaningful price differential between rates at the Economy Parking Garage and terminal-area parking garages. Massport will evaluate increased parking prices for terminal-area parking to encourage Airport passengers and visitors to consider transit and shared-ride alternatives.
- **Parking Operations**: Massport will work to improve the efficiency of its current system of addressing overflow conditions. Massport will continue to explore other options that could reduce the number of days that Logan Airport operates in an overflow condition, such as a parking reservation system.
- **Employee Parking**: Massport will continue to work to reduce the number of Airport employees commuting by private automobile and parking at the Airport by providing off-Airport parking both near Logan Airport and at Logan Express sites, as well as by implementing measures to enhance employee commuting options.

Parking Supply: Build-out to Parking Freeze/SIP Cap

Having implemented numerous measures to better manage Logan Airport parking demand and supply – ranging from increasing parking prices to moving forward with additional off-site parking to serve Logan Express to increasing HOV options – it became clear that additional striped on-Airport parking spaces are essential to executing a comprehensive ground access strategy.

Current Parking Supply is Constrained

- On more than 80 days each year, passengers arrive to find that all parking spaces in the terminal area are full and so are either valet parked or diverted to the economy parking garage.
- As shown in Figure G-1, nearly 35,000 cars were valet parked or diverted in 2013; as many as 1,000 cars a day are valet parked.

Additional Terminal Area Parking Can Help Reduce Pick-Up/Drop-Off Trips

- Air passengers have three major options for getting to Logan Airport: drive and park, use transit or a HOV/shared-ride mode such as Logan Express, or use a pick-up/drop-off vehicle mode such as taxis, limousines, taxi alternatives, or getting a ride from family or friends.
- When passengers use taxi, or similar services, or are dropped off at the Airport by family or friends, it creates more trips per air passenger, as shown in Figure G-2, and therefore more traffic than a passenger parking at the Airport.
- A recent Massport air passenger ground access survey found that 6 in 10 passengers who drive and park are business travelers and half of those would choose to take a taxi or be dropped off if they could not park.
- Better accommodating the parking needs of business travelers who are already driving to the Airport and frequently being valeted or diverted will minimize Logan Airport's impact on the environment while ensuring that the Airport continues to be a catalyst for economic growth and job creation in the Commonwealth.

Figure G-1 Number of Annual Vehicles Diverted and/or Valeted

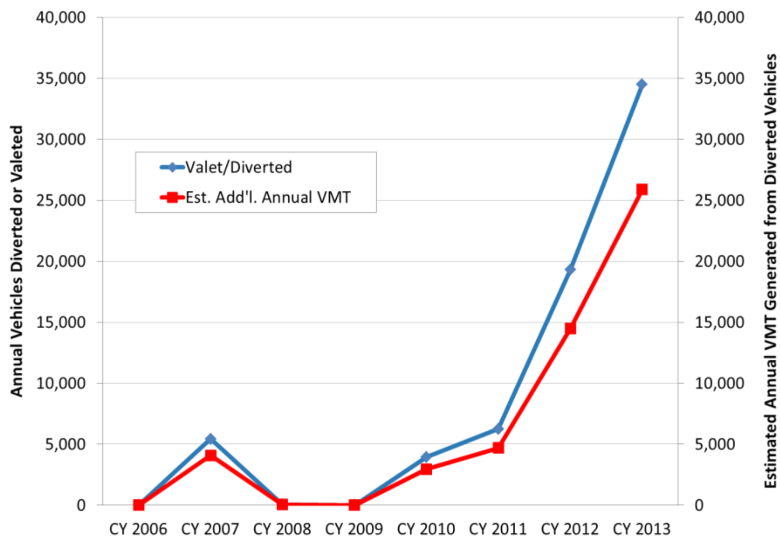
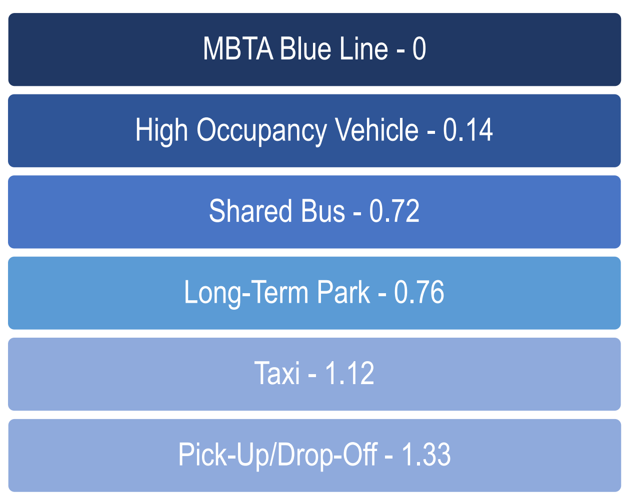


Figure G-2 Hierarchy of Desired Travel Mode Based on Estimated Auto Trips Generated per Air Passenger



In the past 13 years, on two occasions Massport purchased and relocated a total of 1,773 park-and-fly parking spaces from the local East Boston neighborhood to Logan Airport.

Moreover, since the Parking Freeze was implemented, Massport has incrementally reduced on-Airport employee parking by converting approximately 4,400 spaces, from the original 7,100 spaces to just under 2,700 spaces today. Under the conditions of the Parking Freeze, these conversions are permanent and cannot be reversed.

In 2014, in light of continuing strong demand, Massport initiated planning to consolidate, through construction of structured and surface parking spaces that will consolidate 2,050 temporary parking spaces as part of an addition to the West Garage, and other surface locations to be confirmed. The West Garage addition is atop the existing Hilton Hotel parking lot. With this action, Massport will remain fully compliant with the Logan Airport Parking Freeze. The construction of approximately 2,050 structured or surface parking spaces will consolidate existing on-Airport parking located at disparate locations within Logan's Parking Freeze Area; the parking spaces will establish defined physical striped locations for vehicles that already come to the Airport.

Massport is planning for the construction of these 2,050 structured or surface parking spaces as part of a parking consolidation project and comprehensive strategy to address record air passenger traffic and increasing demand for terminal area parking while at the same time fulfilling its responsibilities to its customers and the environment. The consolidations will help alleviate parking pressures on other areas of the Airport, lower the number of taxi and pick-up/drop-off vehicles that congest and pollute Airport and roads, and help sustain the economic growth that Logan Airport provides to the Commonwealth of Massachusetts.

- Even while building the additional parking, Massport would continue to implement a comprehensive and aggressive ground access strategy to minimize traffic and air emissions;
- The additional parking spaces will serve the growing number of air passengers who drive to Logan Airport and find that no parking is available; such drivers are either valet parked or diverted to the economy garage; and
- The number of proposed spaces is within the existing Parking Freeze and would simply consolidate the remaining parking spaces that are permitted to exist under the Parking Freeze.

Additions to the garage in the central terminal area and surface or structured parking in other locations on the Airport more fully respond to commercial parking demand within the terminal area and facilitate the consolidation of parking services in a more efficient manner and with improved customer service and reduced environmental impacts. Like all of Logan's on-Airport parking areas, the garage addition and parking spaces will be carefully managed on a day-to-day basis to ensure strict compliance with the Logan Airport Parking Freeze.

In its letter to Massport dated March 20, 2014[4], the MEPA Office agreed that based upon the assumption that the consolidation of parking at this location would neither attract new traffic to Logan Airport nor create additional parking under the Logan Airport Parking Freeze, no review of the garage addition under MEPA was required.

4 Secretary of the Executive Office of Energy and Environmental Affairs, *Advisory Opinion on Logan Airport Parking* – East Boston, March 20, 2014.

Managing Parking through Parking Rates/Pricing

A component of Massport's parking strategy is the management of parking through adjusting parking rates at on-Airport locations and off-Airport locations. Elements of Massport's parking pricing strategy are described below.

Long-Term vs. Short-Term Duration Parking Rates
For security reasons curbside parking is not permitted and dwell times at the curbs are restricted to only active passenger pick-up and drop-off activity. This makes it necessary for Massport to establish parking rates for short-term duration parking that discourages curbside passenger pick-up and drop-off. Massport sets aside parking spaces specifically designed for this purpose and sets lower rates for short-term duration parking. Furthermore, Massport provides a free short-term parking lot known as the Cell Phone Waiting Lot; this parking lot provides an area for drivers (i.e., meeters and greeters) waiting to pick-up arriving passengers.

Terminal Area vs. Economy Parking Rates
Massport establishes separate parking rates for the Airport's terminal area parking facilities (Central Parking, Terminal B Garage, and Terminal E lots) and the Economy Parking Garage. This two-tier system allows Massport to provide a parking "product" that satisfies different customer preferences for on-Airport parking (Logan Express can also be viewed as another parking product: each of the four suburban locations has a park-and-ride lot where air passengers may leave their vehicles for the duration of their air trip, while traveling to the Airport terminals on an express bus).

Massport recently changed the on-Airport commercial parking rates on July 1, 2014 (see Table G-1). Short-term duration rates remained the same, but the longer-term and daily rates increased. At the same April 2014 Massport Board meeting, the Board approved another set of parking rate increases to become effective in July 2016.

Massport also operates two enhanced parking services: the Parking PASSport Gold and Parking PASSport programs. Both programs allow users to enter and exit Logan Airport's parking garages and lots with an access card that is linked to an established account for faster payment transactions. Parking fees are automatically charged to a registered credit card and the receipt is emailed to the account holder. Massport offers guaranteed parking spaces through its Parking PASSport Gold program, which was first implemented in 2006. Parking PASSport Gold eliminates the need for a motorist to circle the garage looking for available spaces. Approximately 8 percent of spaces in the Central Parking garages and 12 percent of spaces in the Terminal B garage are set aside for these customers.

Table G-1 On-Airport Commercial Parking Rates, 2011, 2012, and 2014

Location/ Facility	2011	2012	2014	2016
Central Parking, Terminal B Garage, Terminal E Lots		*Effective as of March 1, 2012*	*Effective as of July 1, 2014*	*Effective as of July 1, 2016*
0 to 30 minutes	$3	$3	$3	*$3*
31 minutes to 1 hour	$6	$6	$6	*$6*
1 to 1.5 hours	$9	$9	$10	*$12*
1.5 to 2 hours	$12	$12	$14	*$17*
2 to 3 hours	$15	$17	$19	*$22*
3 to 4 hours	$18	$21	$23	*$26*
4 to 7 hours	$22	$25	$27	*$30*
7 to 24 hours (Daily)	**$24**	**$27**	**$29**	***$32***
Additional days 0 to 6 hours	$12	$14	$15	*$16*
Additional day(s) 6 to 24 hours	$24	$27	$29	*$32*

Location / Facility	2011	2012	2014	2016
Economy Parking		*Effective as of March 1, 2012*	*Effective as of July 1, 2014*	*Effective as of July 1, 2016*
Daily Rate*	**$18**	**$18**	**$20**	**$23**
Additional days 0 to 6 hours	$9	$9	$10	$12
Additional days 6 to 24 hours	$18	$18	$20	$23
Weekly Rate (6-7 days)	$108	$108	$120	$132

* short-term rates also available.

Dynamic Pricing
Massport Board members have been interested in the idea of managing parking demand by increasing rates on the highest demand days of the week. The Massport Board has discussed a proposal to adopt a peak period surcharge of one dollar per day every Tuesday, Wednesday, and Thursday in the terminal area parking facilities; this is yet to be confirmed.

Off-Airport (Remote) Parking

Privately-Owned Off-Airport Parking
Several off-Airport parking facilities, such as PreFlight Airport Parking in Chelsea and Park-Shuttle-and-Fly in East Boston, are privately owned and operated, and they are located outside of the Logan Airport Parking Freeze area. Rates for these parking lots are typically below the daily rate for Economy Parking. Massport has no control over the parking rates at these off-Airport parking lots.

Logan Express Parking
Massport provides frequent, scheduled, express coach bus service to Logan Airport for air passengers and Logan Airport employees from four suburban park-and-ride lots in Braintree, Framingham, Woburn, and Peabody. Each location features a full-service bus terminal and secure parking lots. Effectively, Logan Express operates as a remote, off-Airport parking facility in support of Logan Airport ground access. Standard daily parking rate is $7. Massport implements promotional rates during peak holiday periods.

Intercept Lots: North/West/South

To manage the demand for on-Airport parking during peak weeks, Massport has experimented with the use of Suffolk Downs (off Route 1A) as an intercept lot for air passengers wishing to park for their air travel in locations other than Logan Airport. This is intended to be a limited, short-term operation, while Massport examines the potential and feasibility of other Logan Express locations.

Efficiently Managing Overflow Conditions

Current Operations

Overflow conditions have become a regular occurrence and Massport expects parking space utilization early in each week to remain at high levels. Under such conditions, travelers arriving at the Airport to park on Tuesdays and Wednesdays will find themselves unable to park their cars on-Airport.

Not only does parking demand activity above capacity lower customer service levels, it also increases Logan Airport's operating costs. At levels approaching capacity, ground transportation personnel are deployed to direct vehicles to remaining spaces and available facilities—parking garages or lots that were not the customer's facility of choice; when demand exceeds capacity, valet operations are placed into effect—a labor-intensive activity, which requires temporarily parking cars in available areas until parking spaces become available.

Future Considerations

Massport is exploring whether a web-based parking reservation system would support its parking goals and improve the management of parking demand and the on-Airport supply. Web-based parking reservation systems allow customers to reserve and purchase their airport parking prior to their arrival. This system provides customers with the convenience of being assured that a space will be available in their preferred parking facility (e.g., Terminal B garage) and reduces the time spent searching for an empty space.

At most U.S. airports customers can be assured of finding an empty parking space, on- or off-Airport, even on the busiest days of the year. In contrast, parking availability is limited at many European airports. Due to space constraints on and near the airport, these airports do not provide sufficient parking to accommodate peak season demands. Thus, over time, customers have learned the need to reserve a space ahead of time. Many airports in Europe offer online parking reservation systems and several use yield management software to match parking prices to space availability.

In North America, many operators of off-airport parking facilities (e.g., the Parking Spot or Fast Park) have offered online parking reservation systems for many years. In addition, several private companies (e.g., airportparkingreservation.com) offer a single website allowing customers to compare prices at multiple privately operated airport parking facilities.

In the past few years, several North American airports have begun to offer web-based parking reservations. These airports include Bradley International, Buffalo Niagara International Airport, Denver International, the Port Authority of New York and New Jersey's three major airports (Newark International, LaGuardia, and John F. Kennedy International), Greenville-Spartanburg, and Pittsburgh International. See Attachment 1 for additional discussion on parking reservation systems.

Management of Parking for Airport Employees at Logan Airport

Airport employees may have non-traditional (and often unpredictable) working hours that are difficult to match to typical transit service hours. Due to the time-sensitive nature of airline operations, on-time reliability is important for employee transportation, as is flexibility during severe weather or other delays that may extend a typical employee workday or work shift.

Massport strives to reduce the number of Airport employees commuting by private automobile, to enhance commuter options, and to reduce traffic and parking demands at Logan Airport. To help accomplish these objectives Massport continues to:

- Provide off-Airport employee parking in Chelsea, which is served by frequent shuttle bus service to the terminals (Route 77);
- Run free shuttle buses between Airport Station and employment areas in the terminal, service, and cargo areas;
- Operate early morning and late night Logan Express bus trips for commuters;
- Support two Sunrise Shuttle routes for early morning bus service from East Boston;
- Create and maintain a comprehensive sidewalk/walkway system on Logan Airport to facilitate pedestrian access; and
- Provide bicycle racks throughout the Airport.

Parking Freeze Reallocations: Conversions from Employee to Commercial
Since the implementation of the Parking Freeze, Massport has reduced on-Airport employee parking by approximately 4,300 spaces, from approximately 7,000 spaces to just under 2,700 spaces today. Per the regulations, conversions of spaces are allowed only from employee to commercial use, thus permanently reducing the allocation of spaces for employee commuter use.

Logan Transportation Management Association (TMA)
Established in 1997, the Logan TMA advises Airport employers on transit benefits and provides information on available commuting transportation alternatives, ride-matching services, and reduced-rate HOV/transit fare options. Massport contributes $65,000 annually to the Logan TMA, which primarily offers the Sunrise Shuttle service. In addition, the Logan TMA works with airlines, rental car companies, cargo transport companies, and other tenants at Logan Airport to encourage and offer commuting incentives to employees. Furthermore, several companies offer a subsidy to employees using public transit or Logan Express to travel to work at the Airport. The TMA is open to all companies and their employees at Logan Airport; therefore, all employees are eligible to benefit from its services.

Sunrise Shuttle
The two Sunrise Shuttle bus services operate outside of MBTA service hours between 3:00 AM and 6:00 AM, with shuttles every half-hour transporting employees to the Airport terminals. Originally launched in August 2007 (a second shuttle route was added in October 2011 that serves East Boston's Orient Heights neighborhood and Winthrop), this shuttle service provides low-cost transportation to Airport employees who live in nearby East Boston and Winthrop.

Logan Express
Recently, two changes in the Logan Express bus system had a positive effect on use of the service by Airport employees. The first change took place in October 2011 with the addition of more early morning buses from the Logan Express terminals (increasing the frequency of service between 3:00 AM and 5:00 AM) and the addition of bus trips after midnight departing from Logan Airport. These changes were primarily made to address the needs of airline employees, but a significant number of air travelers ride these buses as well. In addition to extra bus service, Massport introduced a monthly pass for airline employees, which reduced the cost of parking and riding the bus from $140 to $100. The cost of a 44-ride employee pass remains unchanged at $75, but the separately purchased monthly Logan Express parking pass was reduced from $65 to $40. Logan Airport employees have responded positively to these pricing incentives, as demonstrated by increases in ridership.

Off-Airport Employee Parking
For over 20 years, Massport has provided off-Airport employee parking in Chelsea. The 1,550-space parking garage is served by frequent shuttle bus service to the terminals (airport shuttle Route 77).

Additional information on these measures is provided in *Chapter 5, Ground Access to and from Logan Airport*.

Monitoring and Reporting

Massport will continue to monitor all of the efforts to manage the supply, pricing, and operation of parking that it controls both at Logan Airport and at Massport-controlled off-Airport locations set forth in this Long-Term Parking Management Plan and regularly report on its activities and progress through two existing reporting mechanisms:

- **EDR/ESPR Reports**: Massport already provides extensive information about parking supply, management, and operations in the ESPR and in the annual EDRs. Rather than establish a separate reporting process to monitor and provide MEPA and the public with information about activities undertaken under this Long-Term Parking Management Plan, Massport believes that (beginning with the *2014 EDR* to be filed in 2015) additional information about activities under the Long-Term Parking Management Plan should be included in the EDR and ESPR documents. The proposed Scope for the *2014 EDR* accordingly includes appropriate language to ensure that the EDR/ESPR serves as the primary reporting mechanism with respect to this Long-Term Parking Management Plan.
- **Parking Freeze Compliance Reports**: Massport submits semi-annual filings to the Massachusetts Department of Environmental Protection (MassDEP) demonstrating Massport's compliance with the Logan Airport Parking Freeze. Beginning in 2010, the semi-annual parking freeze status reports to MassDEP have been posted on Massport's website at http://www.massport.com/environment/environmentalreporting/environmental-filings/. The reports are also included as part of this appendix. These reports will continue to be the primary mechanism by which Massport reports on parking supply issues related to compliance with the Parking Freeze.

Attachment 1

Web-based Parking Reservation Systems

Web-based parking reservation systems allow customers to reserve and purchase their airport parking prior to arriving at the Airport. This system provides customers with the convenience of being assured that a space will be available in their preferred parking facility (e.g., Terminal B parking) and reduces the time spent searching for an empty space.

Key Benefits

Web-based parking reservation systems provide potential benefits to both customers and operators.

Benefits to Customers

The primary benefit to a customer is the improved level of service that results from reserving a space in advance. This improved service is a due to the knowledge that a space will be available in the customer's preferred location and that the customer can avoid time spent searching for an empty space or empty parking structure. Additional customer benefits include:

- **One-stop travel arrangements** as a result of their ability to reserve and pay for their parking at the same time they are reserving and paying for their airline ticket, hotel room, or rental car;
- **Faster exits** compared to customers who must use the pay-on-foot machines; and
- **Pre-payment of parking.**

Benefits to Parking Operators

For the operator, the primary benefit is the potential for increased revenue and the prepayment of parking fees. These benefits arise because web-based reservation systems allow the airport parking operator to:

- **Increase customer awareness** of the full array of parking products and services that are offered, and thus promote under-utilized or lesser known facilities, products, or services.
- **Implement yield management** procedures to quickly adjust parking rates to respond to supply and demand. Such procedures, which are already commonly used by the airlines and hotel/motel operators, allow an airport to increase rates as parking facilities approach capacity. Using historical parking demand data European airports (e.g., Frankfurt) anticipate seasonal fluctuations in demand and offer discounted rates during off-peak months and premium rates during peak periods.
- **Upsell parking products** by improving customer awareness of premium parking products and potentially attracting customers who would have not otherwise purchased these products. Studies have shown customers often perceive higher value even if the services are provided at a higher cost.
- **Expand a customer database** which enables the airport to identify customers, analyze parking characteristics and behavior patterns, distribute promotional materials (e.g., enhancements to existing or proposed loyalty programs), and offer discounts for new products or services. Massport, for example, could extend the PASSport database.
- **Link to loyalty program or frequent parker program.**

Primary Costs

The costs to develop and operate a web-based parking reservation system are minimal. Start-up costs include design and development of the website, including the software to accept and process online payments. In 2009, the operator of Detroit Metropolitan Wayne County Airport paid about $418,000 in software upgrades to their parking revenue control system. Ongoing costs are also negligible, especially if performed by Authority staff.

Most U.S. airports have had their parking management company develop the reservation system or they have retained one of several vendors that provide and maintain the parking reservations software.

Example of reservation system provided by a parking management company
ABM Parking Services, operators of parking reservation systems at Newark Liberty International Airport, John F. Kennedy International Airport, LaGuardia Airport, and Greenville-Spartanburg International Airport, estimate a recurring cost of about 12.5 cents in credit card fees per $5 reservation.

Example of vendor system
Chauntry Corporation, a vendor used by several U.S. airports to host their reservation system, estimates that start-up costs for a standard ParkSpace system begin at around $22,500 for setup, hosting, and training for 3 years. Recurring fees would include a fixed tiered transaction fee that would change depending on volume. Additional fees for contractor or other services can be layered on top.

Operational Concerns

There are several operational concerns for both customers and operators, though none are expected to pose significant issues.

For customers the key concerns result from:

- Being charged for parking despite having pre-paid because the customer accidentally parked in the wrong area, causing the cashier not to accept their pre-payment.
- Needing to cancel a reservation or failure to notify the airport of the trip cancellation. Many airports charge a non-refundable reservation fee, but refund the remainder of the customer's parking payment.
- Difficulty in finding a parking spot if the reserved area is not clearly marked or requires the customer to pass through multiple gate arms.
- Difficultly in understanding or using the website.

For airport operators, the key concerns or challenges include:

- Developing clear on-airport signage;
- Charging customers who over stay or refunding customers who exit early;
- Charging customers who violate parking terms and conditions (e.g., attempt to enter/exit multiple times on a single reservation); and
- Responding to glitches and maintaining website security.

All of the above items are more likely to occur at start-up and can be mitigated through the help of customer feedback.

Table G-2	Logan Express Bus Service Ridership					
	Ridership			Percent Change		
Service Year	Air Passengers	Employees	Total	Air Passengers	Employees	Total
Framingham						
1992	207,847	7,573	215,420	4.3%	21.3%	4.8%
1993	229,064	12,307	241,371	10.2%	62.5%	12.0%
1994	250,342	17,352	267,694	9.3%	41.0%	10.9%
1995	274,754	21,129	295,883	9.8%	21.8%	10.5%
1996	325,665	22,932	348,597	18.5%	8.5%	17.8%
1997	316,306	29,871	346,175	(2.9)%	30.3%	(0.7)%
1998	337,007	33,971	370,978	6.5%	13.7%	7.2%
1999	345,715	31,946	380,661	3.5%	(6.0)%	2.6%
2000	371,560	34,508	406,068	6.6%	8.0%	6.7%
2001	354,521	38,740	393,261	(4.6)%	12.3%	(3.2)%
2002	342,746	42,441	385,187	(3.3)%	8.7%	(2.1)%
2003	310,024	55,979	366,003	(9.5)%	31.9%	(5.0)%
2004	323,931	54,763	378,694	4.5%	(2.2%)	3.5%
2005	318,125	57,569	375,694	(1.8%)	5.1%	(0.8%)
2006	349,022	60,764	409,789	9.7%	5.5%	9.1%
2007	311,299	57,252	368,551	(2.1%)[5]	(0.6%)[5]	(1.9%)[5]
2008	276,112	57,797	333,909	(11.3%)	1.0%	(9.4%)
2009	264,233	59,840	324,073	(4.3%)	3.5%	(2.9%)
2010	272,190	62,226	334,416	3.0%	4.0%	3.2%
2011[1]	272,301	68,228	340,529	0.0%	9.6%	1.8%
2012	**279,603**	**82,951**	**362,554**	**2.7%**	**21.6%**	**6.5%**
2013	**295,654**	**84,008**	**379,662**	**5.7%**	**1.3%**	**4.7%**
Braintree						
1992	186,217	9,694	195,911	10.6%	16.6%	10.8%
1993	205,209	22,768	227,977	10.2%	134.9%	16.4%
1994	247,636	37,489	285,125	20.7%	64.7%	25.1%
1995	264,579	70,723	335,302	6.8%	88.7%	17.6%
1996	335,232	103,519	438,751	26.7%	46.4%	30.1%
1997	300,006	135,340	435,346	(10.5)%	30.7%	(0.8)%
1998	300,005	156,105	456,110	0.0%	15.3%	4.8%
1999	328,818	125,286	454,105	9.6%	(19.7)%	(0.5)%
2000	355,932	149,687	505,619	8.2%	19.5%	11.3%
2001	345,249	156,240	501,489	(3.0)%	4.4%	(0.8)%
2002	323,115	190,360	513,475	(6.4)%	21.8%	2.4%
2003	301,013	216,765	517,778	(6.8)%	13.9%	0.8%
2004	318,100	208,566	526,666	5.7%	(3.8%)	1.7%
2005	307,659	189,531	497,190	(3.2%)	(9.1%)	(5.5%)
2006	333,413	202,983	536,396	8.4%	7.1%	7.9%
2007	300,715	196,955	497,670	(2.3%)[5]	3.9%[5]	0.1%[5]
2008	252,289	221,591	473,880	(16.1%)	12.5%	(4.8%)
2009	231,151	234,908	466,059	(8.4%)	6.0%	(1.7%)
2010	231,422	251,443	482,865	0.1%	7.0%	3.6%
2011[1]	233,521	285,515	519,036	0.9%	13.6%	7.5%
2012	**247,346**	**314,542**	**561,888**	**5.9%**	**10.2%**	**8.3%**
2013	**268,154**	**320,329**	**588,483**	**8.4%**	**1.8%**	**4.7%**

Table G-2	Logan Express Bus Service Ridership (Continued)					
	Ridership			Percent Change		
Service Year	Air Passengers	Employees	Total	Air Passengers	Employees	Total
Woburn[2]						
1992[3]	3,052	91	3,143	NA	NA	-
1993	59,635	5,027	64,662	NA	NA	-
1994	119,567	9,082	128,649	100.5%	80.7%	99.0%
1995	150,147	13,376	163,523	25.6%	47.3%	27.1%
1996	190,566	17,322	207,888	26.9%	29.5%	27.1%
1997	199,715	20,018	219,733	4.8%	15.6%	5.7%
1998	208,286	22,876	231,162	4.3%	14.3%	5.2%
1999	191,454	23,495	214,949	(8.1)%	2.7%	(7.0)%
2000	195,744	27,522	223,266	2.2%	17.1%	3.9%
2001	177,375	38,318	215,530	(9.4)%	39.2%	(3.4)%
2002	161,145	73,277	234,422	(9.2)%	91.0%	8.7%
2003	164,980	103,963	268,943	(2.4)%	41.9%	14.7%
2004	172,110	111,326	283,436	4.3%	7.1%	5.4%
2005	163,227	110,961	274,188	(5.1%)	(0.3%)	(3.2%)
2006	167,341	121,672	289,013	2.5%	9.7%	5.4%
2007	149,149	123,066	272,215	(8.6%)[5]	10.9%[5]	(0.7%)[5]
2008	129,385	122,777	252,162	(13.3%)	(0.2%)	(7.4%)
2009	113,607	121,633	235,240	(12.2%)	(0.9%)	(6.7%)
2010	115,257	127,120	242,377	1.5%	4.5%	3.0%
2011[1]	118,232	151,029	269,261	2.6%	18.8%	11.1%
2012	**126,549**	**188,747**	**315,296**	**7.0%**	**25.0%**	**17.1%**
2013	**140,407**	**192,289**	**332,696**	**11.0%**	**1.9%**	**5.5%**
Peabody						
2001[4]	8,151	3,097	11,248	NA	NA	NA
2002	28,626	20,629	49,255	NA	NA	NA
2003	32,318	23,425	55,743	21.4%	13.6%	13.2%
2004	43,389	33,642	77,031	34.3%	43.6%	38.2%
2005	51,023	39,599	87,622	17.6%	17.7%	13.7%
2006	42,142	32,632	74,774	(17.4%)	(17.6%)	(14.7%)
2007	36,367	26,949	63,316	(28.7%)[5]	(31.9%)[5]	(27.7%)[5]
2008	30,887	30,596	61,483	(15.1%)	13.5%	(2.9%)
2009	27,856	32,220	60,076	(9.8%)	5.3%	(2.3%)
2010	25,543	26,231	51,744	(8.3%)	(18.6%)	(13.8%)
2011[1]	25,555	31,741	57,296	0.0%	21.0%	10.7%
2012	**27,542**	**37,909**	**65,451**	**7.8%**	**19.4%**	**14.2%**
2013	**28,790**	**38,067**	**66,857**	**4.5%**	**0.4%**	**2.1%**

NA Not applicable.
1 Changes to employee parking and bus fares were implemented in October 2011.
2 Woburn Express moved from Mishawum Station to the Anderson Regional Transportation Center (ARTC) in Woburn in May 2001.
3 Reflects a partial year of operation; Woburn Logan Express service was implemented in November 1992.
4 Reflects a partial year of operation. The Peabody Logan Express service commenced in September 2001.
5 Percent comparison between 2007 and 2005. The I-90 Ted Williams Tunnel closures in 2006 resulted in atypical ridership.
6 Note that Back Bay Logan Express service commenced in April 2014. Ridership will be reported in the *2014 EDR*.

Table G-2	Logan Express Bus Service Ridership (Continued)					
	Ridership			Percent Change		
Service Year	Air Passengers	Employees	Total	Air Passengers	Employees	Total
Total System Ridership						
1992	397,116	17,358	414,474	8.0%	19.2%	8.5%
1993	493,908	39,832	533,740	24.4%	129.5%	28.8%
1994	617,545	63,923	681,468	25.0%	60.5%	27.7%
1995	689,480	105,228	794,708	11.6%	64.6%	16.6%
1996	851,463	143,773	995,236	23.4%	36.6%	25.2%
1997	816,015	185,229	1,001,254	(4.2)%	28.8%	0.6%
1998	845,598	212,952	1,058,550	3.6%	15.0%	5.7%
1999	868,987	180,727	1,049,714	2.7%	(15.2)%	(0.8)%
2000	923,236	211,717	1,134,953	6.2%	17.1%	8.1%
2001	885,296	236,395	1,121,691	(4.1)%	11.7%	(1.2)%
2002	855,632	326,707	1,182,339	(3.4)%	38.2%	5.4%
2003	808,335	400,132	1,208,467	(5.5%)	22.5%	2.2%
2004	857,530	408,297	1,265,827	6.1%	2.0%	2.2%
2005	837,034	397,660	1,234,694	(2.4%)	(2.6%)	(2.4%)
2006	891,918	418,051	1,309,969	6.6%	5.1%	6.1%
2007	797,530	404,222	1,201,752	(4.7%)[5]	1.7%[5]	(2.7%)[2]
2008	688,673	432,761	1,121,434	(13.6%)	7.1%	(6.7%)
2009	636,847	448,601	1,085,448	(7.5%)	3.7%	(3.2%)
2010	644,412	467,020	1,111,432	1.2%	4.1%	2.4%
2011[1]	649,609	536,513	1,186,122	0.8%	14.9%	6.7%
2012	**681,040**	**624,149**	**1,305,189**	**4.8%**	**16.3%**	**10.0%**
2013	**733,005**	**634,693**	**1,367,698**	**8.0%**	**2.0%**	**5.0%**

1 Changes to employee parking and bus fares were implemented in October 2011.
2 Percent comparison between 2007 and 2005. The I-90 Ted Williams Tunnel closures in 2006 resulted in atypical ridership.

Table G-3 Water Transportation Services Ridership to and from Logan Airport

	Rowes Wharf/Fan Pier Water Shuttle	Private Water Taxi (on-demand)[1]	Harbor Express (Long Wharf/Quincy/Hull)	Boston-Logan Water Shuttle (Long Wharf)	Total
1990	181,530	NS	NS	NS	181,530
1991	142,500	NS	NS	NS	142,500
1992	133,297	NS	NS	NS	133,297
1993	159,525	NS	NS	NS	159,525
1994	209,057	NS	NS	NS	209,057
1995	203,829	NS	NS	NS	203,829
1996	159,992	3,364	11,781	NS	175,137
1997	132,542	6,299	71,309	NS	210,150
1998	124,836	9,243	101,174	NS	235,253
1999	122,211	17,252	98,539	NS	238,002
2000	128,097	26,335	83,243	NS	237,675
2001	107,400	29,642	82,704	NS	219,746
2002	75,304	36,736	66,471	NS	178,511
2003	26,480[2]	35,724[3]	61,849	5,722[4]	129,775
2004	NS	54,540	58,788	3,202[5]	116,530
2005	NS	44,975	51,960	NS	96,935
2006	NS	63,639	70,998	NS	134,637
2007	NS	50,737	59,460	NS	110,197
2008	NS	48,630	48,003	NS	96,633
2009	NS	50,734	37,861	NS	88,595
2010	NS	54,382	34,794	NS	89,176
2011	NS	58,879	33,403	NS	92,282
2012	**NS**	**60,840**	**31,197**	**NS**	**92,037**
2013	**NS**	**70,378**	**NA**	**NS**	**70,378**

Note: Figures from 2003 – 2007 have been revised from previous documents.
1 Operates April-October only.
2 Rowes Wharf Water Shuttle operated from January to June only in 2003.
3 Operated from May to October only in 2003.
4 Long Wharf Boston-Logan Water Shuttle operated from August to December in 2003.
5 Joint operation with City Water Taxi began on August 16, 2003.
NA Data not available.
NS Operation not in service.

Table G-4 Massachusetts Bay Transportation Authority (MBTA) Airport Station Passengers

Year	Entrances	Exits	Total Turnstile Count[1]	Percent Change
1990	NA	NA	2,854,317	-
1991	NA	NA	2,515,293	(11.9)%
1992	NA	NA	2,626,572	4.2%
1993	NA	NA	2,604,980	(0.8)%
1994	NA	NA	3,108,734	19.3%
1995	NA	NA	3,040,868	(2.2)%
1996	NA	NA	2,974,850	(2.2)%
1997[2]	NA	NA	2,774,268	(6.7)%
1998	NA	NA	2,850,367	2.7%
1999	NA	NA	2,974,045	4.3%
2000	NA	NA	3,019,086	1.5%
2001	NA	NA	2,896,638	(4.1)%
2002	NA	NA	2,670,594	(7.8)%
2003[3]	1,300,272	1,275,627	2,575,899	(3.6)%
2004	1,373,861	1,366,511	2,740,372	6.4%
2005	NA	NA	NA	NA
2006	NA	NA	NA	NA
2007[4]	1,412,055	--	2,524,079	--
2008[4]	2,212,111	--	3,647,394	56.7%
2009	2,329,370	--	3,750,549	5.3%
2010	2,270,241	--	3,629,193	(2.5%)
2011	2,277,311	NA	NA	0.3%
2012	**2,442,085**	**NA**	**NA**	**7.2%**
2013	**2,597,306**	**NA**	**NA**	**6.3%**

Source: MBTA.

Note: Turnstile counts include both Logan Airport bound (turnstile exits) and non-Logan Airport bound (turnstile entrances) passengers.

1 As stated in the *Logan Airport 1999 ESPR*, Massport believes that ridership estimates through 2005 from the old Airport Station were actually understated because many travelers that were destined for the Airport with baggage had been observed to avoid the turnstiles and exit the old Airport Station via the wide gate (designed for handicapped access) that did not have the capability to count passengers.

2 Airport Station was closed on six weekends during September and October 1997 due to construction.

3 Airport Station was closed on eight weekend days during 2003.

4 Automated fare collection and new fare gates implemented beginning January 2007. Station access to Bremen Street Park opened June 2007. Exits are undercounted.

5 Exits are undercounted, as some exits occur through exit doors rather than turnstiles.

NA Data not available

Table G-5 Annual Taxi Dispatches (Tickets Sold)

Year	Total[1]	Percent Change
1990	1,330,418	
1991	1,208,611	(9.2)%
1992	1,266,033	4.8%
1993	1,336,603	5.6%
1994	1,409,505	5.5%
1995	1,499,869	6.4%
1996	1,721,093	14.7%
1997	1,827,244	6.2%
1998	1,888,281	3.3%
1999	1,955,895	3.6%
2000	2,140,724	9.4%
2001	1,789,736	(16.4)%
2002	1,679,508	(6.2)%
2003	1,562,076	(7.0)%
2004	1,713,696	9.7%
2005	1,769,876	3.3%
2006	1,857,609	5.0%
2007	1,925,817	3.7%
2008	1,749,730	(9.1)%
2009	1,630,333	(6.8)%
2010	1,829,961	12.1%
2011	1,937,743	6.0%
2012	**2,022,239**	**4.4%**
2013	**2,131,371**	**5.0%**

1 Represents yearly total of tickets sold

Table G-6 Logan Airport Employee Parking Supply

Location	March 2011	September 2011	March 2012	September 2012	March 2013	September 2013
	Number of Spaces					
Terminal Area	779	821	**831**	**879**	**879**	**879**
North Service Area	914	884	**900**	**952**	**966**	**964**
Southwest Service Area	0	0	**0**	**0**	**0**	**0**
South Service Area	894	893	**893**	**808**	**808**	**808**
Airside (Fire/Rescue)	5	5	**5**	**5**	**5**	**5**
Total spaces in service	2,592	2,603	**2,629**	**2,644**	**2,658**	**2,656**
Total spaces out of service	781	70	**44**	**29**	**15**	**17**
Total employee spaces	3,373	2,673	**2,673**	**2,673**	**2,673**	**2,673**

Source: Logan Airport Parking Space Inventory submitted to Massachusetts Department of Environmental Protection (MassDEP), March and September 2012 and 2013.

Note: As of July 2012, the Logan Airport Parking Freeze sets a limit of 18,265 commercial spaces and 2,673 employee spaces at the Airport. As of June 2013, the Logan Airport Parking Freeze sets a limit of 18,415 commercial spaces and 2,673 employee spaces at the Airport.

Table G-7 Logan Airport Commercial Parking Supply

Location	March 2011	September 2011	March 2012	September 2012	March 2013	September 2013
	Number of Spaces					
Terminal Area						
Central Garage and West Garage	10,375	10,344	**10,344**	**10,396**	**10,396**	**10,396**
Terminal B Garage	2,380	1,644	**2,632**	**2,553**	**2,553**	**2,553**
Terminal E Lot 1	269	269	**269**	**269**	**269**	**269**
Terminal E Lot 2	257	257	**257**	**251**	**251**	**251**
Terminal E Lot 3 (Gulf Lot)	229	229	**222**	**222**	**222**	**222**
Signature (General Aviation)	35	35	**35**	**35**	**35**	**35**
Logan Airport Hilton	235	235	**235**	**235**	**235**	**235**
North Service Area						
Economy Lot 2	n/a	n/a	**n/a**	**n/a**	**n/a**	**n/a**
Economy Garage	2,880	2,789	**2,789**	**2,809**	**2,809**	**2,809**
Overflow Lot(s)	250	0	**0**	**0**	**0**	**0**
South Service Area						
Harborside Hyatt Conference Center and Hotel	270	270	**270**	**270**	**270**	**270**
Southwest Service Area						
Former USPS Site (Lot 3)	416	416	**0**	**0**	**0**	**0**
Total spaces in service	17,596	16,072	**17,053**	**17,040**	**17,040**	**17,040**
Total spaces out of service	23	1,947	**966**	**1,225**	**1,225**	**1,375**
Total commercial spaces	17,619	18,019	**18,019**	**18,265**	**18,265**	**18,415**

Source: Logan Airport Parking Space Inventory submitted to MassDEP, March and September 2012 and 2013.

Note: Logan Airport Parking Freeze sets a limit of 21,088 spaces on Airport. As of June 2013, the allocation is 18,415 commercial and 2,673 employee spaces.

Table G-8A 2012 Existing Conditions – Airport-Related Traffic, On-Airport Link Attributes, Traffic Assignment and Vehicle Miles Traveled (VMT) Summary

Link Name	Link Distance (ft)	Link Speed (mph)	VOLUME AM Peak	VOLUME PM Peak	VOLUME High 8-Hour	VOLUME AWDT	VMT AM Peak	VMT PM Peak	VMT High 8-Hour	VMT AWDT
1	344	27	689	902	6320	13775	45	59	412	898
2	496	29	783	1024	7176	15640	74	96	674	1469
3	1347	21	542	709	4967	10825	138	181	1267	2762
4	1166	26	687	899	6298	13727	152	199	1391	3031
5	378	25	1229	1608	11265	24552	88	115	807	1759
6	441	30	601	786	5508	12005	50	66	460	1003
7	896	22	626	818	5735	12499	106	139	974	2122
8	644	24	1026	1343	9407	20503	125	164	1148	2503
9	1214	15	245	321	2246	4895	56	74	516	1125
10	1655	29	743	972	6810	14843	233	305	2135	4652
11	1363	9	378	495	3467	7557	98	128	895	1951
12	2453	33	19	25	176	383	9	12	82	178
13	2043	23	47	62	432	941	18	24	167	364
14	750	26	1472	1926	13496	29415	209	274	1917	4178
15	441	24	825	1079	7564	16485	69	90	632	1376
16	106	23	106	139	973	2120	2	3	20	43
17	163	24	107	140	980	2136	3	4	30	66
20	252	5	11	15	102	223	1	1	5	11
21	127	15	36	47	329	717	1	1	8	17
22	74	5	11	15	102	223	0	0	1	3
23	507	25	211	277	1938	4225	20	27	186	406
24	179	25	188	245	1719	3747	6	8	58	127
25	126	25	26	33	234	510	1	1	6	12
26	121	5	10	13	88	191	0	0	2	4
27	101	22	26	33	234	510	1	1	4	10
29	119	22	10	13	88	191	0	0	2	4
30	74	26	9	11	80	175	0	0	1	2
31	94	7	10	13	88	191	0	0	2	3
32	261	30	24	31	219	478	1	2	11	24
33	79	12	6	8	59	128	0	0	1	2
34	185	12	50	66	461	1004	2	2	16	35
35	683	25	60	78	549	1196	8	10	71	155
36	667	33	34	45	315	686	4	6	40	87
37	433	25	49	64	446	973	4	5	37	80
38	387	33	34	45	315	686	2	3	23	50
39	84	13	113	148	1039	2264	2	2	17	36
40	217	23	113	148	1039	2264	5	6	43	93
42	151	5	10	13	88	191	0	0	3	5
44	132	19	51	67	468	1020	1	2	12	25
45	76	13	10	13	88	191	0	0	1	3
46	208	22	32	42	293	638	1	2	12	25
48	88	22	32	42	293	638	1	1	5	11
50	316	22	32	42	293	638	2	3	18	38
51	45	33	34	45	315	686	0	0	3	6
52	240	33	75	98	688	1499	3	4	31	68
53	446	33	76	99	695	1515	6	8	59	128
54	447	6	73	96	673	1467	6	8	57	124
55	145	6	73	96	673	1467	2	3	19	40
56	247	6	135	176	1236	2694	6	8	58	126
57	366	23	313	409	2867	6250	22	28	199	433
63	361	30	26	34	241	526	2	2	16	36
65	504	30	118	155	1083	2360	11	15	103	225
66	170	30	118	155	1083	2360	4	5	35	76

Table G-8A 2012 Existing Conditions – Airport-Related Traffic, On-Airport Link Attributes, Traffic Assignment and Vehicle Miles Traveled (VMT) Summary (Continued)

Link Name	Link Distance (ft)	Link Speed (mph)	VOLUME AM Peak	VOLUME PM Peak	VOLUME High 8-Hour	VOLUME AWDT	VMT AM Peak	VMT PM Peak	VMT High 8-Hour	VMT AWDT
67	217	31	109	143	1002	2184	4	6	41	90
68	231	31	109	143	1002	2184	5	6	44	96
69	299	31	164	215	1507	3284	9	12	85	186
70	146	31	8	10	73	159	0	0	2	4
71	243	31	38	50	351	765	2	2	16	35
72	281	31	38	50	351	765	2	3	19	41
73	398	31	22	29	205	446	2	2	15	34
74	130	31	22	29	205	446	1	1	5	11
75	171	31	41	54	380	829	1	2	12	27
76	63	9	30	40	278	606	0	0	3	7
77	183	26	30	40	278	606	1	1	10	21
79	171	28	34	45	315	686	1	1	10	22
81	146	5	12	16	110	239	0	0	3	7
82	36	9	34	45	315	686	0	0	2	5
83	108	9	31	41	285	622	1	1	6	13
84	164	25	31	41	285	622	1	1	9	19
87	160	5	7	9	66	143	0	0	2	4
88	34	9	7	9	66	143	0	0	0	1
89	128	16	30	40	278	606	1	1	7	15
90	582	8	204	267	1873	4081	22	29	206	450
91	472	13	213	279	1953	4257	19	25	175	380
92	158	27	35	46	322	701	1	1	10	21
93	164	27	35	46	322	701	1	1	10	22
96	154	25	39	51	358	781	1	1	10	23
97	154	5	16	21	146	319	0	1	4	9
98	80	27	39	51	358	781	1	1	5	12
113	565	13	182	238	1668	3635	19	25	179	389
114	609	24	223	291	2041	4448	26	34	235	513
115	451	29	337	441	3087	6728	29	38	264	575
116	399	14	43	56	395	861	3	4	30	65
117	283	14	203	265	1858	4050	11	14	100	217
118	295	13	532	696	4879	10634	30	39	272	594
119	240	7	201	263	1843	4018	9	12	84	183
120	365	22	219	286	2004	4368	15	20	139	302
121	356	14	348	455	3189	6951	23	31	215	469
122	486	12	123	161	1127	2455	11	15	104	226
123	486	22	115	150	1053	2296	11	14	97	211
124	280	25	107	140	980	2136	6	7	52	113
125	280	22	103	135	944	2057	5	7	50	109
126	884	21	353	461	3233	7047	59	77	541	1179
127	1050	20	230	301	2107	4592	46	60	419	913
128	257	25	11	15	102	223	1	1	5	11
129	257	23	16	21	146	319	1	1	7	16
131	784	28	2	3	22	48	0	0	3	7
132	302	24	373	488	3416	7445	21	28	195	426
133	177	23	220	288	2019	4400	7	10	68	147
134	1521	24	365	477	3343	7286	105	137	963	2098
135	1542	23	227	298	2085	4544	66	87	609	1327
136	189	13	30	40	278	606	1	1	10	22
137	173	28	24	31	219	478	1	1	7	16
138	210	23	12	16	110	239	0	1	4	10

Table G-8A 2012 Existing Conditions – Airport-Related Traffic, On-Airport Link Attributes, Traffic Assignment and Vehicle Miles Traveled (VMT) Summary (Continued)

Link Name	Link Distance (ft)	Link Speed (mph)	VOLUME AM Peak	VOLUME PM Peak	VOLUME High 8-Hour	VOLUME AWDT	VMT AM Peak	VMT PM Peak	VMT High 8-Hour	VMT AWDT
139	248	26	36	47	329	717	2	2	15	34
140	369	23	270	353	2472	5389	19	25	173	377
141	265	23	230	301	2107	4592	12	15	106	231
142	192	17	340	445	3116	6792	12	16	113	247
143	272	17	272	356	2494	5437	14	18	129	280
144	518	6	196	257	1799	3922	19	25	176	384
145	195	27	110	144	1009	2200	4	5	37	81
146	463	27	108	141	988	2152	9	12	87	189
147	230	27	290	379	2655	5787	13	17	116	252
148	794	27	93	122	856	1865	14	18	129	280
149	661	23	108	141	988	2152	14	18	124	269
150	281	23	129	169	1185	2583	7	9	63	137
151	360	23	75	98	688	1499	5	7	47	102
152	88	32	2	3	22	48	0	0	0	1
153	66	31	53	70	490	1068	1	1	6	13
154	173	33	56	73	512	1116	2	2	17	37
155	258	30	255	334	2341	5102	12	16	115	250
156	645	29	141	185	1295	2822	17	23	158	345
157	218	26	115	150	1053	2296	5	6	43	95
158	185	23	208	272	1909	4161	7	10	67	146
159	354	21	324	424	2970	6473	22	28	199	434
160	470	27	60	78	549	1196	5	7	49	106
161	94	20	201	263	1843	4018	4	5	33	72
162	50	20	21	27	190	415	0	0	2	4
163	66	20	180	236	1653	3603	2	3	21	45
164	367	33	49	65	454	988	3	5	32	69
165	124	30	115	150	1053	2296	3	4	25	54
166	84	30	107	140	980	2136	2	2	16	34
167	956	30	107	140	980	2136	19	25	177	387
168	380	15	54	71	497	1084	4	5	36	78
169	293	18	161	211	1478	3220	9	12	82	179
170	205	33	9	11	80	175	0	0	3	7
174	502	15	144	189	1324	2886	14	18	126	274
175	640	22	397	519	3636	7924	48	63	441	961
176	319	26	853	1116	7820	17043	51	67	472	1028
177	286	29	853	1116	7820	17043	46	60	424	923
178	353	23	708	926	6488	14141	47	62	434	947
179	348	31	891	1165	8164	17792	59	77	538	1172
180	366	18	555	726	5084	11080	38	50	352	768
181	453	18	117	153	1075	2344	10	13	92	201
182	119	18	117	153	1075	2344	3	3	24	53
183	50	18	100	131	914	1993	1	1	9	19
184	54	18	11	15	102	223	0	0	1	2
185	62	18	167	218	1529	3332	2	3	18	39
186	39	18	217	284	1990	4336	2	2	15	32
188	212	33	10	13	88	191	0	1	4	8
190	193	32	8	10	73	159	0	0	3	6
192	540	5	50	66	461	1004	5	7	47	103
193	138	22	399	522	3658	7972	10	14	95	208
194	932	22	405	529	3709	8083	71	93	654	1426
195	79	19	89	117	819	1786	1	2	12	27
196	49	19	176	230	1609	3507	2	2	15	32
197	83	12	176	230	1609	3507	3	4	25	55
198	692	12	196	256	1792	3906	26	34	235	512

Table G-8A 2012 Existing Conditions – Airport-Related Traffic, On-Airport Link Attributes, Traffic Assignment and Vehicle Miles Traveled (VMT) Summary (Continued)

Link Name	Link Distance (ft)	Link Speed (mph)	VOLUME AM Peak	VOLUME PM Peak	VOLUME High 8-Hour	VOLUME AWDT	VMT AM Peak	VMT PM Peak	VMT High 8-Hour	VMT AWDT
199	70	27	98	128	900	1961	1	2	12	26
201	160	5	17	22	154	335	1	1	5	10
202	335	10	17	22	154	335	1	1	10	21
204	2022	29	210	275	1924	4193	80	105	737	1606
205	71	6	298	389	2728	5947	4	5	37	80
206	142	27	208	272	1909	4161	6	7	51	112
207	859	27	286	375	2626	5724	47	61	427	931
208	284	33	223	292	2048	4464	12	16	110	240
209	80	32	419	548	3840	8370	6	8	58	127
210	71	18	381	499	3497	7621	5	7	47	103
211	390	18	640	837	5867	12786	47	62	433	944
212	117	18	330	432	3028	6600	7	10	67	147
213	1344	18	825	1079	7564	16485	210	275	1926	4198
214	449	21	1175	1538	10775	23484	100	131	916	1996
215	1110	30	151	197	1383	3013	32	41	291	633
216	905	31	452	591	4140	9024	78	101	710	1548
217	1050	31	315	412	2889	6297	63	82	574	1252
218	581	31	523	685	4799	10459	58	75	528	1150
219	1063	26	372	487	3409	7429	75	98	687	1496
220	415	31	411	538	3767	8211	32	42	296	645
221	698	31	42	55	388	845	6	7	51	112
222	1920	26	4	5	37	80	1	2	13	29
223	1564	26	899	1176	8237	17952	266	348	2440	5317
224	377	29	437	572	4009	8737	31	41	287	624
225	551	29	115	150	1053	2296	12	16	110	240
226	788	29	221	289	2026	4416	33	43	302	659
227	1303	32	226	295	2070	4512	56	73	511	1113
228	580	32	967	1265	8866	19323	106	139	974	2124
229	1653	30	402	526	3687	8035	126	165	1154	2515
230	2058	32	565	739	5179	11288	220	288	2019	4400
231	1300	28	564	738	5172	11272	139	182	1273	2775
232	736	18	1187	1552	10877	23707	165	216	1516	3303
233	488	29	733	958	6715	14636	68	89	621	1353
234	449	27	333	435	3050	6648	28	37	259	565
235	310	11	231	303	2121	4623	14	18	125	271
236	310	10	101	133	929	2025	6	8	55	119
237	105	5	152	198	1390	3029	3	4	28	60
238	697	6	37	48	336	733	5	6	44	97
239	186	24	19	25	176	383	1	1	6	13
240	145	22	143	187	1309	2854	4	5	36	79
241	578	23	162	212	1485	3236	18	23	163	355
242	125	23	37	48	336	733	1	1	8	17
243	564	30	37	48	336	733	4	5	36	78
244	88	30	37	48	336	733	1	1	6	12
246	175	30	162	212	1485	3236	5	7	49	107
247	65	14	3	4	29	64	0	0	0	1
248	39	15	202	264	1851	4034	1	2	14	30
249	128	14	165	216	1514	3300	4	5	37	80
250	484	14	175	229	1602	3492	16	21	147	320
252	308	14	214	280	1960	4273	13	16	115	250
253	54	15	12	16	110	239	0	0	1	2
255	290	14	3	4	29	64	0	0	2	4
256	377	24	4	5	37	80	0	0	3	6

Table G-8A 2012 Existing Conditions – Airport-Related Traffic, On-Airport Link Attributes, Traffic Assignment and Vehicle Miles Traveled (VMT) Summary (Continued)

			VOLUME				VMT			
Link Name	Link Distance (ft)	Link Speed (mph)	AM Peak	PM Peak	High 8-Hour	AWDT	AM Peak	PM Peak	High 8-Hour	AWDT
257	215	24	3	4	29	64	0	0	1	3
260	362	23	3	4	29	64	0	0	2	4
261	219	26	4	5	37	80	0	0	2	3
262	218	13	6	8	59	128	0	0	2	5
265	2458	27	95	124	870	1897	44	58	405	883
266	752	27	479	626	4389	9566	68	89	625	1362
267	1323	27	531	694	4864	10602	133	174	1218	2656
268	450	22	676	884	6196	13504	58	75	529	1152
269	801	11	657	859	6020	13121	100	130	913	1991
270	1005	15	472	618	4330	9438	90	118	824	1796
271	1048	14	233	305	2136	4655	46	61	424	924
272	665	24	117	153	1075	2344	15	19	135	295
273	294	12	110	144	1009	2200	6	8	56	122
274	1244	28	431	564	3950	8609	102	133	931	2028
275	50	28	421	551	3862	8418	4	5	36	79
276	599	28	124	162	1134	2471	14	18	129	280
277	2473	18	98	128	900	1961	46	60	422	919
278	573	31	264	346	2421	5277	29	38	263	573
279	458	26	272	356	2494	5437	24	31	216	471
280	295	27	164	214	1500	3268	9	12	84	183
281	440	14	164	215	1507	3284	14	18	125	273
282	76	14	145	190	1331	2902	2	3	19	42
283	697	14	320	419	2933	6393	42	55	387	843
284	690	17	654	856	5998	13073	85	112	783	1707
285	91	17	587	768	5384	11734	10	13	93	202
286	464	17	816	1068	7483	16310	72	94	658	1434
287	229	22	786	1028	7205	15704	34	45	313	682
288	500	15	762	997	6986	15226	72	94	661	1440
289	738	26	1341	1755	12297	26800	187	245	1719	3746
290	190	29	1101	1441	10095	22001	40	52	363	791
291	494	27	311	407	2853	6218	29	38	267	582
292	689	29	789	1033	7235	15768	103	135	944	2056
293	325	26	1486	1944	13621	29686	91	120	839	1828
294	396	23	240	314	2202	4799	18	24	165	360
295	1017	29	1248	1633	11441	24935	240	315	2204	4804
296	162	14	229	300	2099	4576	7	9	64	141
297	140	14	158	207	1448	3157	4	5	38	84
298	951	12	180	235	1646	3587	32	42	297	646
299	805	17	152	198	1390	3029	23	30	212	462
300	518	15	115	150	1053	2296	11	15	103	225
301	749	5	160	210	1470	3205	23	30	209	455
302	652	14	241	315	2209	4815	30	39	273	595
303	547	8	61	79	556	1212	6	8	58	125
304	406	5	53	70	490	1068	4	5	38	82
305	442	5	28	37	256	558	2	3	21	47
306	207	19	81	106	746	1626	3	4	29	64
307	70	5	136	177	1244	2710	2	2	16	36
308	319	10	63	82	578	1259	4	5	35	76
309	281	5	128	168	1178	2567	7	9	63	137
310	555	32	428	560	3921	8545	45	59	412	897
311	208	30	2109	2759	19334	42137	83	109	762	1660
312	125	30	796	1042	7300	15911	19	25	173	377

Table G-8A 2012 Existing Conditions – Airport-Related Traffic, On-Airport Link Attributes, Traffic Assignment and Vehicle Miles Traveled (VMT) Summary (Continued)

			VOLUME				VMT			
Link Name	Link Distance (ft)	Link Speed (mph)	AM Peak	PM Peak	High 8-Hour	AWDT	AM Peak	PM Peak	High 8-Hour	AWDT
313	332	26	792	1036	7256	15815	50	65	457	995
314	440	26	1290	1688	11828	25780	108	141	986	2149
315	215	13	543	711	4982	10857	22	29	203	442
316	543	11	151	197	1383	3013	16	20	142	310
317	180	9	236	309	2165	4719	8	11	74	161
318	221	6	236	309	2165	4719	10	13	91	197
319	2544	5	375	491	3438	7493	181	237	1656	3610
320	552	9	444	582	4074	8880	46	61	426	928
321	628	13	88	115	805	1754	10	14	96	209
322	181	9	128	167	1170	2551	4	6	40	87
323	58	10	109	142	995	2168	1	2	11	24
324	387	12	18	24	168	367	1	2	12	27
325	406	10	127	166	1163	2535	10	13	89	195
326	89	5	60	78	549	1196	1	1	9	20
327	463	15	136	179	1251	2726	12	16	110	239
328	79	15	182	238	1668	3635	3	4	25	54
329	103	15	182	238	1668	3635	4	5	32	71
330	323	12	41	53	373	813	3	3	23	50
331	179	8	361	472	3306	7206	12	16	112	244
332	993	9	535	701	4908	10698	101	132	923	2012
333	384	14	14	19	132	287	1	1	10	21
334	366	14	460	602	4221	9199	32	42	292	637
335	583	31	855	1118	7834	17075	94	123	865	1885
336	428	32	610	798	5589	12180	49	65	453	988
337	94	21	185	242	1697	3699	3	4	30	66
338	366	5	159	208	1456	3173	11	14	101	220
339	311	7	26	33	234	510	2	2	14	30
340	273	20	22	28	198	430	1	1	10	22
341	66	8	22	28	198	430	0	0	2	5
343	52	26	90	118	827	1802	1	1	8	18
344	82	8	10	14	95	207	0	0	1	3
345	25	5	61	79	556	1212	0	0	3	6
346	121	5	61	79	556	1212	1	2	13	28
347	303	18	71	93	651	1419	4	5	37	81
348	146	20	437	571	4001	8721	12	16	111	241
349	67	20	315	412	2889	6297	4	5	37	80
350	446	5	122	160	1119	2439	10	14	94	206
351	335	5	101	133	929	2025	6	8	59	129
352	430	5	120	157	1097	2391	10	13	89	195
353	360	5	194	254	1778	3874	13	17	121	264
354	50	18	173	227	1587	3460	2	2	15	33
355	88	9	321	420	2941	6409	5	7	49	107
356	113	9	429	561	3928	8561	9	12	84	183
357	965	23	298	389	2728	5947	54	71	499	1087
358	463	13	341	446	3124	6808	30	39	274	597
359	229	27	10	13	88	191	0	1	4	8
360	245	20	13	17	117	255	1	1	5	12
361	248	19	22	28	198	430	1	1	9	20
362	199	18	32	42	293	638	1	2	11	24
363	230	17	30	39	271	590	1	2	12	26
364	256	13	386	505	3540	7716	19	25	172	374

Table G-8A 2012 Existing Conditions – Airport-Related Traffic, On-Airport Link Attributes, Traffic Assignment and Vehicle Miles Traveled (VMT) Summary (Continued)

			VOLUME				VMT			
Link Name	Link Distance	Link Speed	AM Peak	PM Peak	High 8-Hour	AWDT	AM Peak	PM Peak	High 8-Hour	AWDT
365	201	25	14	18	124	271	1	1	5	10
366	201	10	72	94	658	1435	3	4	25	55
367	337	31	764	1000	7008	15273	49	64	447	975
368	868	10	528	691	4843	10554	87	114	797	1736
369	167	10	493	645	4521	9853	16	20	143	312
370	96	12	244	319	2238	4879	4	6	41	88
371	141	26	393	514	3599	7844	10	14	96	209
					Logan Airport VMT		8390.96	10977.97	76920.2	167646.51

AWDT = Average annual weekday daily traffic

Table G-8B 2013 Existing Conditions – Airport-Related Traffic, On-Airport Link Attributes, Traffic Assignment and Vehicle Miles Traveled (VMT) Summary

			VOLUME				VMT			
Link Name	Link Distance (ft)	Link Speed (mph)	AM Peak	PM Peak	High 8-Hour	AWDT	AM Peak	PM Peak	High 8-Hour	AWDT
1	344	27	964	1221	8570	18951	62.82	79.56	558.44	1234.89
2	496	29	601	762	5347	11823	56.45	71.58	502.26	1110.57
3	1347	21	495	627	4401	9732	126.29	159.96	1122.81	2482.88
4	1166	26	833	1055	7410	16385	183.94	232.96	1636.26	3618.11
5	378	25	1328	1682	11811	26118	95.14	120.49	846.11	1871.04
6	441	30	657	832	5840	12913	54.89	69.51	487.92	1078.85
7	896	21	677	857	6019	13309	114.94	145.50	1021.87	2259.51
8	644	28	1149	1455	10214	22587	140.25	177.60	1246.73	2756.99
9	1214	18	333	422	2963	6552	76.55	97.01	681.11	1506.13
10	1655	25	809	1025	7197	15914	253.58	321.28	2255.85	4988.14
11	1363	9	407	515	3615	7995	105.06	132.94	933.19	2063.87
12	2453	19	1	1	6	13	0.46	0.46	2.79	6.04
13	2043	23	50	63	444	982	19.34	24.37	171.76	379.88
14	750	28	1565	1982	13917	30774	222.31	281.54	1976.89	4371.41
15	441	23	894	1133	7953	17586	74.65	94.60	664.06	1468.39
16	106	23	119	151	1057	2337	2.39	3.03	21.23	46.93
17	163	23	118	150	1052	2327	3.63	4.62	32.40	71.67
20	252	5	13	17	118	262	0.62	0.81	5.63	12.50
21	127	15	37	47	333	736	0.89	1.13	8.01	17.70
22	74	5	13	17	118	262	0.18	0.24	1.66	3.69
23	507	25	238	302	2118	4683	22.85	28.99	203.31	449.52
24	179	25	214	271	1903	4208	7.24	9.16	64.34	142.28
25	126	25	27	35	244	540	0.64	0.83	5.81	12.86
26	121	5	10	13	89	196	0.23	0.30	2.04	4.50
27	101	22	27	35	244	540	0.51	0.67	4.65	10.29
29	119	22	10	13	89	196	0.23	0.29	2.01	4.43
30	74	26	9	12	83	183	0.13	0.17	1.16	2.55
31	94	7	10	13	89	196	0.18	0.23	1.58	3.49
32	261	30	25	32	225	497	1.24	1.58	11.13	24.59
33	79	12	7	8	59	131	0.10	0.12	0.88	1.96
34	185	12	53	68	475	1050	1.85	2.38	16.60	36.70
35	683	25	61	77	542	1198	7.89	9.96	70.10	154.94
36	667	33	34	43	302	668	4.29	5.43	38.12	84.32
37	433	25	56	71	500	1106	4.59	5.82	41.02	90.73
38	387	33	34	43	303	671	2.49	3.15	22.19	49.14
39	84	13	129	163	1144	2530	2.06	2.60	18.28	40.43
40	217	23	129	163	1144	2530	5.30	6.69	46.97	103.88
42	151	5	10	13	89	196	0.29	0.37	2.54	5.59
44	132	19	53	68	475	1050	1.32	1.70	11.85	26.19
45	76	13	10	13	89	196	0.14	0.19	1.27	2.80
46	208	22	30	38	266	589	1.18	1.50	10.48	23.20
48	88	22	30	38	268	592	0.50	0.63	4.45	9.83
50	316	22	30	38	268	592	1.80	2.27	16.04	35.42
51	45	33	34	43	302	668	0.29	0.37	2.57	5.69
52	240	33	86	109	768	1698	3.90	4.95	34.87	77.09
53	446	33	86	109	768	1698	7.26	9.20	64.86	143.39
54	447	6	70	89	622	1374	5.93	7.54	52.71	116.44
55	145	6	69	88	617	1365	1.90	2.42	16.96	37.53
56	247	6	133	168	1182	2615	6.23	7.87	55.35	122.44
57	366	23	354	448	3146	6957	24.54	31.05	218.08	482.25
63	361	30	28	35	246	543	1.91	2.39	16.81	37.10
65	504	30	122	154	1080	2389	11.65	14.71	103.14	228.14
66	170	30	121	153	1074	2376	3.89	4.92	34.53	76.40

Table G-8B 2013 Existing Conditions – Airport-Related Traffic, On-Airport Link Attributes, Traffic Assignment and Vehicle Miles Traveled (VMT) Summary (Continued)

	Link	Link	VOLUME				VMT			
Link Name	Distance (ft)	Speed (mph)	AM Peak	PM Peak	High 8-Hour	AWDT	AM Peak	PM Peak	High 8-Hour	AWDT
67	217	31	114	144	1012	2238	4.68	5.91	41.52	91.82
68	231	31	114	144	1014	2242	4.99	6.30	44.38	98.13
69	299	31	172	218	1527	3377	9.75	12.36	86.58	191.48
70	146	31	5	6	44	98	0.14	0.17	1.21	2.70
71	243	31	40	50	352	779	1.84	2.30	16.18	35.80
72	281	31	39	50	351	776	2.08	2.66	18.68	41.29
73	398	31	20	26	179	396	1.51	1.96	13.49	29.85
74	130	31	20	26	179	396	0.49	0.64	4.40	9.74
75	171	31	40	51	355	785	1.30	1.65	11.50	25.42
76	63	9	34	44	306	677	0.40	0.52	3.63	8.02
77	183	26	34	44	306	677	1.18	1.53	10.62	23.49
79	171	28	35	44	311	687	1.13	1.42	10.07	22.24
81	146	5	12	16	111	245	0.33	0.44	3.07	6.78
82	36	9	35	44	311	687	0.24	0.30	2.10	4.64
83	108	9	36	46	324	717	0.73	0.94	6.61	14.62
84	164	25	36	46	324	717	1.12	1.43	10.09	22.33
87	160	5	7	9	64	141	0.21	0.27	1.93	4.26
88	34	9	7	9	64	141	0.04	0.06	0.41	0.91
89	128	16	32	40	283	625	0.77	0.97	6.84	15.11
90	582	8	218	276	1940	4290	24.03	30.43	213.88	472.96
91	472	13	229	290	2035	4500	20.46	25.91	181.84	402.11
92	158	27	36	46	321	710	1.08	1.38	9.62	21.28
93	164	27	36	46	321	710	1.12	1.43	9.95	22.01
96	154	25	41	52	363	802	1.20	1.52	10.59	23.39
97	154	5	17	21	149	331	0.50	0.61	4.36	9.67
98	80	27	41	52	363	802	0.62	0.78	5.47	12.08
113	565	13	195	246	1730	3826	20.88	26.35	185.27	409.74
114	609	24	238	302	2118	4683	27.44	34.82	244.22	539.98
115	451	29	351	445	3124	6908	29.98	38.01	266.84	590.06
116	399	14	41	52	366	808	3.10	3.93	27.66	61.05
117	283	14	215	273	1915	4235	11.53	14.64	102.70	227.12
118	295	13	566	716	5029	11120	31.61	39.98	280.83	620.96
119	240	7	213	270	1893	4186	9.68	12.28	86.06	190.31
120	365	22	235	298	2091	4624	16.25	20.61	144.61	319.79
121	356	14	374	474	3328	7360	25.23	31.97	224.49	496.47
122	486	12	136	173	1212	2680	12.51	15.92	111.53	246.61
123	486	22	133	168	1179	2608	12.23	15.45	108.43	239.84
124	280	25	112	141	992	2193	5.94	7.47	52.57	116.22
125	280	22	107	136	952	2104	5.67	7.21	50.45	111.50
126	884	21	383	485	3408	7537	64.09	81.16	570.26	1261.18
127	1050	20	247	312	2193	4850	49.10	62.02	435.93	964.09
128	257	25	25	32	226	501	1.22	1.56	10.99	24.37
129	257	23	25	31	221	488	1.22	1.51	10.75	23.74
131	784	28	3	4	30	65	0.45	0.59	4.45	9.65
132	302	24	413	523	3675	8126	23.62	29.91	210.14	464.66
133	177	23	236	299	2097	4637	7.91	10.02	70.27	155.38
134	1521	24	420	531	3731	8250	120.95	152.92	1074.47	2375.88
135	1542	23	236	298	2096	4634	68.94	87.05	612.26	1353.63
136	189	13	32	40	281	622	1.14	1.43	10.04	22.21
137	173	28	27	35	243	537	0.89	1.15	7.98	17.63
138	210	23	13	16	114	252	0.52	0.64	4.54	10.03

Table G-8B 2013 Existing Conditions – Airport-Related Traffic, On-Airport Link Attributes, Traffic Assignment and Vehicle Miles Traveled (VMT) Summary (Continued)

			VOLUME				VMT			
Link Name	Link Distance (ft)	Link Speed (mph)	AM Peak	PM Peak	High 8-Hour	AWDT	AM Peak	PM Peak	High 8-Hour	AWDT
139	248	26	41	51	361	798	1.92	2.39	16.94	37.45
140	369	23	277	351	2464	5449	19.36	24.53	172.18	380.77
141	265	23	235	297	2087	4614	11.80	14.92	104.81	231.72
142	192	17	417	528	3704	8191	15.16	19.19	134.65	297.77
143	272	17	331	419	2941	6502	17.06	21.59	151.55	335.05
144	518	6	197	250	1752	3875	19.31	24.50	171.73	379.82
145	195	27	128	162	1140	2520	4.74	5.99	42.18	93.24
146	463	27	123	155	1091	2412	10.78	13.59	95.63	211.41
147	230	27	286	363	2547	5632	12.47	15.83	111.08	245.62
148	794	27	89	113	790	1748	13.38	16.98	118.74	262.73
149	661	23	150	190	1336	2955	18.78	23.78	167.25	369.92
150	281	23	151	191	1344	2971	8.04	10.17	71.53	158.13
151	360	23	99	125	878	1941	6.74	8.52	59.82	132.24
152	88	32	5	7	49	108	0.08	0.12	0.82	1.81
153	66	31	53	67	474	1047	0.66	0.84	5.92	13.07
154	173	33	59	74	521	1152	1.93	2.43	17.09	37.78
155	258	30	231	293	2054	4542	11.31	14.34	100.55	222.34
156	645	29	105	133	934	2065	12.82	16.24	114.02	252.08
157	218	26	126	160	1122	2481	5.20	6.60	46.30	102.38
158	185	23	238	301	2115	4676	8.35	10.56	74.19	164.03
159	354	21	364	461	3240	7163	24.42	30.93	217.36	480.54
160	470	27	59	75	525	1162	5.25	6.67	46.69	103.34
161	94	20	164	207	1456	3220	2.93	3.70	26.02	57.54
162	50	20	0	0	0	0	0.00	0.00	0.00	0.00
163	66	20	164	207	1456	3220	2.06	2.60	18.32	40.51
164	367	33	63	79	556	1230	4.38	5.49	38.67	85.55
165	124	30	148	188	1317	2913	3.47	4.40	30.85	68.23
166	84	30	135	171	1199	2651	2.16	2.73	19.16	42.37
167	956	30	134	170	1191	2634	24.26	30.78	215.64	476.91
168	380	15	55	70	490	1083	3.96	5.03	35.24	77.88
169	293	18	189	239	1681	3718	10.50	13.28	93.38	206.53
170	205	33	13	16	115	255	0.50	0.62	4.46	9.89
174	502	15	183	232	1629	3603	17.39	22.04	154.78	342.34
175	640	22	388	492	3453	7635	47.03	59.64	418.56	925.48
176	319	26	941	1191	8363	18493	56.77	71.86	504.56	1115.73
177	286	29	941	1191	8363	18493	50.99	64.53	453.14	1002.02
178	353	23	757	959	6731	14883	50.67	64.20	450.58	996.29
179	348	31	935	1185	8317	18391	61.57	78.03	547.64	1210.97
180	366	18	690	874	6134	13564	47.83	60.58	425.18	940.19
181	453	18	145	184	1292	2857	12.44	15.78	110.82	245.06
182	119	18	145	184	1292	2857	3.25	4.13	29.00	64.13
183	50	18	120	152	1069	2363	1.14	1.44	10.12	22.36
184	54	18	12	15	107	236	0.12	0.15	1.09	2.39
185	62	18	140	178	1248	2759	1.64	2.08	14.61	32.30
186	39	18	209	264	1856	4104	1.55	1.96	13.78	30.48
188	212	33	12	16	110	242	0.48	0.64	4.43	9.74
190	193	32	13	16	114	252	0.47	0.58	4.16	9.20
192	540	5	68	87	608	1345	6.96	8.90	62.23	137.66
193	138	22	388	491	3450	7628	10.13	12.82	90.05	199.09
194	932	22	390	493	3464	7661	68.82	86.99	611.25	1351.84
195	79	19	108	137	960	2124	1.62	2.06	14.42	31.91
196	49	19	157	199	1394	3083	1.45	1.83	12.84	28.41
197	83	12	157	199	1397	3089	2.48	3.15	22.09	48.85
198	692	12	284	359	2523	5580	37.22	47.05	330.68	731.35

Table G-8B 2013 Existing Conditions – Airport-Related Traffic, On-Airport Link Attributes, Traffic Assignment and Vehicle Miles Traveled (VMT) Summary (Continued)

Link Name	Link Distance (ft)	Link Speed (mph)	VOLUME AM Peak	VOLUME PM Peak	VOLUME High 8-Hour	VOLUME AWDT	VMT AM Peak	VMT PM Peak	VMT High 8-Hour	VMT AWDT
199	70	27	162	206	1443	3191	2.16	2.74	19.21	42.47
201	160	10	127	161	1131	2500	3.84	4.87	34.20	75.60
202	335	29	127	161	1128	2494	8.05	10.21	71.54	158.17
204	2022	6	195	247	1733	3832	74.67	94.58	663.57	1467.29
205	71	27	350	443	3111	6879	4.73	5.98	42.02	92.91
206	142	27	238	301	2116	4680	6.41	8.11	57.02	126.11
207	859	33	250	317	2226	4922	40.66	51.56	362.03	800.49
208	284	32	241	305	2143	4739	12.96	16.40	115.26	254.89
209	80	18	536	679	4770	10547	8.16	10.34	72.61	160.54
210	71	18	505	639	4489	9925	6.83	8.64	60.70	134.21
211	390	18	776	983	6904	15266	57.29	72.58	509.74	1127.13
212	117	18	380	481	3380	7474	8.44	10.68	75.05	165.95
213	1344	21	893	1132	7944	17567	227.39	288.24	2022.80	4473.12
214	449	30	1186	1502	10543	23313	100.80	127.66	896.08	1981.44
215	1110	31	158	200	1406	3109	33.20	42.03	295.47	653.35
216	905	31	498	630	4423	9781	85.40	108.04	758.49	1677.31
217	1050	31	288	365	2565	5671	57.27	72.58	510.04	1127.66
218	581	26	582	737	5171	11434	64.01	81.06	568.73	1257.56
219	1063	31	368	466	3274	7239	74.12	93.85	659.39	1457.96
220	415	31	399	506	3552	7854	31.35	39.76	279.11	617.15
221	698	26	33	42	293	648	4.37	5.56	38.76	85.72
222	1920	26	5	6	44	98	1.82	2.18	16.00	35.64
223	1564	29	950	1203	8444	18673	281.37	356.31	2500.95	5530.58
224	377	29	556	704	4940	10924	39.74	50.32	353.08	780.77
225	551	29	195	247	1733	3832	20.35	25.77	180.83	399.85
226	788	32	235	297	2085	4611	35.07	44.32	311.17	688.15
227	1303	32	228	289	2029	4487	56.25	71.30	500.56	1106.95
228	580	30	946	1198	8407	18591	103.97	131.67	923.99	2043.28
229	1653	32	384	487	3416	7553	120.21	152.45	1069.35	2364.41
230	2058	28	561	711	4992	11038	218.67	277.13	1945.78	4302.39
231	1300	18	634	803	5637	12465	156.05	197.65	1387.49	3068.14
232	736	29	1169	1481	10396	22989	162.89	206.37	1448.63	3203.40
233	488	27	730	924	6488	14347	67.47	85.40	599.68	1326.09
234	449	11	399	506	3550	7851	33.92	43.02	301.83	667.51
235	310	10	241	306	2146	4745	14.15	17.96	125.98	278.55
236	310	5	158	200	1404	3106	9.29	11.76	82.56	182.65
237	105	6	228	288	2025	4477	4.54	5.74	40.36	89.22
238	697	24	32	41	287	635	4.22	5.41	37.86	83.77
239	186	22	23	29	206	455	0.81	1.02	7.24	15.99
240	145	23	148	188	1319	2916	4.07	5.18	36.31	80.27
241	578	23	171	217	1524	3371	18.73	23.77	166.97	369.32
242	125	30	32	40	283	625	0.76	0.95	6.69	14.78
243	564	30	32	40	283	625	3.42	4.27	30.22	66.75
244	88	30	32	40	284	628	0.53	0.66	4.71	10.41
246	175	14	172	218	1529	3380	5.70	7.22	50.67	112.01
247	65	15	3	4	30	65	0.04	0.05	0.37	0.80
248	39	14	207	262	1838	4064	1.52	1.92	13.50	29.84
249	128	14	175	222	1555	3439	4.23	5.37	37.63	83.22
250	484	14	184	234	1640	3626	16.88	21.47	150.48	332.71
252	308	15	217	274	1925	4257	12.68	16.01	112.46	248.70
253	54	14	10	12	87	193	0.10	0.12	0.89	1.97
255	290	24	3	4	30	65	0.17	0.22	1.65	3.58
256	377	24	6	8	53	118	0.43	0.57	3.79	8.43

Table G-8B 2013 Existing Conditions – Airport-Related Traffic, On-Airport Link Attributes, Traffic Assignment and Vehicle Miles Traveled (VMT) Summary (Continued)

Link Name	Link Distance (ft)	Link Speed (mph)	VOLUME AM Peak	VOLUME PM Peak	VOLUME High 8-Hour	VOLUME AWDT	VMT AM Peak	VMT PM Peak	VMT High 8-Hour	VMT AWDT
257	215	24	3	4	30	65	0.12	0.16	1.22	2.65
260	362	23	3	4	30	65	0.21	0.27	2.05	4.45
261	219	26	6	8	55	121	0.25	0.33	2.28	5.03
262	218	13	7	8	59	131	0.29	0.33	2.43	5.40
265	2458	27	101	128	900	1990	47.02	59.58	418.96	926.36
266	752	27	459	581	4080	9022	65.37	82.74	581.06	1284.89
267	1323	27	531	673	4725	10449	133.01	168.58	1183.59	2617.43
268	450	22	687	870	6105	13499	58.61	74.22	520.80	1151.56
269	801	11	691	875	6145	13587	104.85	132.77	932.43	2061.66
270	1005	15	524	664	4659	10302	99.73	126.38	886.76	1960.80
271	1048	14	262	332	2328	5148	52.00	65.89	462.03	1021.69
272	665	24	133	169	1184	2618	16.75	21.29	149.16	329.81
273	294	12	132	168	1177	2602	7.34	9.35	65.48	144.76
274	1244	28	475	602	4224	9340	111.91	141.83	995.20	2200.56
275	50	28	464	588	4129	9130	4.38	5.55	38.98	86.20
276	599	28	138	175	1230	2719	15.65	19.85	139.52	308.43
277	2473	18	107	136	955	2111	50.12	63.71	447.37	988.90
278	573	31	285	361	2534	5602	30.94	39.19	275.08	608.14
279	458	26	333	422	2960	6545	28.87	36.59	256.62	567.42
280	295	27	213	270	1897	4195	11.91	15.09	106.05	234.53
281	440	14	214	271	1903	4208	17.82	22.56	158.43	350.32
282	76	14	191	241	1695	3747	2.77	3.49	24.54	54.25
283	697	14	477	604	4243	9382	62.92	79.68	559.72	1237.64
284	690	17	671	849	5963	13185	87.63	110.88	778.75	1721.93
285	91	17	625	791	5556	12285	10.77	13.63	95.71	211.63
286	464	17	864	1094	7682	16987	75.94	96.16	675.20	1493.06
287	229	22	860	1089	7642	16899	37.33	47.27	331.69	733.48
288	500	15	836	1058	7431	16431	79.09	100.09	703.02	1554.49
289	738	26	1573	1992	13987	30928	219.88	278.44	1955.12	4323.16
290	190	29	1306	1655	11616	25686	46.93	59.48	417.45	923.09
291	494	27	396	501	3518	7779	37.07	46.90	329.32	728.19
292	689	29	912	1155	8108	17930	118.94	150.63	1057.38	2338.29
293	325	26	1537	1947	13667	30221	94.63	119.87	841.42	1860.59
294	396	23	244	309	2173	4804	18.32	23.19	163.11	360.60
295	1017	29	1293	1638	11500	25430	249.08	315.55	2215.37	4898.85
296	162	14	262	332	2328	5148	8.05	10.20	71.49	158.09
297	140	14	175	222	1558	3446	4.64	5.88	41.27	91.29
298	951	12	180	228	1603	3544	32.43	41.08	288.82	638.54
299	805	17	200	253	1774	3924	30.50	38.58	270.50	598.33
300	518	15	140	177	1242	2746	13.74	17.37	121.91	269.54
301	749	5	211	267	1875	4146	29.94	37.88	266.04	588.27
302	652	14	244	309	2171	4801	30.13	38.16	268.08	592.84
303	547	8	63	80	561	1240	6.52	8.28	58.08	128.38
304	406	5	64	81	571	1263	4.92	6.23	43.90	97.10
305	442	5	44	56	394	870	3.68	4.69	33.00	72.86
306	207	19	109	137	965	2134	4.28	5.37	37.85	83.70
307	70	5	169	215	1507	3331	2.24	2.85	19.98	44.17
308	319	10	64	81	571	1263	3.87	4.89	34.51	76.32
309	281	5	178	226	1585	3505	9.47	12.02	84.32	186.46
310	555	32	548	695	4876	10783	57.56	72.99	512.12	1132.52
311	208	30	2238	2834	19898	43999	88.16	111.64	783.86	1733.29
312	125	30	876	1109	7789	17223	20.74	26.25	184.40	407.74

Table G-8B 2013 Existing Conditions – Airport-Related Traffic, On-Airport Link Attributes, Traffic Assignment and Vehicle Miles Traveled (VMT) Summary (Continued)

Link Name	Link Distance (ft)	Link Speed (mph)	VOLUME				VMT			
			AM Peak	PM Peak	High 8-Hour	AWDT	AM Peak	PM Peak	High 8-Hour	AWDT
313	332	26	792	1003	7043	15574	49.85	63.13	443.28	980.20
314	440	26	1337	1693	11887	26285	111.47	141.15	991.03	2191.41
315	215	13	545	691	4848	10721	22.20	28.14	197.44	436.64
316	543	11	191	242	1699	3757	19.65	24.90	174.79	386.52
317	180	9	242	307	2155	4765	8.25	10.47	73.47	162.45
318	221	6	242	307	2155	4765	10.12	12.83	90.09	199.19
319	2544	5	422	534	3750	8292	203.31	257.27	1806.70	3994.98
320	552	9	485	614	4308	9526	50.68	64.15	450.12	995.32
321	628	13	84	106	746	1649	10.00	12.61	88.77	196.23
322	181	9	128	162	1138	2517	4.39	5.55	39.02	86.30
323	58	10	76	96	675	1492	0.84	1.06	7.45	16.47
324	387	12	20	26	182	403	1.47	1.91	13.35	29.56
325	406	10	96	122	857	1895	7.38	9.37	65.85	145.60
326	89	5	75	95	670	1482	1.26	1.60	11.25	24.89
327	463	15	102	129	903	1996	8.94	11.31	79.19	175.04
328	79	15	163	207	1452	3210	2.44	3.10	21.74	48.07
329	103	15	163	207	1452	3210	3.17	4.02	28.22	62.38
330	323	12	23	29	206	455	1.41	1.77	12.59	27.82
331	179	8	381	482	3386	7487	12.91	16.33	114.75	253.73
332	993	9	566	717	5035	11133	106.43	134.82	946.73	2093.34
333	384	14	15	19	133	295	1.09	1.38	9.68	21.47
334	366	14	502	636	4462	9867	34.77	44.05	309.01	683.33
335	583	31	863	1093	7676	16974	95.29	120.68	847.53	1874.14
336	428	32	665	842	5914	13077	53.94	68.29	479.69	1060.68
337	94	21	211	267	1872	4140	3.77	4.76	33.41	73.88
338	366	5	164	207	1455	3217	11.36	14.34	100.80	222.88
339	311	7	47	59	416	920	2.76	3.47	24.47	54.11
340	273	20	25	31	221	488	1.29	1.60	11.42	25.21
341	66	8	25	31	221	488	0.31	0.39	2.75	6.08
343	52	26	118	150	1052	2327	1.16	1.48	10.36	22.92
344	82	8	12	16	111	245	0.19	0.25	1.73	3.81
345	25	5	73	92	645	1427	0.35	0.44	3.05	6.76
346	121	5	72	91	641	1417	1.64	2.08	14.64	32.36
347	303	18	85	107	752	1662	4.88	6.14	43.14	95.35
348	146	20	473	599	4204	9297	13.09	16.58	116.37	257.35
349	67	20	347	440	3087	6826	4.39	5.56	39.02	86.29
350	446	5	164	207	1455	3217	13.85	17.48	122.83	271.58
351	335	5	132	167	1172	2592	8.39	10.61	74.47	164.69
352	430	5	126	159	1119	2474	10.25	12.94	91.06	201.31
353	360	5	184	233	1634	3613	12.53	15.86	111.26	246.01
354	50	18	85	107	752	1662	0.80	1.01	7.12	15.74
355	88	9	346	438	3074	6797	5.78	7.31	51.33	113.51
356	113	9	463	586	4113	9094	9.91	12.55	88.05	194.69
357	965	23	325	412	2892	6394	59.40	75.31	528.60	1168.70
358	463	13	313	397	2785	6159	27.43	34.79	244.05	539.72
359	229	27	11	14	99	219	0.48	0.61	4.30	9.51
360	245	20	13	17	118	262	0.60	0.79	5.48	12.18
361	248	19	25	31	219	484	1.17	1.45	10.28	22.71
362	199	18	33	42	296	654	1.24	1.58	11.17	24.67
363	230	17	36	45	318	704	1.57	1.96	13.84	30.64
364	256	13	360	456	3201	7078	17.46	22.12	155.29	343.38

Table G-8B 2013 Existing Conditions – Airport-Related Traffic, On-Airport Link Attributes, Traffic Assignment and Vehicle Miles Traveled (VMT) Summary (Continued)

Link Name	Link Distance (ft)	Link Speed (mph)	VOLUME				VMT			
			AM Peak	PM Peak	High 8-Hour	AWDT	AM Peak	PM Peak	High 8-Hour	AWDT
365	201	25	13	16	114	252	0.49	0.61	4.34	9.59
366	201	10	75	95	666	1473	2.86	3.62	25.38	56.13
367	337	31	786	996	6993	15462	50.18	63.58	446.42	987.06
368	868	10	569	721	5063	11195	93.59	118.59	832.73	1841.29
369	167	10	542	687	4823	10665	17.18	21.78	152.89	338.08
370	96	12	278	353	2476	5475	5.04	6.40	44.86	99.19
371	141	26	354	449	3149	6964	9.45	11.98	84.04	185.86
				Logan Airport VMT			9,006	11,407	80,088	177,094

AWDT = Average annual weekday daily traffic

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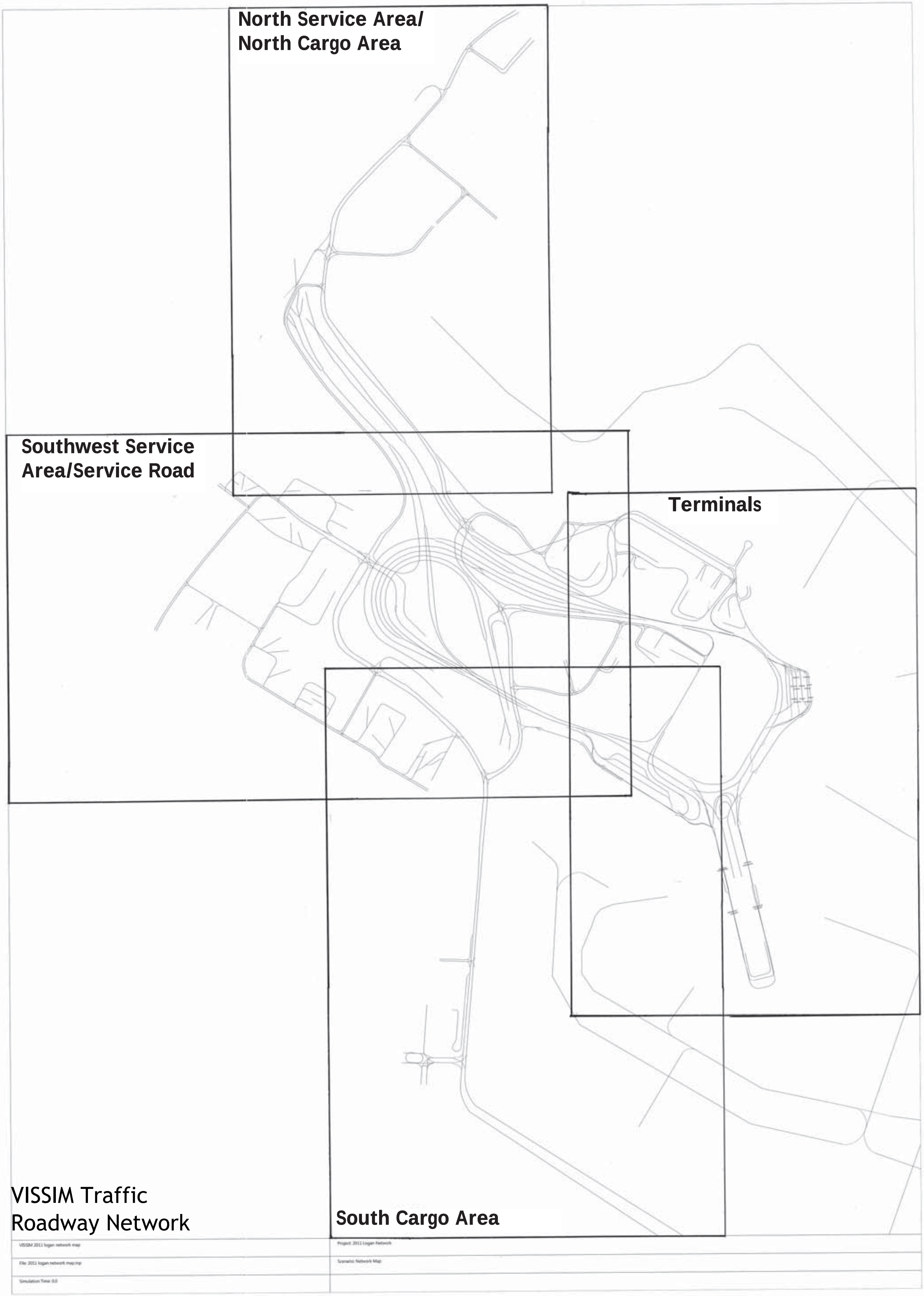
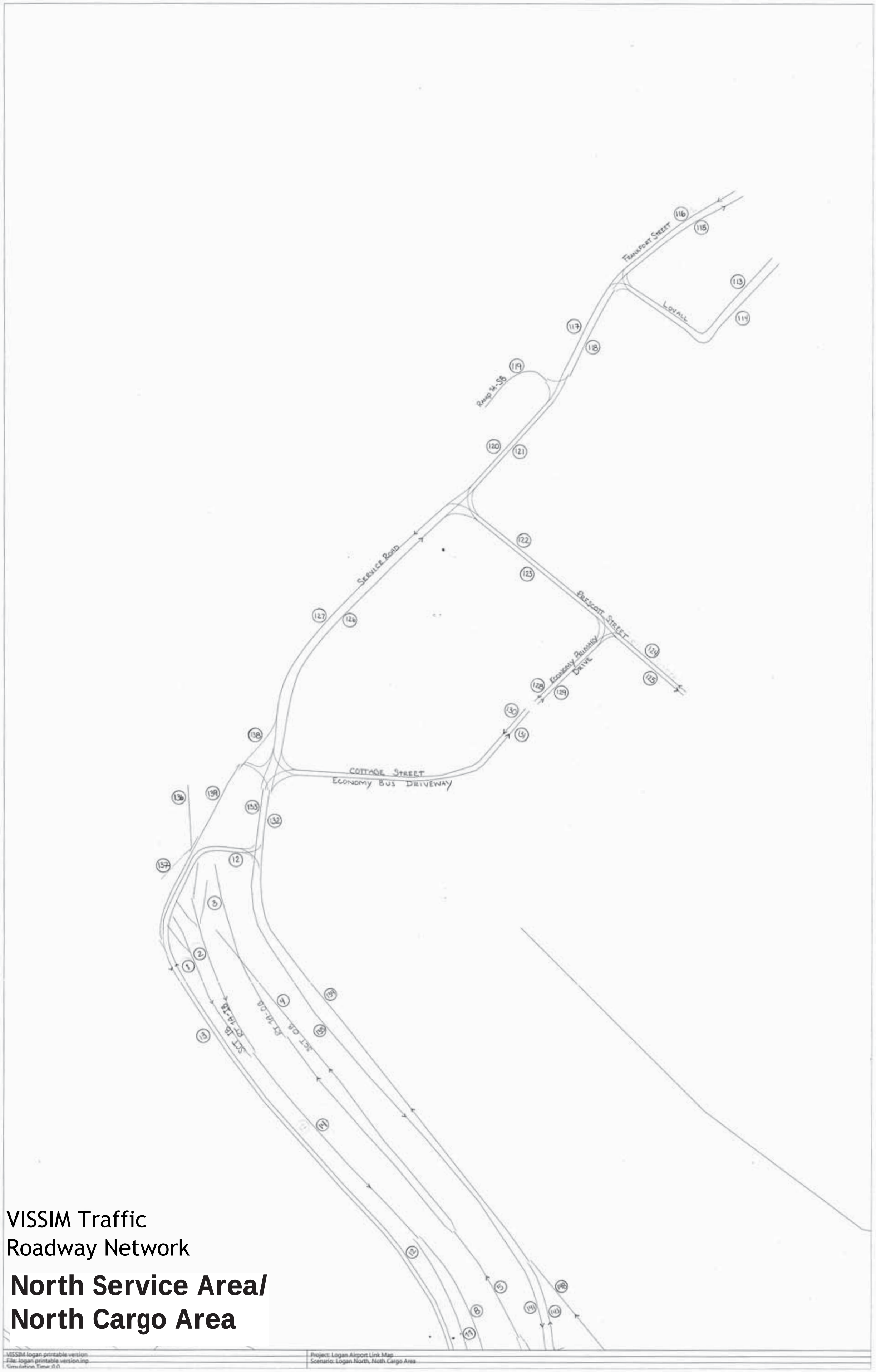
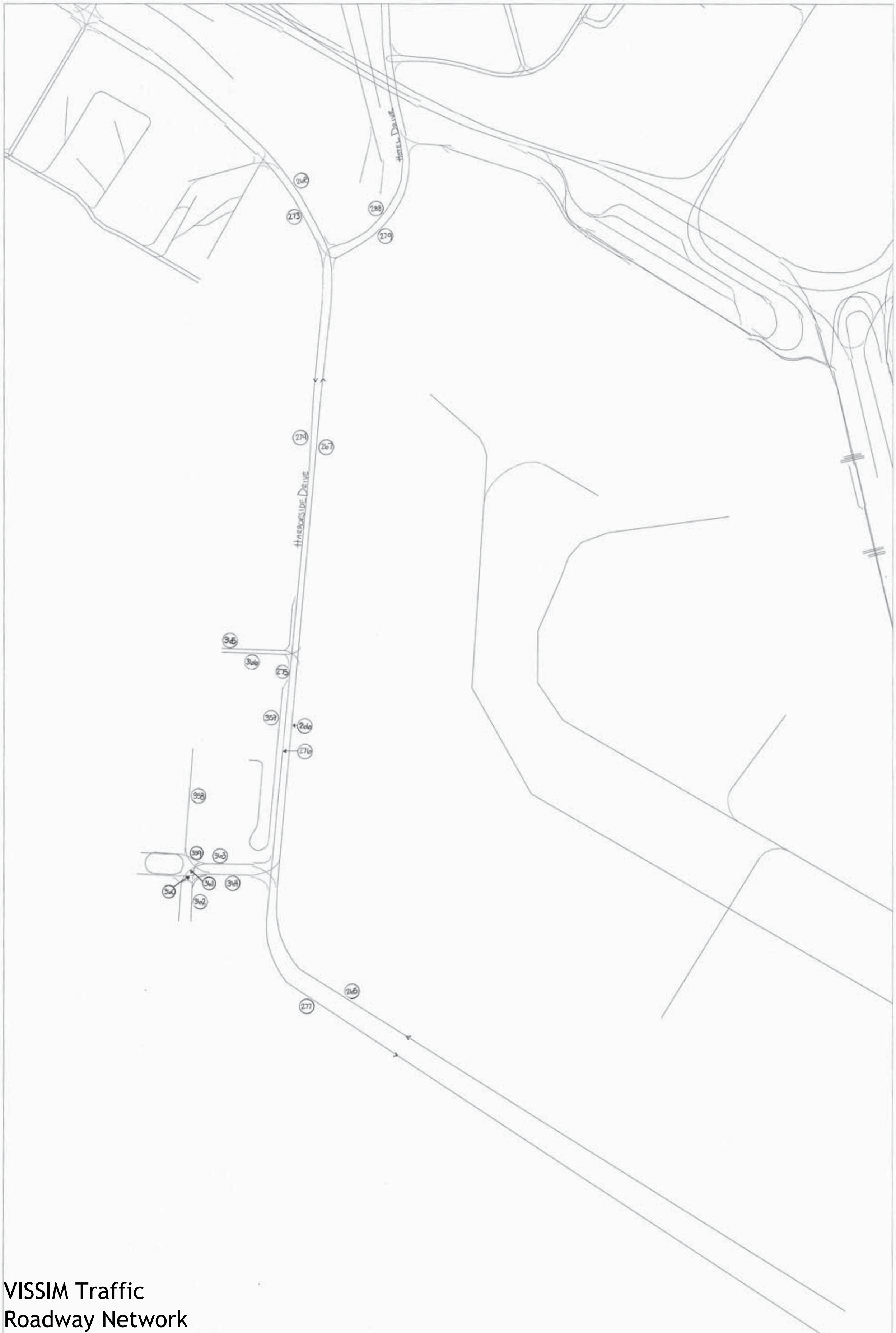

North Service Area/
North Cargo Area
Southwest Service
Area/Service Road
Terminals
South Cargo Area
VISSIM Traffic
Roadway Network



VISSIM Traffic
Roadway Network

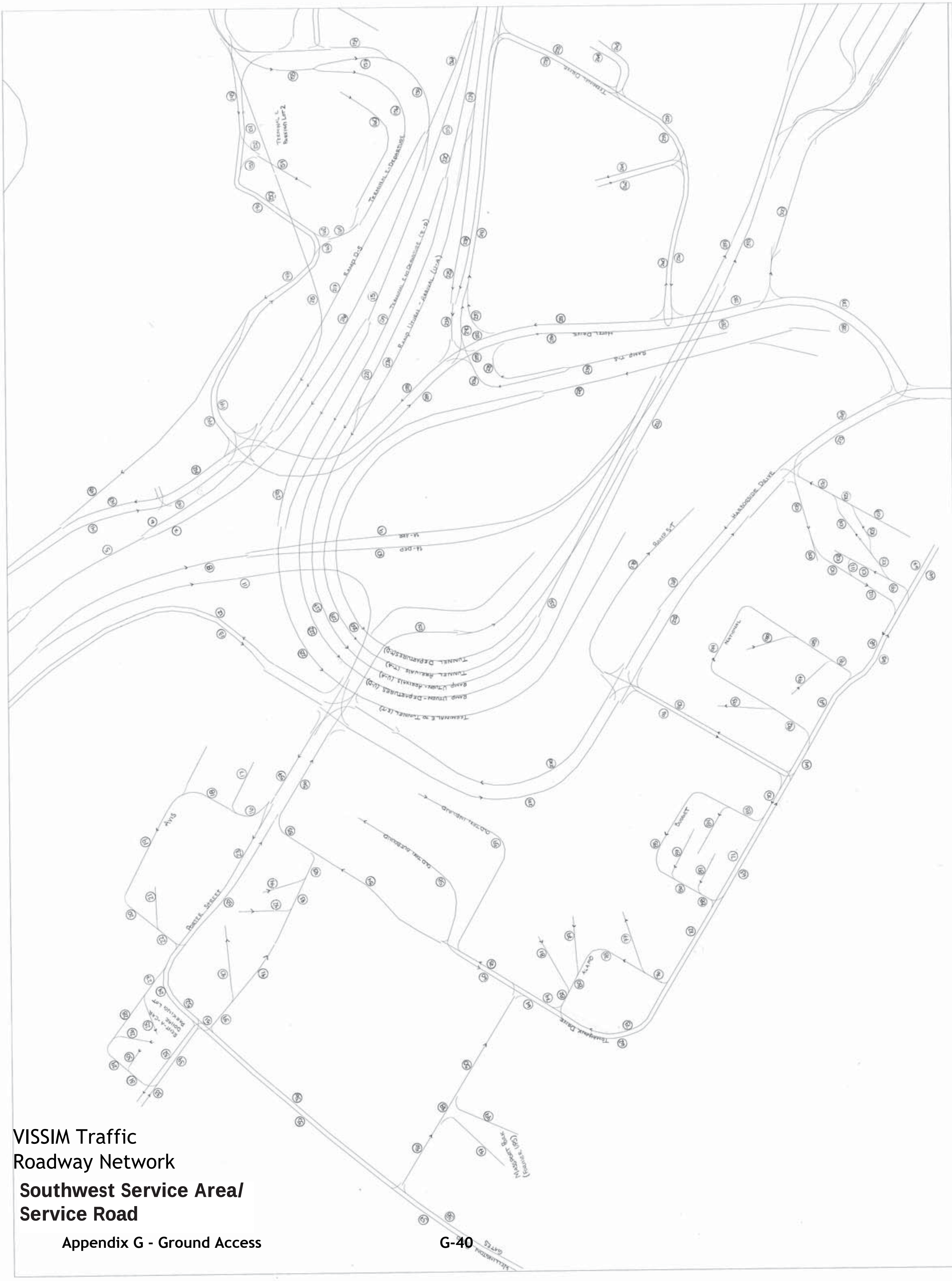
North Service Area/
North Cargo Area



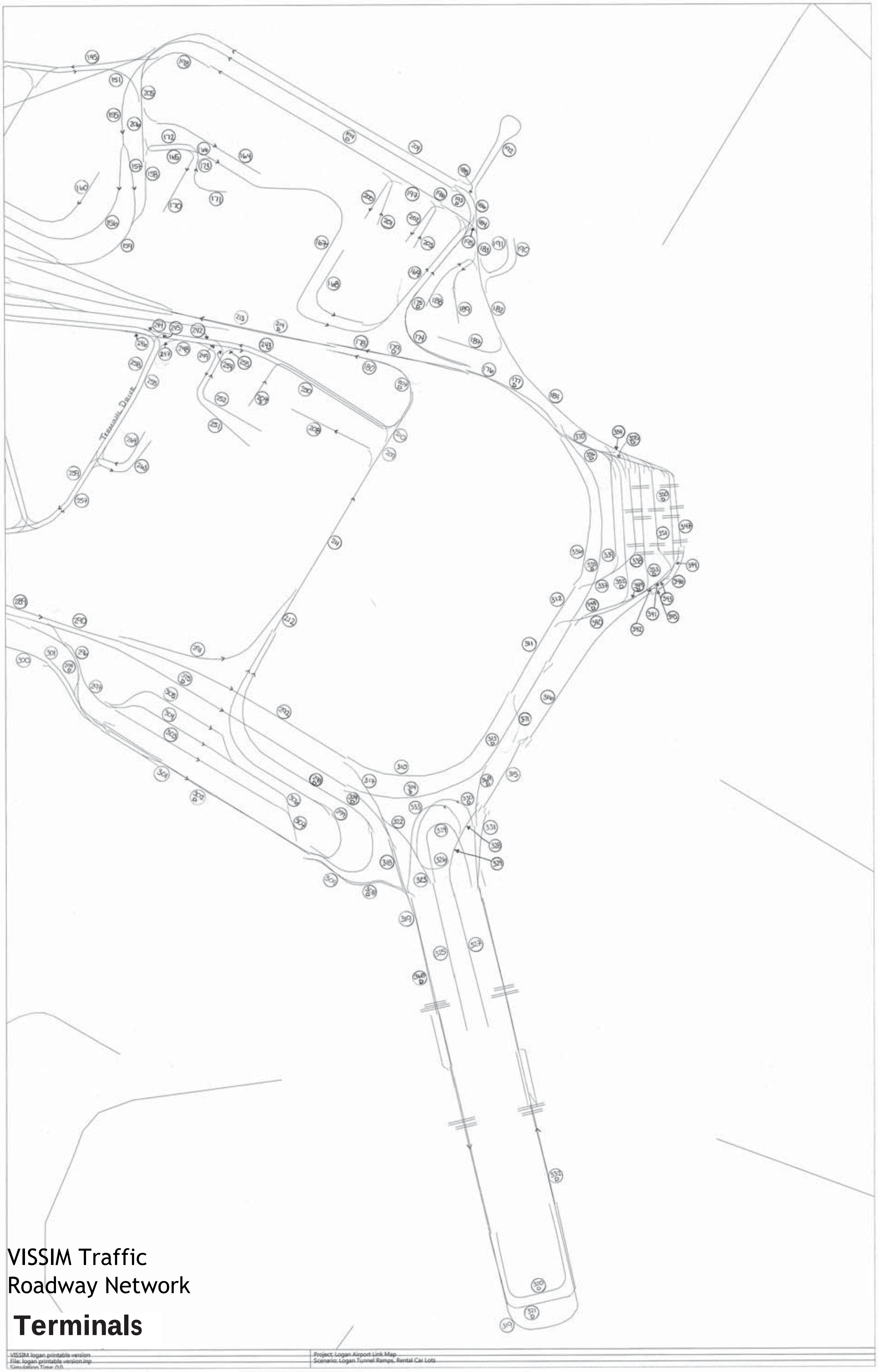
VISSIM Traffic
Roadway Network

South Cargo Area

VISSIM logan printable version	Project: Logan Airport Map Link
File: logan printable version.inp	Scenario: Harborside Drive
Simulation Time: 0.0	



VISSIM Traffic
Roadway Network
Southwest Service Area/
Service Road



VISSIM Traffic
Roadway Network

Terminals

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Massachusetts Port Authority
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Telephone (617) 568-5000
www.massport.com

March 1st, 2012

Christine Kirby
Department of Environmental Protection
Division of Air Quality Control
One Winter Street
Boston, MA 02108

Re: March 1st, 2012 Logan Airport Parking Space Inventory

Dear Ms. Kirby:

In compliance with the reporting requirements of 310 CMR 7.30 (3)(d), enclosed are the following March 1st, 2012 Massachusetts Port Authority submissions:

- Commercial Parking Space Inventory
- Employee Parking Space Inventory
- Location Map

Massport's parking program remains in compliance with the Aviation and Transportation Security Act of 2001 (ATSA) and supplemental FAA security directives, and our top priority continues to be the safe and secure operation of our transportation and parking facilities. We continue to provide information on rental car spaces as a courtesy.

The attachments provide the quantity, physical distribution and allocation of commercial and employee parking spaces as defined by 310 CMR 7.30, as amended. These inventory tables are based on information provided by the Aviation Department's Ground Transportation Unit, as supplemented by field checks, and represent the most up to date information on parking at Logan International Airport as of March 1st, 2012.

The Commercial Parking Space Inventory now totals 18,019 parking spaces (17,053 in service and 966 designated). The Employee Parking Space Inventory totals 2,673 employee parking spaces (2,619 in service and 54 designated). Designated spaces reflect parking spaces that are temporarily out of service. The total inventory of spaces at Logan Airport remains unchanged at 20,692.

Terminal B Garage capacity has been reduced by approximately 650 spaces due to garage and roadway construction.

The South West Service Area is now under construction as part of the Consolidated Rental Car project and this will affect the location and number of rental car spaces until the project is completed in 2015. Therefore, the Rental Car Parking Space locations on the attached map may not reflect current site conditions.

The attached Logan Airport Parking Space Inventory reflects Massport's successful management of its parking program, within the requirements of 310 CMR 7.30, as amended. If you have any questions, please call me at (617) 568-3570.

Sincerely,

Craig Leiner
Economic Planning & Development Department

cc: L. Dantas
S. Dalzell
I. Wallach
B. Desrosiers
D. Cook

Commercial Parking Spaces

Map ID#	Location of Commercial Parking Areas	Number of Spaces
Terminal Area and Economy Spaces		
C1a	Central Garage	7,236
C1b	West Garage	3,108
C2	Terminal B Garage	2,632
C6	Economy Garage	2,789
C8a	Terminal E Lot 1	269
C8b	Terminal E Lot 2	257
C9	Terminal E Lot 3 (fka "Gulf Station" Lot)	222
	subtotal	*16,513*
Hotel Spaces		
C4	Logan Airport Hilton Hotel (two lots)	235
C7a	Harborside Hyatt Conference Center	270
	subtotal	*505*
General Aviation Spaces		
C5	Signature (General Aviation Terminal)	35
	subtotal	*35*

Total In-Service Commercial Parking Spaces	**17,053**
Total Designated Commercial Parking Spaces	**966**
Total Commercial Parking Spaces	**18,019**
Total Employee Parking Spaces *(see table on next page)*	**2,673**
TOTAL PARKING FREEZE SPACES	**20,692**

Employee Parking Spaces

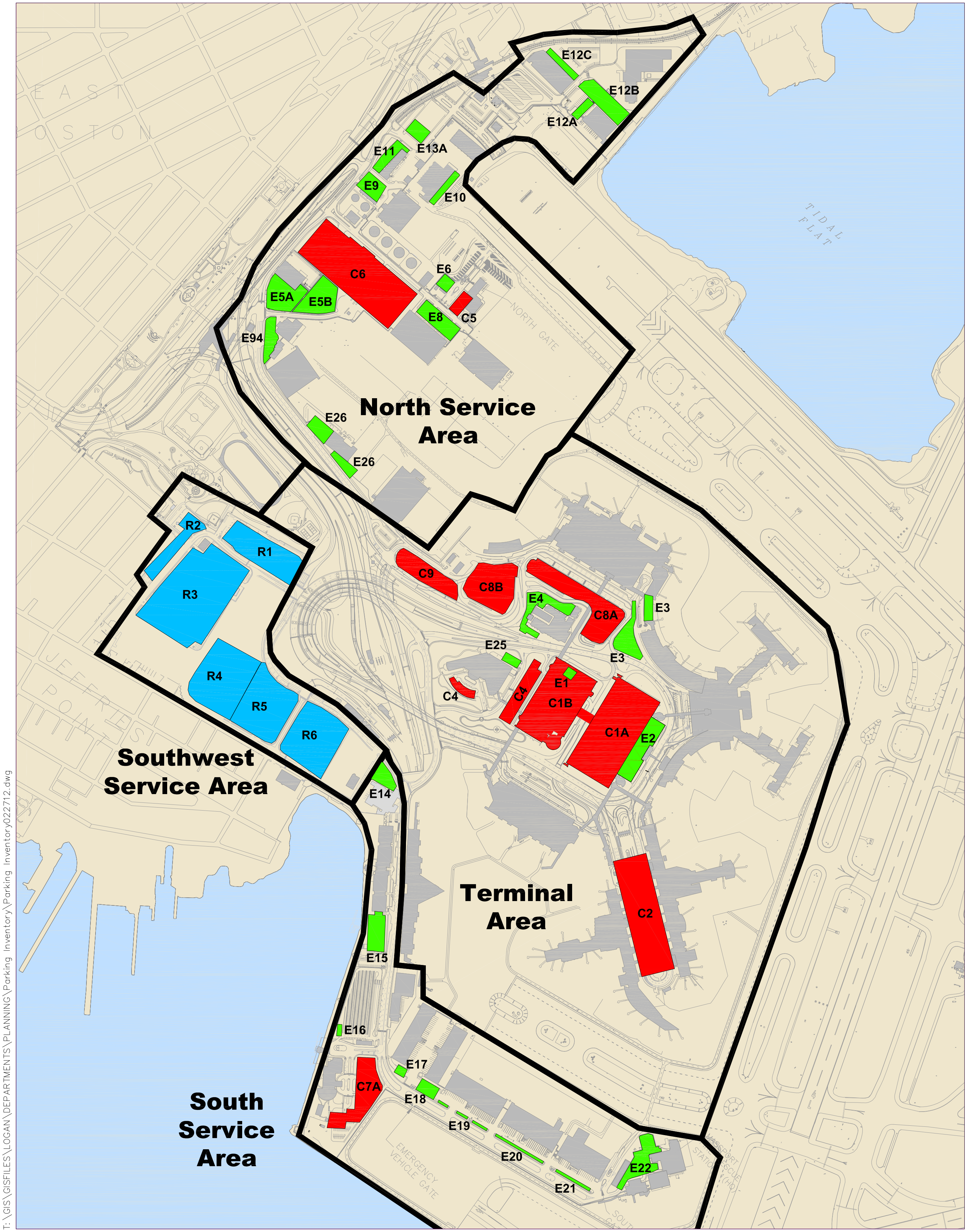
Map ID#	Location of Employee Parking Areas	Number of Spaces
E1	Central Parking / West Garage	93
E2	Massport Tower	517
E3	Terminal C Pier A (Old Terminal D) (two lots)	87
E4	Massport Facilities 1 (Heating Plant)	94
E5a	North Cargo Building 11, TSA lot	81
E5b	North Cargo Building 11, State Police lot	158
E6	North Gate & EMS Trailer	31
E8	North Cargo Building 8	111
E9	US Airways Administration	84
E10	Massport Facilities 2 (airside)	35
E11	Massport Facilities 3	95
E12a	LSG Sky Chefs, main lot	20
E12b	LSG Sky Chefs, overflow lot	126
E12c	Flight Kitchen Building 1	37
E13a	Lovell Street Lot	12
E14	Gate Gourmet	85
E15	Bird Island Flats (BIF) / LOC Garage	504
E16	Massport Taxi Pool	9
E17	South Cargo Building 63	16
E18	South Cargo Building 62	51
E19	South Cargo Building 58	23
E20	South Cargo Building 57	44
E21	South Cargo Building 56	72
E22	Fire-Rescue HQ & Amelia Earhart Building	89
E25	Hilton Hotel	30
E26	UPS (Cargo Building 13)	44
E94	United Aircraft Maint. (Buildings 93 & 94)	66
N/A	*ARFF Satellite Station* [1]	5

[1] This facility is located on the airfield and is not shown in the map.

Total In-Service Employee Parking Spaces	**2,619**
Total Designated Employee Parking Spaces	**54**
Total Employee Parking Spaces	**2,673**
Total Commercial Parking Spaces *(see table on previous page)*	**18,019**
TOTAL PARKING FREEZE SPACES	**20,692**

Rental Car Company Parking Spaces

Map ID#	Number of Spaces
R1	1,027
R2	130
R3	1,016
R4	1,550
R5	960
R6	337
Total Rental Car Spaces	**5,020**



Logan Airport
Parking Space Inventory

Logan International Airport
East Boston, MA
Massachusetts Port Authority
March 1, 2012

Legend:

- Logan Parking Service Area Zones
- Commercial Parking Space Locations
- Employee Parking Space Locations
- Rental Car Parking Space Locations

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in feet

Notes:

This plan is intended for informational purposes only and no use may be made of the same without the express written permission of the Massachusetts Port Authority ("Massport"). Massport does not certify the accuracy, information or title to the properties contained in this plan nor make any warranties of any kind, express or implied, in fact or by law, with respect to any boundaries, easements, restrictions, claims, overlaps or other encumbrances affecting such properties.

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September 4th, 2012

Christine Kirby, Deputy Director
Department of Environmental Protection
Division of Consumer and Transportation Programs
Bureau of Waste Prevention
One Winter Street
Boston, MA 02108

Re: September 1st, 2012 Logan Airport Parking Space Inventory

Dear Ms. Kirby:

In compliance with the reporting requirements of 310 CMR 7.30 (3)(d), enclosed are the following September 1st, 2012 Massachusetts Port Authority submissions:

- Commercial Parking Space Inventory
- Employee Parking Space Inventory
- Location Map

Massport's parking program remains in compliance with the Aviation and Transportation Security Act of 2001 (ATSA) and supplemental FAA security directives, and our top priority continues to be the safe and secure operation of our transportation and parking facilities. We continue to provide information on rental car spaces as a courtesy.

The attachments provide the quantity, physical distribution and allocation of commercial and employee parking spaces as defined by 310 CMR 7.30, as amended. These inventory tables are based on information provided by the Aviation Department's Ground Transportation Unit, as supplemented by field checks, and represent the most up to date information on parking at Logan International Airport as of September 1st, 2012.

In July 2012, Massport acquired property at 135B Bremen in East Boston. This property supported Park-and-Fly spaces which were included in the East Boston Parking Freeze. In a letter dated July 27th, 2012, the Massachusetts Department of Environmental Protection certified a revised Parking Freeze inventory for Logan Airport and East Boston. The inventory of commercial spaces in the Logan Airport Freeze was increased by 246 spaces.

The Commercial Parking Space Inventory now totals 18,265 spaces. The Employee Parking Space Inventory totals 2,673 employee parking spaces. The total inventory of spaces at Logan Airport is 20,938.

The South West Service Area remains under construction as part of the Consolidated Rental Car project and this continues to affect the location and number of rental car spaces. Therefore, the Rental Car Parking Space locations shown on the attached map (R-1 through R-6) may not reflect daily site conditions.

The attached Logan Airport Parking Space Inventory reflects Massport's successful management of its parking program, within the requirements of 310 CMR 7.30, as amended. If you have any questions, please call me at (617) 568-3570.

Sincerely,

Craig Leiner
Economic Planning & Development Department

cc: L. Dantas
S. Dalzell
I. Wallach
B. Desrosiers
D. Conroy

Commercial Parking Spaces

Map ID#	Location of Commercial Parking Areas	Number of Spaces
Terminal Area and Economy Spaces		
C1a	Central Garage	7,288
C1b	West Garage	3,108
C2	Terminal B Garage	2,553
C6	Economy Garage	2,809
C8a	Terminal E Lot 1	269
C8b	Terminal E Lot 2	251
C9	Terminal E Lot 3 (fka "Gulf Station" Lot)	222
	subtotal	*16,500*
Hotel Spaces		
C4	Logan Airport Hilton Hotel (two lots)	235
C7a	Harborside Hyatt Conference Center	270
	subtotal	*505*
General Aviation Spaces		
C5	Signature (General Aviation Terminal)	35
	subtotal	*35*

Total In-Service Commercial Parking Spaces	**17,040**
Total Designated Commercial Parking Spaces	**1,225**
Total Commercial Parking Spaces	**18,265**
Total Employee Parking Spaces *(see table on next page)*	**2,673**
TOTAL PARKING FREEZE SPACES	**20,938**

Employee Parking Spaces

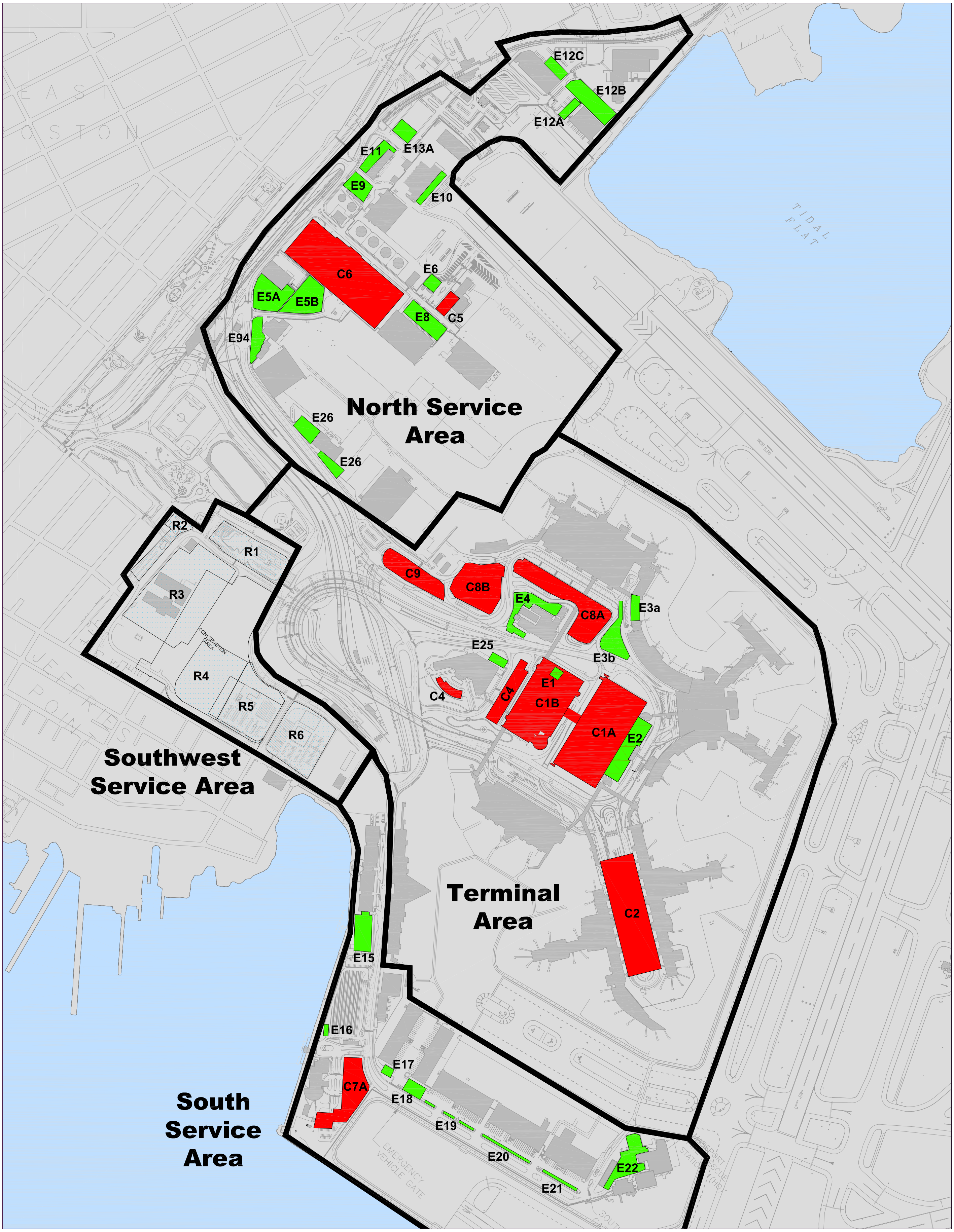
Map ID#	Location of Employee Parking Areas	Number of Spaces
E1	Central Parking / West Garage	98
E2	Massport Tower	524
E3	Terminal C Pier A (Old Terminal D) (two lots)	133
E4	Massport Facilities 1 (Heating Plant)	94
E5a	North Cargo Building 11, TSA lot	81
E5b	North Cargo Building 11, State Police lot	158
E6	North Gate & EMS Trailer	31
E8	North Cargo Building 8	111
E9	US Airways Administration	82
E10	Massport Facilities 2 (airside)	35
E11	Massport Facilities 3	96
E12a	LSG Sky Chefs, main lot	20
E12b	LSG Sky Chefs, overflow lot	126
E12c	Flight Kitchen Building 1 (and nearby)	77
E13a	Lovell Street Lot (for contractors use)	25
~~E14~~	former Gate Gourmet building (demolished)	0
E15	Bird Island Flats (BIF) / LOC Garage	504
E16	Massport Taxi Pool	9
E17	South Cargo Building 63	16
E18	South Cargo Building 62	51
E19	South Cargo Building 58	23
E20	South Cargo Building 57	44
E21	South Cargo Building 56	72
E22	Fire-Rescue HQ & Amelia Earhart Building	89
E25	Hilton Hotel	30
E26	UPS (Cargo Building 13)	44
E94	United Aircraft Maint. (Buildings 93 & 94)	66
N/A	*ARFF Satellite Station* [1]	5

[1] This facility is located on the airfield and is not shown in the map.

Total In-Service Employee Parking Spaces	**2,644**
Total Designated Employee Parking Spaces	**29**
Total Employee Parking Spaces	**2,673**
Total Commercial Parking Spaces *(see table on previous page)*	**18,265**
TOTAL PARKING FREEZE SPACES	**20,938**

Rental Car Company Parking Spaces

Map ID#	Number of Spaces
R1	1,027
R2	130
R3	1,016
R4	1,550
R5	960
R6	337
Total Rental Car Spaces	**5,020**



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Logan Airport
Parking Space Inventory

Logan International Airport
East Boston, MA

Massachusetts Port Authority
September 2012

Legend:

- Logan Parking Service Area Zones
- Commercial Parking Space Locations
- Employee Parking Space Locations
- Rental Car Parking Space Locations

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in feet

Notes:

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Massachusetts Port Authority
One Harborside Drive, Suite 200S
East Boston, MA 02128-2909
Telephone (617) 568-5000
www.massport.com

March 1st, 2013

Christine Kirby, Deputy Director
Department of Environmental Protection
Division of Consumer and Transportation Programs
Bureau of Waste Prevention
One Winter Street
Boston, MA 02108

Re: March 1st, 2013 Logan Airport Parking Space Inventory

Dear Ms. Kirby:

In compliance with the reporting requirements of 310 CMR 7.30 (3)(d), enclosed are the following March 1st, 2013 Massachusetts Port Authority submissions:

- Commercial Parking Space Inventory
- Employee Parking Space Inventory
- Location Map

Massport's parking program remains in compliance with the Aviation and Transportation Security Act of 2001 (ATSA) and supplemental FAA security directives, and our top priority continues to be the safe and secure operation of our transportation and parking facilities. We continue to provide information on rental car spaces as a courtesy.

The attachments provide the quantity, physical distribution and allocation of commercial and employee parking spaces as defined by 310 CMR 7.30, as amended. These inventory tables are based on information provided by the Aviation Department's Ground Transportation Unit, as supplemented by field checks, and represent the most up to date information on parking at Logan International Airport as of March 1st, 2013.

The Commercial Parking Space Inventory totals 18,265 spaces; the Employee Parking Space Inventory totals 2,673 employee parking spaces; the total inventory of spaces at Logan Airport is 20,938.

The South West Service Area remains under construction as part of the Consolidated Rental Car facility project and this activity continues to affect the location and number of rental car spaces. Therefore, the Rental Car Parking Space locations shown on the attached map (R-1 through R-6) does not reflect daily site conditions. The new facility is expected to be occupied later this year; thus the September 1st, 2013 submission will include a revised location map showing the footprint of the new consolidated rental car facility.

The attached Logan Airport Parking Space Inventory reflects Massport's successful management of its parking program, within the requirements of 310 CMR 7.30, as amended. If you have any questions, please call me at (617) 568-3570.

Sincerely,

Craig Leiner
Economic Planning & Development Department

cc: L. Dantas
S. Dalzell
I. Wallach
B. Desrosiers
D. Conroy

Employee Parking Space Inventory
Logan International Airport
March 1, 2013 Submission

Employee Parking Spaces

Map ID#	Location of Employee Parking Areas	Number of Spaces
E1	West Garage	98
E2	Massport Tower (Central Parking Garage)	524
E3	Terminal C Pier A (Old Terminal D) (two lots)	133
E4	Massport Facilities 1 (Heating Plant)	94
E5a	North Cargo Building 11, TSA lot	81
E5b	North Cargo Building 11, State Police lot	158
E6	North Gate & EMS Trailer	31
E8	North Cargo Building 8	111
E9	US Airways Administration	82
E10	Massport Facilities 2 (airside)	35
E11	Massport Facilities 3	96
E12a	LSG Sky Chefs, main lot	20
E12b	LSG Sky Chefs, overflow lot	126
E12c	Flight Kitchen Building 1 (and nearby)	77
E13a	Lovell Street Lot (for contractors use)	25
E14	Green Bus Depot (bus maintenance facility)	14
E15	Bird Island Flats (BIF) / LOC Garage	504
E16	Massport Taxi Pool	9
E17	South Cargo Building 63	16
E18	South Cargo Building 62	51
E19	South Cargo Building 58	23
E20	South Cargo Building 57	44
E21	South Cargo Building 56	72
E22	Fire-Rescue HQ & Amelia Earhart Building	89
E25	Hilton Hotel	30
E26	UPS (Cargo Building 13)	44
E94	United Aircraft Maint. (Buildings 93 & 94)	66
N/A	*ARFF Satellite Station* [1]	5

[1] This facility is located on the airfield and is not shown in the map.

Total In-Service Employee Parking Spaces	**2,658**
Total Designated Employee Parking Spaces	**15**
Total Employee Parking Spaces	**2,673**
Total Commercial Parking Spaces *(see table on previous page)*	**18,265**
TOTAL PARKING FREEZE SPACES	**20,938**

Commercial Parking Space Inventory
Logan International Airport
March 1, 2013 Submission

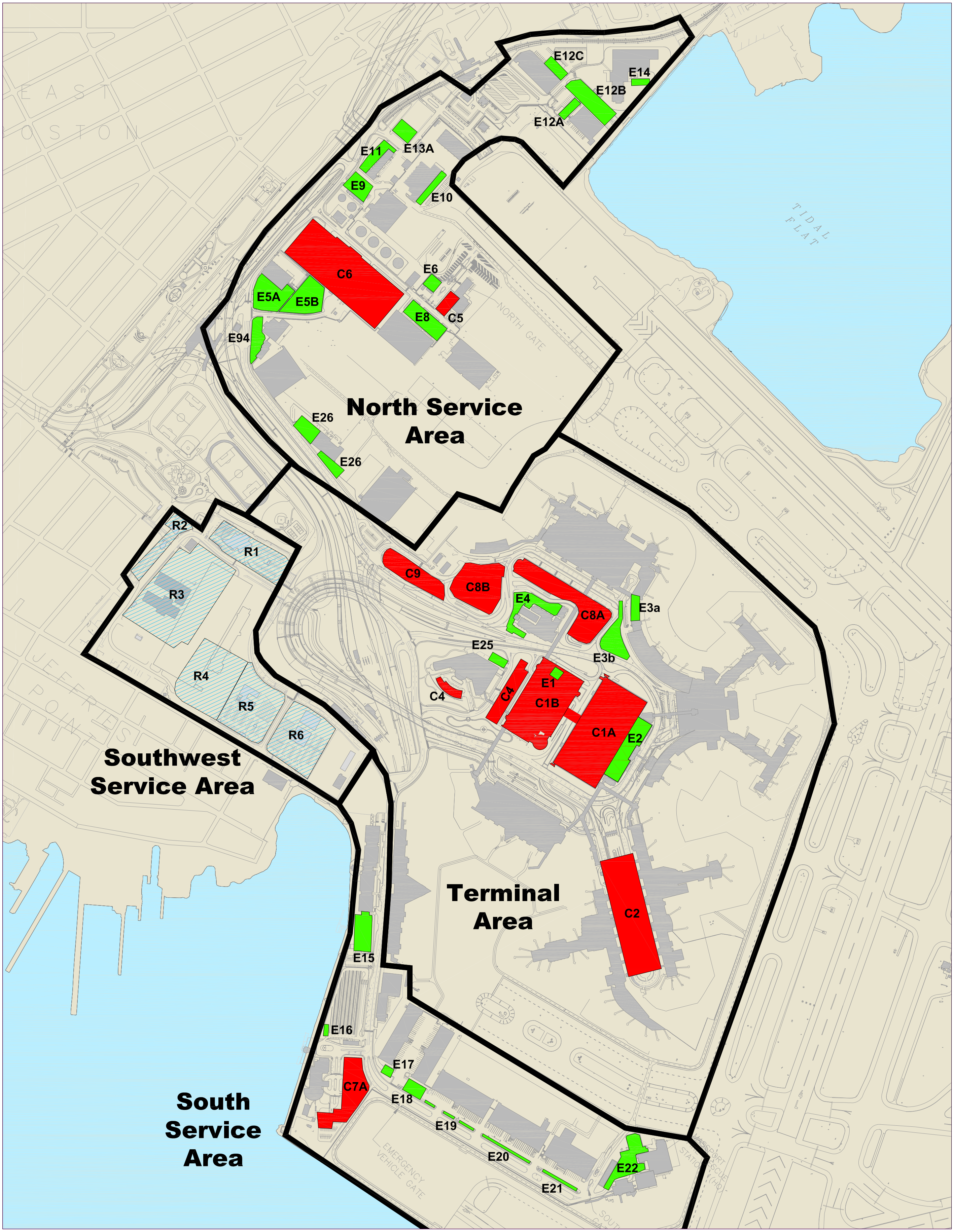
Commercial Parking Spaces

Map ID#	Location of Commercial Parking Areas	Number of Spaces
Terminal Area and Economy Spaces		
C1a	Central Garage	7,288
C1b	West Garage	3,108
C2	Terminal B Garage	2,553
C6	Economy Garage	2,809
C8a	Terminal E Lot 1	269
C8b	Terminal E Lot 2	251
C9	Terminal E Lot 3 (fka "Gulf Station" Lot)	222
	subtotal	*16,500*
Hotel Spaces		
C4	Logan Airport Hilton Hotel (two lots)	235
C7a	Harborside Hyatt Conference Center	270
	subtotal	*505*
General Aviation Spaces		
C5	Signature (General Aviation Terminal)	35
	subtotal	*35*

Total In-Service Commercial Parking Spaces	**17,040**
Total Designated Commercial Parking Spaces	**1,225**
Total Commercial Parking Spaces	**18,265**
Total Employee Parking Spaces *(see table on next page)*	**2,673**
TOTAL PARKING FREEZE SPACES	**20,938**

Rental Car Company Parking Spaces

Map ID#	Number of Spaces
R1	1,027
R2	130
R3	1,016
R4	1,550
R5	960
R6	337
Total Rental Car Spaces	**5,020**



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Logan Airport
Parking Space Inventory

Logan International Airport
East Boston, MA

massport
Massachusetts Port Authority
March 2013

Legend:

- Logan Parking Service Area Zones
- Commercial Parking Space Locations
- Employee Parking Space Locations
- Rental Car Parking Space Locations

N

0 250 500 1000
in feet

Notes:

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Massachusetts Port Authority
One Harborside Drive, Suite 200S
East Boston, MA 02128-2909
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September 3rd, 2013

Christine Kirby, Deputy Director
Department of Environmental Protection
Division of Consumer and Transportation Programs
Bureau of Waste Prevention
One Winter Street
Boston, MA 02108

Re: September 1st, 2013 Logan Airport Parking Space Inventory

Dear Ms. Kirby:

In compliance with the reporting requirements of 310 CMR 7.30 (3)(d), enclosed are the following September 1st, 2013 Massachusetts Port Authority submissions:

- Commercial Parking Space Inventory
- Employee Parking Space Inventory
- Location Map

Massport's parking program remains in compliance with the Aviation and Transportation Security Act of 2001 (ATSA) and supplemental FAA security directives, and our top priority continues to be the safe and secure operation of our transportation and parking facilities. We continue to provide information on rental car spaces as a courtesy.

The attachments provide the quantity, physical distribution and allocation of commercial and employee parking spaces as defined by 310 CMR 7.30, as amended. These inventory tables are based on information provided by the Aviation Department's Ground Transportation Unit, as supplemented by field checks, and represent the most up to date information on parking at Logan International Airport as of September 1st, 2013.

The Commercial Parking Space Inventory totals 18,415 spaces; the Employee Parking Space Inventory totals 2,673 employee parking spaces; the total inventory of spaces at Logan Airport is 21,088. This revised total reflects the additional 150 spaces transferred from Paul's Parking as confirmed in your June 4th, 2013 letter to Massport and the Boston Air Pollution Control Commission.

The South West Service Area remains under construction as part of the Consolidated Rental Car facility (CONRAC) project and this activity continues to affect the location and number of rental car spaces. The Rental Car Parking Space locations shown on the attached map (R-1 through R-6) is approximate and does not reflect daily site conditions.

The CONRAC is expected to open September 25th, 2013, with all rental car operations transferred to the new facility on that date. The opening of the CONRAC will coincide with the start of Massport's Unified Shuttle Bus system. This shuttle system will reduce the number of shuttles operating on the airport, with substantial air quality and customer service benefits. Massport has purchased a new fleet of 60-foot diesel-electric hybrid buses to provide this service. Massport's March 1st, 2014 submission will include a revised location map showing the footprint of the new rental car facility.

As you may know, demand for commercial parking at Logan Airport continues to be strong. While the Aviation Department deploys operational innovations to accommodate passenger parking demand, a broader strategic planning effort is underway to plan for ground access needs at future passenger levels. This effort is considering a range of high occupancy vehicle initiatives coupled with a long-range parking plan. The development of a long-range parking plan was noted in Massport's MEPA filing for the on-airport Economy Garage.

The attached Logan Airport Parking Space Inventory reflects Massport's successful management of its parking program, within the requirements of 310 CMR 7.30, as amended. If you have any questions, please call me at (617) 568-3570.

Sincerely,

Craig Leiner
Economic Planning & Development Department

cc: L. Dantas
S. Dalzell
I. Wallach
B. Desrosiers
D. Conroy

Commercial Parking Space Inventory
Logan International Airport
September 1, 2013 Submission

Commercial Parking Spaces

Map ID#	Location of Commercial Parking Areas	Number of Spaces
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C1a	Central Garage	7,288
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C8a	Terminal E Lot 1	269
C8b	Terminal E Lot 2	251
C9	Terminal E Lot 3 (fka "Gulf Station" Lot)	222
	subtotal	*16,210*
Hotel Spaces		
C4	Logan Airport Hilton Hotel (two lots)	235
C7a	Harborside Hyatt Conference Center	270
	subtotal	*505*
General Aviation Spaces		
C5	Signature (General Aviation Terminal)	35
	subtotal	*35*

Total In-Service Commercial Parking Spaces	**16,750**
Total Designated Commercial Parking Spaces	**1,665**
Total Commercial Parking Spaces	**18,415**
Total Employee Parking Spaces *(see table on next page)*	**2,673**
TOTAL PARKING FREEZE SPACES	**21,088**

Employee Parking Spaces

Map ID#	Location of Employee Parking Areas	Number of Spaces
E1	West Garage	98
E2	Massport Tower (Central Parking Garage)	524
E3	Terminal C Pier A (Old Terminal D) (two lots)	133
E4	Massport Facilities 1 (Heating Plant)	94
E5a	North Cargo Building 11, TSA lot	81
E5b	North Cargo Building 11, State Police lot	158
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E8	North Cargo Building 8	101
E9	US Airways Administration	82
E10	Massport Facilities 2 (airside)	35
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E12b	LSG Sky Chefs, overflow lot	126
E12c	Flight Kitchen Building 1 (and nearby)	80
E13a	Lovell Street Lot (for contractors use)	25
E14	Green Bus Depot (bus maintenance facility)	14
E15	Bird Island Flats (BIF) / LOC Garage	504
E16	Massport Taxi Pool	9
E17	South Cargo Building 63	16
E18	South Cargo Building 62	51
E19	South Cargo Building 58	23
E20	South Cargo Building 57	44
E21	South Cargo Building 56	72
E22	Fire-Rescue HQ & Amelia Earhart Building	89
E25	Hilton Hotel	30
E26	UPS (Cargo Building 13)	44
E94	United Aircraft Maint. (Buildings 93 & 94)	66
N/A	*ARFF Satellite Station* [1]	5

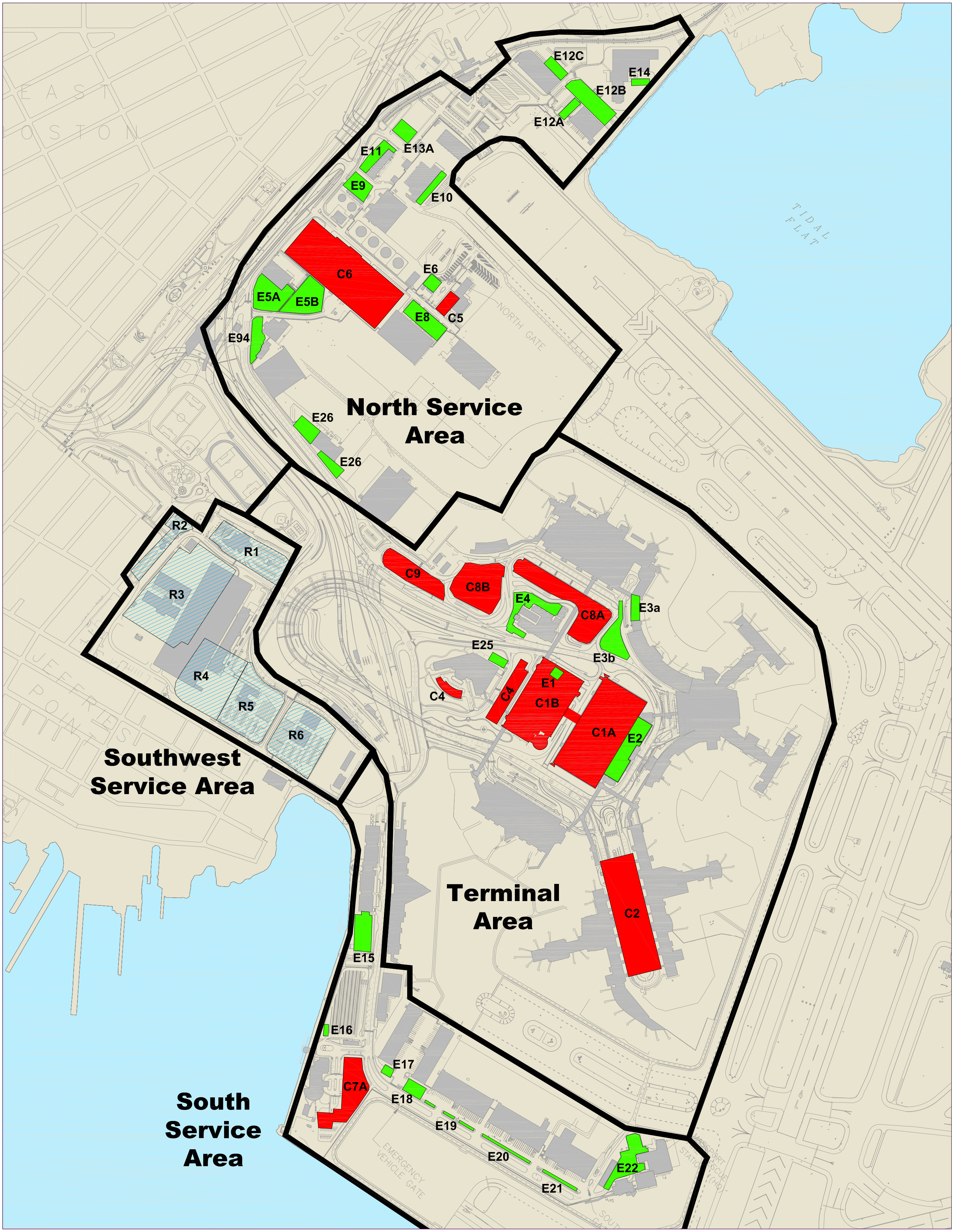
[1] This facility is located on the airfield and is not shown in the map.

Total In-Service Employee Parking Spaces	**2,656**
Total Designated Employee Parking Spaces	**17**
Total Employee Parking Spaces	**2,673**
Total Commercial Parking Spaces *(see table on previous page)*	**18,415**
TOTAL PARKING FREEZE SPACES	**21,088**

Supplemental Information: Rental Car Spaces Inventory
Logan International Airport
September 1, 2013 Submission

Rental Car Company Parking Spaces

Map ID#	Number of Spaces
R1	1,027
R2	130
R3	1,016
R4	1,550
R5	960
R6	337
Total Rental Car Spaces	**5,020**



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Logan Airport
Parking Space Inventory

Logan International Airport
East Boston, MA

Massachusetts Port Authority
September 1, 2013

Legend:

- Logan Parking Service Area Zones
- Commercial Parking Space Locations
- Employee Parking Space Locations
- Rental Car Parking Space Locations

N

0 250 500 1000
in feet

Notes:

This plan is intended for informational purposes only and no use may be made of the same without the express written permission of the Massachusetts Port Authority ("Massport"). Massport does not certify the accuracy, information or title to the properties contained in this plan nor make any warranties of any kind, express or implied, in fact or by law, with respect to any boundaries, easements, restrictions, claims, overlaps or other encumbrances affecting such properties.

H

Noise Abatement

This appendix provides detailed information, tables, and figures in support of *Chapter 6, Noise Abatement*:

- Fundamentals of Acoustics and Environmental Noise

- Logan Airport RealContours™ Data Inputs

- Annual Model Results and Status of Mitigation Programs

Fundamentals of Acoustics and Environmental Noise

Introduction

This section introduces the fundamentals of acoustics and noise terminology as well as the effects of noise on human activity and community annoyance.

Introduction to Acoustics and Noise Terminology

Chapter 6, Noise Abatement of this *2012/2013 Environmental Data Report (EDR)* relies largely on a measure of cumulative noise exposure over an entire calendar year, in terms of a metric called the Day-Night Average Sound Level (DNL). However, DNL does not always provide a sufficient description of noise for many purposes. Other measures are available to address essentially any issue of concern. This section introduces the following acoustic metrics, which are all related to DNL, but provide bases for evaluating a broad range of noise situations.

- Decibel (dB);
- A-Weighted Decibel (dBA);
- Sound Exposure Level (SEL);
- Equivalent Sound Level (L_{eq});
- Time Above (TA);
- Time Above, Night (TAN); and
- DNL.

The Decibel (dB)

All sounds come from a sound source – a musical instrument, a voice speaking, or an airplane that passes overhead. It takes energy to produce sound. The sound energy produced by any sound source is transmitted through the air in the form of sound waves – tiny, quick oscillations of pressure just above and just below atmospheric pressure. These oscillations, or sound pressures, impinge on the ear, creating the sound we hear.

Our ears are sensitive to a wide range of sound pressures. The loudest sounds that we hear without pain have about one million times more energy than the quietest sounds we hear. However, our ears are incapable of detecting small differences in these pressures. Thus, to match how we hear this sound energy, we compress the total range of sound pressures to a more meaningful range by introducing the concept of sound pressure level (SPL). SPL is a measure of the sound pressure of a given noise source relative to a standard reference value (typically the quietest sound that a young person with good hearing can detect). SPLs are measured in decibels (abbreviated dB). Decibels are logarithmic quantities – logarithms of the squared ratio of two pressures, the numerator being the pressure of the sound source of interest, and the denominator being the reference pressure (the quietest sound we can hear).

The logarithmic conversion of sound pressure to SPL means that the quietest sound we can hear (the reference pressure) has a SPL of about zero decibels, while the loudest sounds we hear without pain have SPLs of about 120 dB. Most sounds in our day-to-day environment have SPLs from 30 to 100 dB.

Because decibels are logarithmic quantities, they do not behave like regular numbers with which we are more familiar. For example, if two sound sources each produce 100 dB and they are operated together, they produce only 103 dB – not 200 dB as we might expect. Four equal sources operating simultaneously result in a total SPL of 106 dB. In fact, for every doubling of the number of equal sources, the SPL goes up another three decibels.

A tenfold increase in the number of sources makes the SPL go up 10 dB. A hundredfold increase makes the level go up 20 dB, and it takes a thousand equal sources to increase the level 30 dB.

If one source is much louder than another source, the two sources together will produce the same SPL (and sound to our ears) as if the louder source were operating alone. For example, a 100 dB source plus an 80 dB source produces 100 dB when operating together. The louder source "masks" the quieter one, but if the quieter source gets louder, it will have an increasing effect on the total SPL. When the two sources are equal, as described above, they produce a level three decibels above the sound of either one by itself.

From these basic concepts, note that one hundred 80 dB sources will produce a combined level of 100 dB; if a single 100 dB source is added, the group will produce a total SPL of 103 dB. Clearly, the loudest source has the greatest effect on the total decibel level.

A-Weighted Decibel, dBA

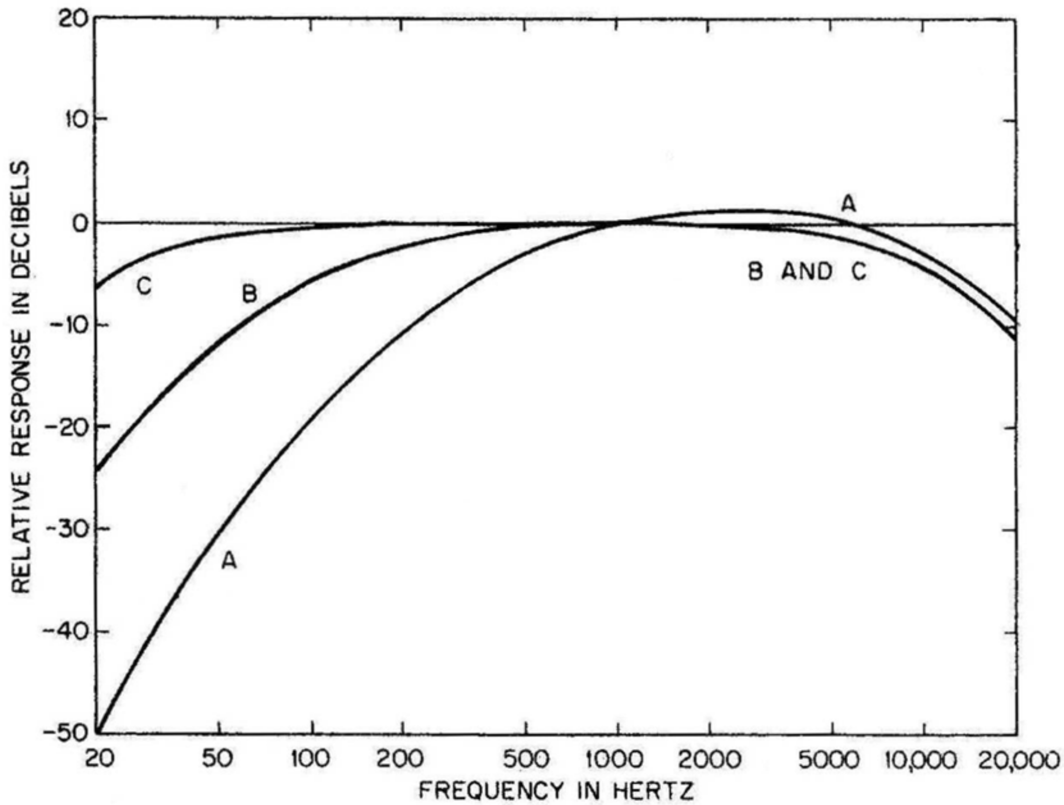
Another important characteristic of sound is its frequency, or "pitch." This is the rate of repetition of the sound pressure oscillations as they reach our ear. Formerly expressed in cycles per second, frequency is now expressed in units known as Hertz (Hz).

Most people hear from about 20 Hz to about 10,000 to 15,000 Hz. People respond to sound most readily when the predominant frequency is in the range of normal conversation, around 1,000 to 2,000 Hz. Acousticians have developed "filters" to match our ears' sensitivity and help us to judge the relative loudness of sounds made up of different frequencies. The so-called "A" filter does the best job of matching the sensitivity of our ears to most environmental noises. SPLs measured through this filter are referred to as A-weighted levels (dBA). A-weighting significantly de-emphasizes noise at low and very high frequencies (below about 500 Hz and above about 10,000 Hz) where we do not hear as well. Because this filter generally matches our ears' sensitivity, sounds having higher A-weighted sound levels are usually judged louder than those with lower A-weighted sound levels, a relationship which does not always hold true for unweighted levels. It is for these reasons that A-weighted sound levels are normally used to evaluate environmental noise.

Other weighting networks include the B and C filters. They correspond to different level ranges of the ear. The rarely used B-weighting attenuates low frequencies (those less than 500 Hz), but to a lesser degree than A-weighting. C weighting is nearly flat throughout the audible frequency range, hardly de-emphasizing low frequency noise. C-weighted levels can be preferable in evaluating sounds whose low-frequency components are responsible for secondary effects such as the shaking of a building, window rattle, or perceptible vibrations. Uses include the evaluation of blasting noise, artillery fire, and in some cases, aircraft noise inside buildings.

Figure H-1 compares these various weighting networks.

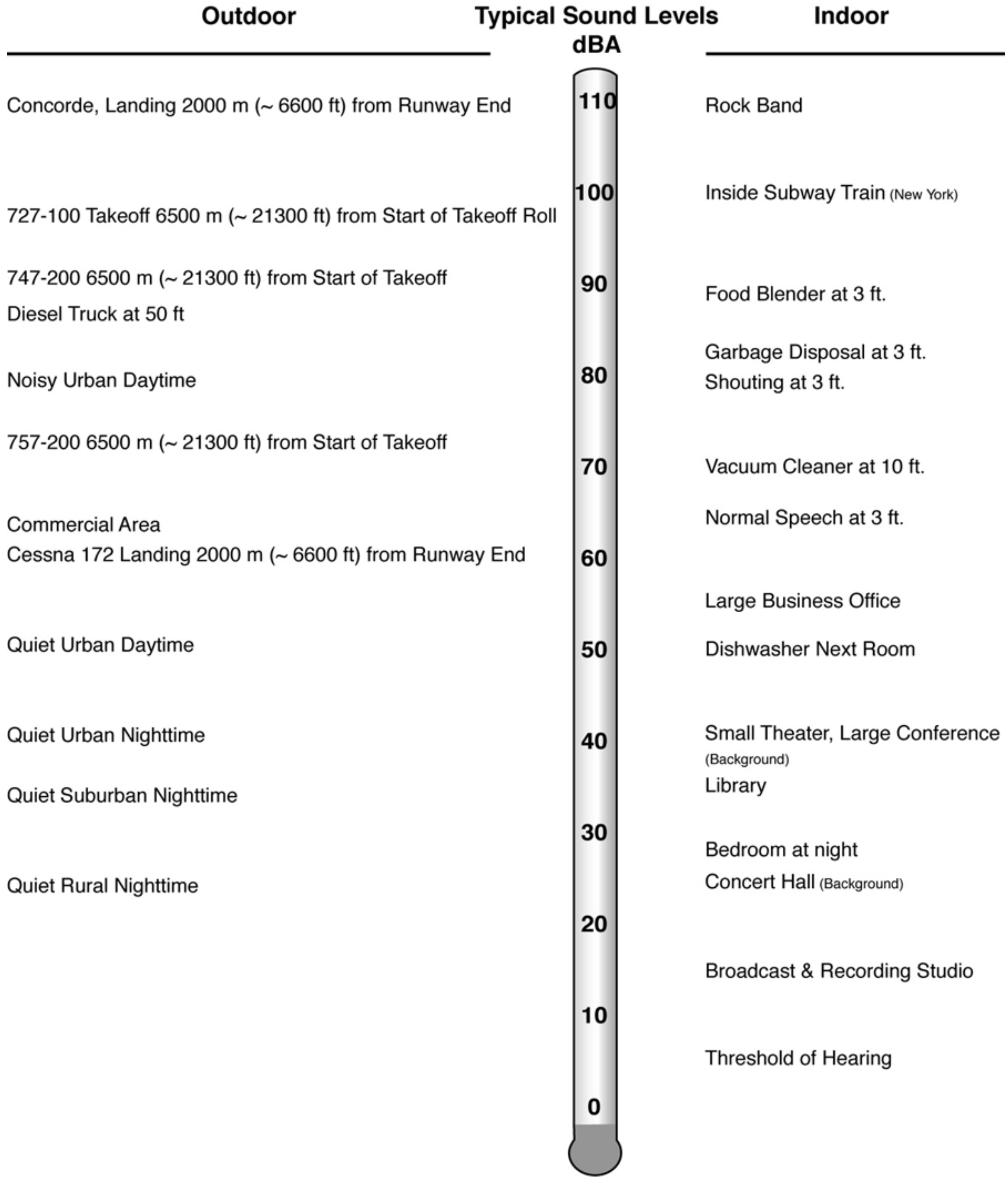
Figure H-1 Frequency-Response Characteristics of Various Weighting Networks



Source: Harris, Cyril M., editor; Handbook of Acoustical Measurements and Noise Control, (Chapter 5, "Acoustical Measurement Instruments"; Johnson, Daniel L.; Marsh, Alan H.; and Harris, Cyril M.); New York; McGraw-Hill, Inc.; 1991; p. 5.13.

Because of the correlation with our hearing, the A-weighted level has been adopted as the basic measure of environmental noise by the U.S. Environmental Protection Agency (EPA) and by nearly every other federal and state agency concerned with community noise. Figure H-2 presents typical A-weighted sound levels of several common environmental sources.

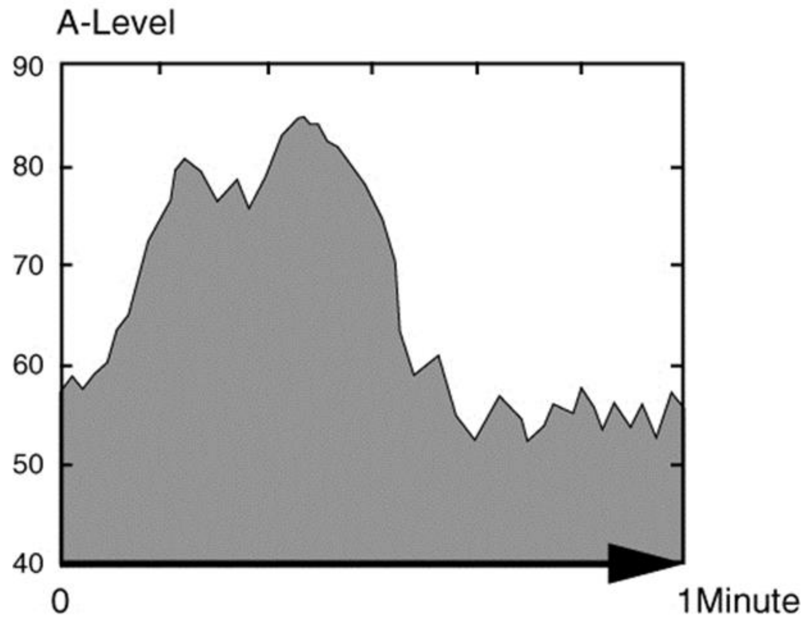
Figure H-2 Common Environmental Sound Levels, in dBA



Source: HMMH (Aircraft noise levels from FAA Advisory Circular 36-3H)

An additional dimension to environmental noise is that A-weighted levels vary with time. For example, the sound level increases as an aircraft approaches, then falls and blends into the background as the aircraft recedes into the distance (though even the background varies as birds chirp or the wind blows or a vehicle passes by). Figure H-3 illustrates this concept.

Figure H-3 Variations in the A-Weighted Sound Level Over Time



Source: HMMH

Maximum A-Weighted Noise Level, L_{max}

The variation in noise level over time often makes it convenient to describe a particular noise "event" by its maximum sound level, abbreviated as L_{max}. In the figure above, it is approximately 85 dBA.

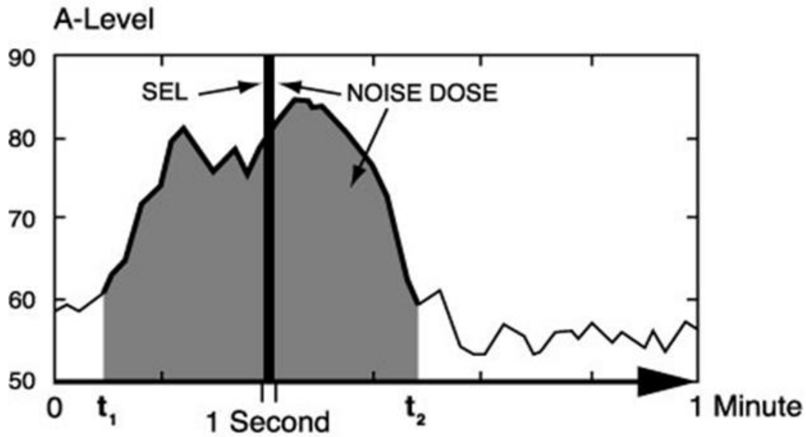
The maximum level describes only one dimension of an event; it provides no information on the cumulative noise exposure. In fact, two events with identical maxima may produce very different total exposures. One may be of very short duration, while the other may continue for an extended period and be judged much more annoying. The next measure corrects for this deficiency.

Sound Exposure Level (SEL)

The most frequently used measure of noise exposure for an individual aircraft noise event (and the measure that Part 150 specifies for this purpose) is the SEL. SEL is a measure of the total noise energy produced during an event, from the time when the A-weighted sound level first exceeds a threshold level (normally just above the background or ambient noise) to the time that the sound level drops back down below the threshold. To allow comparison of noise events with very different durations, SEL "normalizes" the duration in every case to one second; that is, it is expressed as the steady noise level with just a one-second duration that includes the same amount of noise energy as the actual longer duration, time-varying noise. In lay terms, SEL "squeezes" the entire noise event into one second.

Figure H-4 depicts this transformation. The shaded area represents the energy included in an SEL measurement for the noise event, where the threshold is set to 60 dBA. The dark shaded vertical bar, which is 90 dBA high and just one second long (wide), contains exactly the same sound energy as the full event.

Figure H-4 Sound Exposure Level (SEL)



Source: HMMH

Because the SEL is normalized to one second, it will always be larger than the L_{max} for an event longer than one second. In this case, the SEL is 90 dB; the L_{max} is approximately 85 dBA. For most aircraft overflights, the SEL is normally on the order of 7 to 12 dB higher than L_{max}. Because SEL considers duration, longer exposure to relatively slow, quiet aircraft, such as propeller models, can have the same or higher SEL than shorter exposure to faster, louder planes, such as corporate jets.

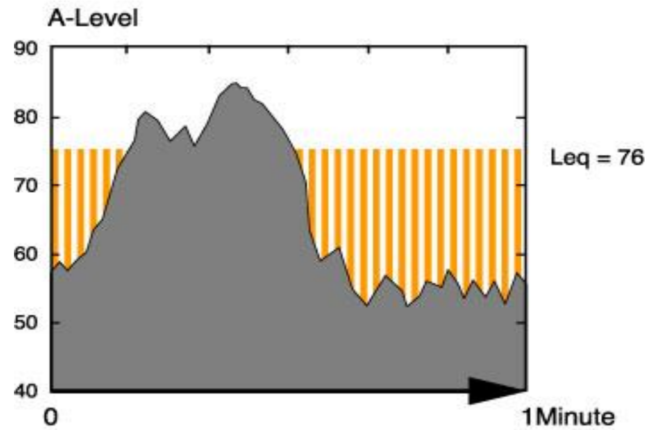
Equivalent Sound Level (L_{eq})

The L_{max} and SEL quantify the noise associated with individual events. The remaining metrics in this section describe longer-term cumulative noise exposure that can include many events.

The Equivalent Sound Level (L_{eq}) is a measure of exposure resulting from the accumulation of A-weighted sound levels over a particular period of interest (e.g., an hour, an eight-hour school day, nighttime, or a full 24-hour day). Because the length of the period can differ, the applicable period should always be identified or clearly understood when discussing the metric. Such durations are often identified through a subscript, for example $L_{eq(8)}$ or $L_{eq(24)}$.

L_{eq} is equivalent to the constant sound level over the period of interest that contains as much sound energy as the actual time-varying level. This is illustrated in Figure H-5. Both the solid and striped shaded areas have a one-minute L_{eq} value of 76 dB. It is important to recognize, however, that the two signals (the constant one and the time-varying one) would sound very different in real life. Also, be aware that the "average" sound level suggested by L_{eq} is not an arithmetic value, but a logarithmic, or "energy-averaged" sound level. Thus, loud events dominate L_{eq} measurements.

Figure H-5 Example of a One Minute Equivalent Sound Level (L_{eq})



Source: HMMH

In airport noise studies, L_{eq} is often presented for consecutive one-hour periods to illustrate how the exposure rises and falls throughout a 24-hour period, and how individual hours are affected by unusual activity, such as rush hour traffic or a few loud aircraft.

Time Above (TA)
TA is a metric that gives the duration, in minutes, for which aircraft-related noise exceeds a specified A-weighted sound level during a given period. The measure is referred to generally as TA. For this *2012/2013 EDR*, three threshold sound levels are used in the analysis: 65, 75, and 85 dBA. These times are computed using the Federal Aviation Administration (FAA)-approved Integrated Noise Model (INM).

Time Above Night (TAN)
Identical to TA, except it is computed for only the 9-hour period between 10:00 PM and 7:00 AM. The TAN is also developed using three threshold sound levels 65, 75, and 85 dBA.

Day-Night Average Sound Level (DNL)

Virtually all studies of aircraft noise rely on a slightly more complicated measure of noise exposure that describes cumulative noise exposure during an average annual day: the DNL. The EPA identified DNL as the most appropriate means of evaluating airport noise based on the following considerations:[1]

1. The measure should be applicable to the evaluation of pervasive long-term noise in various defined areas and under various conditions over long periods.
2. The measure should correlate well with known effects of the noise environment and on individuals and the public.
3. The measure should be simple, practical, and accurate. In principal, it should be useful for planning as well as for enforcement or monitoring purposes.
4. The required measurement equipment, with standard characteristics, should be commercially available.
5. The measure should be closely related to existing methods currently in use.
6. The single measure of noise at a given location should be predictable, within an acceptable tolerance, from knowledge of the physical events producing the noise.
7. The measure should lend itself to small, simple monitors, which can be left unattended in public areas for long periods.

Most federal agencies dealing with noise have formally adopted DNL. The Federal Interagency Committee on Noise (FICON) reaffirmed the appropriateness of DNL in 1992. The FICON summary report stated; "There are no new descriptors or metrics of sufficient scientific standing to substitute for the present DNL cumulative noise exposure metric."

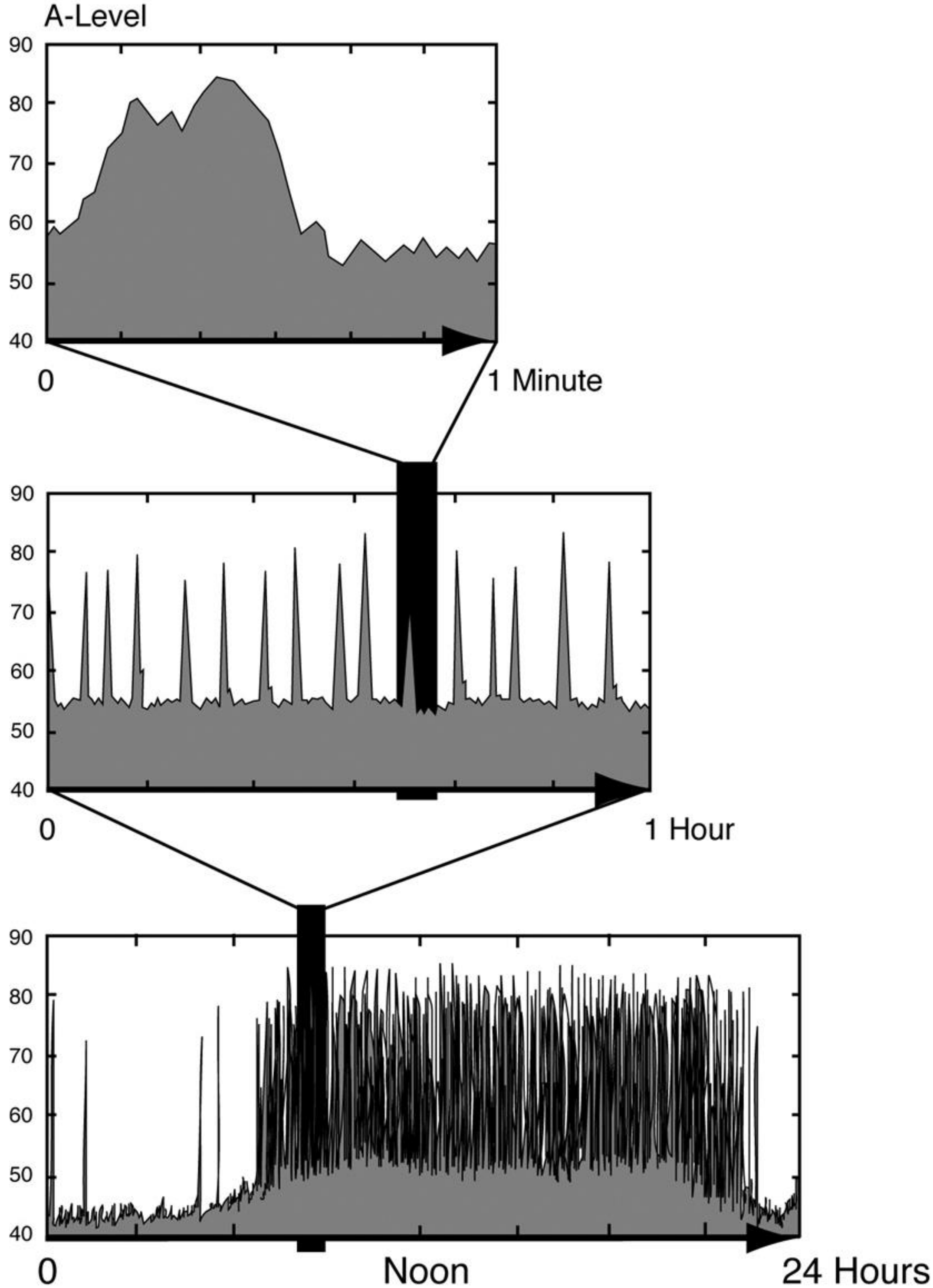
The DNL represents noise as it occurs over a 24-hour period, with one important exception: DNL treats nighttime noise differently from daytime noise. In determining DNL, it is assumed that the A-weighted levels occurring at night (defined as 10:00 PM to 7:00 AM) are 10 dB louder than they really are. This 10 dB penalty is applied to account for greater sensitivity to nighttime noise, and the fact that events at night are often perceived to be more intrusive because nighttime ambient noise is less than daytime ambient noise.

Figure H-4 illustrated the A-weighted sound level due to an aircraft fly-over as it changed with time. The top frame of Figure H-6 repeats this figure. The shaded area reflects the noise dose that a listener receives during the one-minute period of the sample. The center frame of Figure H-4 includes this one-minute sample within a full hour. The shaded area represents the noise during that hour with 16 noise events, each producing an SEL. Similarly, the bottom frame includes the one-hour interval within a full 24 hours. Here the shaded area represents the listener's noise dose over a complete day. Note that several overflights occur at a time when the background noise drops some 10 dB, to approximately 45 dBA.

DNL can be measured or estimated. Measurements are practical only for obtaining DNL values for relatively limited numbers of points, and, in the absence of a permanently installed monitoring system, only for relatively short time periods. Most airport noise studies are based on computer-generated DNL estimates, determined by accounting for all of the SELs from individual events, which comprise the total noise dose at a given location. Computed DNL values are often depicted in terms of equal-exposure noise contours (much as topographic maps have contours of equal elevation). Figure H-7 depicts typical DNL values for a variety of noise environments.

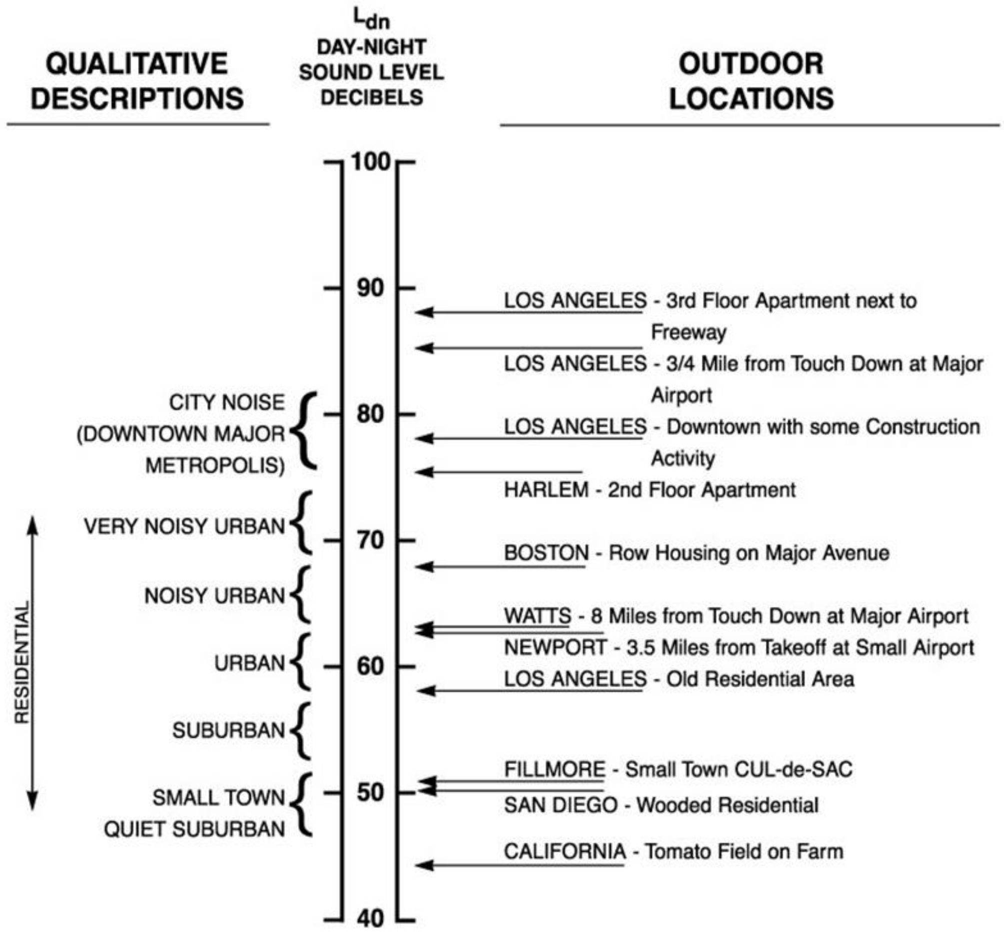
1 Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety," U. S. EPA Report No. 550/9-74-004, March 1974

Figure H-6 Daily Noise Dose



Source: HMMH

Figure H-7 Examples of Day-Night Average Sound Levels (DNL)



Source: EPA, Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety, March 1974, p. 14.

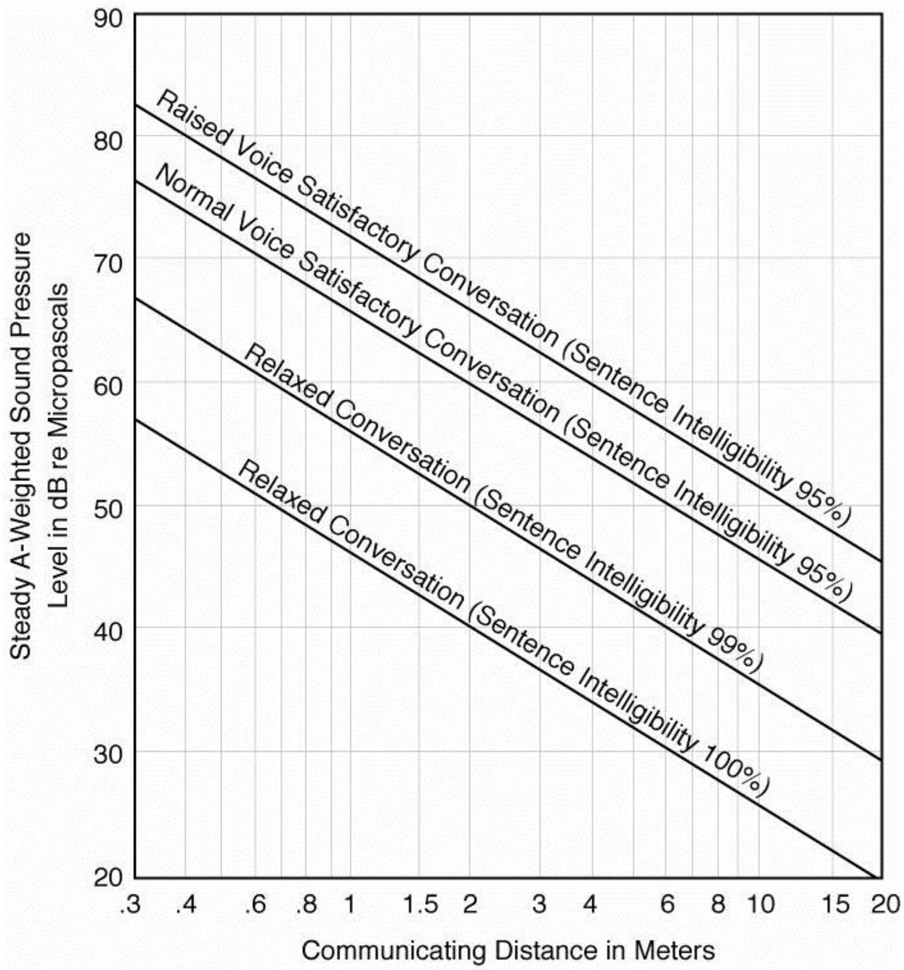
The Effects of Aircraft Noise on People

To residents around airports, aircraft noise can be an annoyance and a nuisance. It can interfere with conversation and listening to television, it can disrupt classroom activities in schools, and it can disrupt sleep. Relating these effects to specific noise metrics helps in the understanding of how and why people react to their environment.

Speech Interference

A primary effect of aircraft noise is its tendency to drown out or "mask" speech, making it difficult to carry on a normal conversation. The sound level of speech decreases as the distance between a talker and listener increases. As the background sound level increases, it becomes harder to hear speech. Figure H-8 presents typical distances between talker and listener for satisfactory outdoor conversations, in the presence of different steady A-weighted background noise levels for raised, normal, and relaxed voice effort. As the background level increases, the talker must raise his/her voice, or the individuals must get closer together to continue talking.

Figure H-8 Outdoor Speech Intelligibility



Source: EPA, Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety, March 1974, p. D-5.

As indicated in the figure, "satisfactory conversation" does not always require hearing every word; 95 percent intelligibility is acceptable for many conversations. Listeners can infer a few unheard words when they occur in a familiar context. However, in relaxed conversation, we have higher expectations of hearing speech and generally require closer to 100 percent intelligibility. Any combination of talker-listener distances and background noise that falls below the bottom line in Figure H-8 (thus assuring 100 percent intelligibility) represents an ideal environment for outdoor speech communication and is considered necessary for acceptable indoor conversation as well.

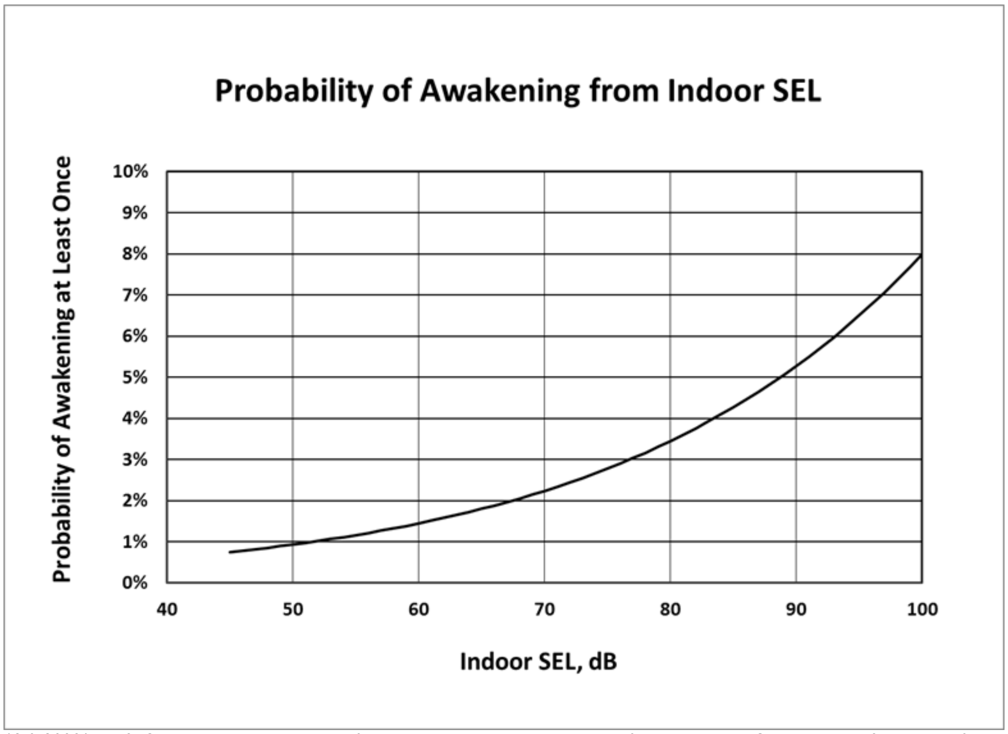
One implication of the relationships in Figure H-8 is that for typical communication at distances of 3 or 4 feet (1 to 1.5 meters), acceptable outdoor conversations can be carried on in a normal voice as long as the background noise outdoors is less than about 65 dBA. If the noise exceeds this level, as might occur when an aircraft passes overhead, intelligibility would be lost unless vocal effort were increased or communication distance were decreased.

Indoors, typical distances, voice levels, and intelligibility expectations generally require a background level less than 45 dBA. With windows partly open, housing generally provides about 12 dBA of interior-to-exterior noise level reduction. Thus, if the outdoor sound level is 60 dBA or less, there is a reasonable chance that the resulting indoor sound level will afford acceptable conversation inside. With windows closed, 24 dB of attenuation is typical.

Sleep Interference

Research on sleep disruption from noise has led to widely varying observations. In part, this is because (1) sleep can be disturbed without awakening, (2) the deeper the sleep the more noise it takes to cause arousal, and (3) the tendency to awaken increases with age, and other factors. Figure H-9 shows one such relationship from recent research conducted in the U.S. – the probability that a group of people will be awakened at least once when exposed to a given indoor SEL.

Figure H-9 Probability of Awakening at Least Once from Indoor Noise Event



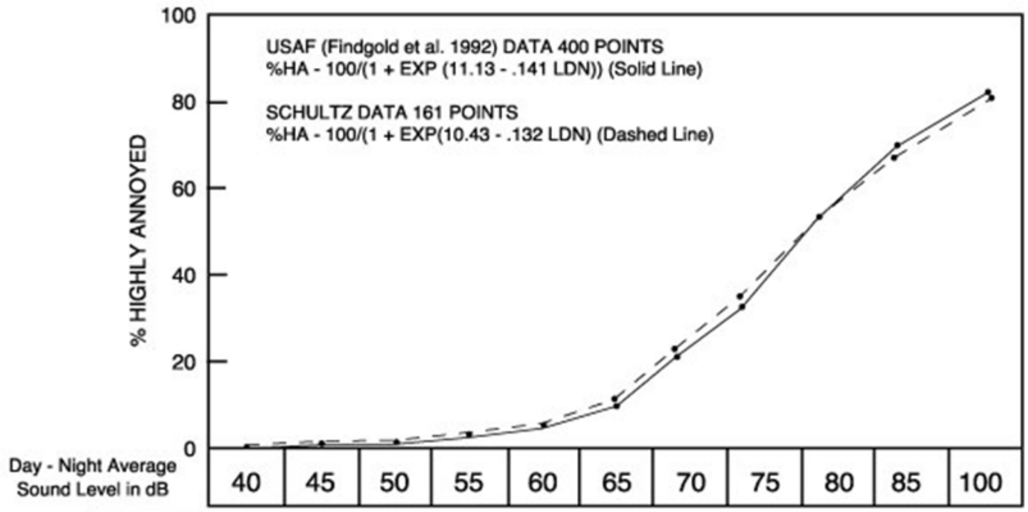
Source: ANSI S12.9-2008/Part 6, Quantities and Procedures for Description and Measurement of Environmental Sound — Part 6: Methods for Estimation of Awakenings Associated with Outdoor Noise Events Heard in Homes; Equation 1

For example, an indoor SEL of 80 dB results in approximately 3.5 percent of the exposed population being awakened. If windows are open in the bedroom on a warm evening and a house provides a typical outside-to-inside noise level reduction of around 15 dB, which suggests it takes an SEL of about 95 dB outdoors to awaken 3.5 percent of the population. The American National Standards Institute (ANSI) has extended this concept further and developed a standard (ANSI S12.9-2008/Part 6) for computing the percentage of the population that is likely to be awakened by multiple noise events occurring throughout the night. The Federal Interagency Committee on Aviation Noise (FICAN) subsequently endorsed the standard as the best available means of estimating behavioral awakenings from aircraft noise.[2]

2 http://www.fican.org/pdf/FICAN_Sleep_Dec08.pdf

Community Annoyance
Social survey data make it clear that individual reactions to noise vary widely for a given noise level. Nevertheless, as a group, people's aggregate response is predictable and relates well to measures of cumulative noise exposure such as DNL. Figure H-10 shows a widely recognized relationship between environmental noise and annoyance.

Figure H-10 Percentage of People Highly Annoyed



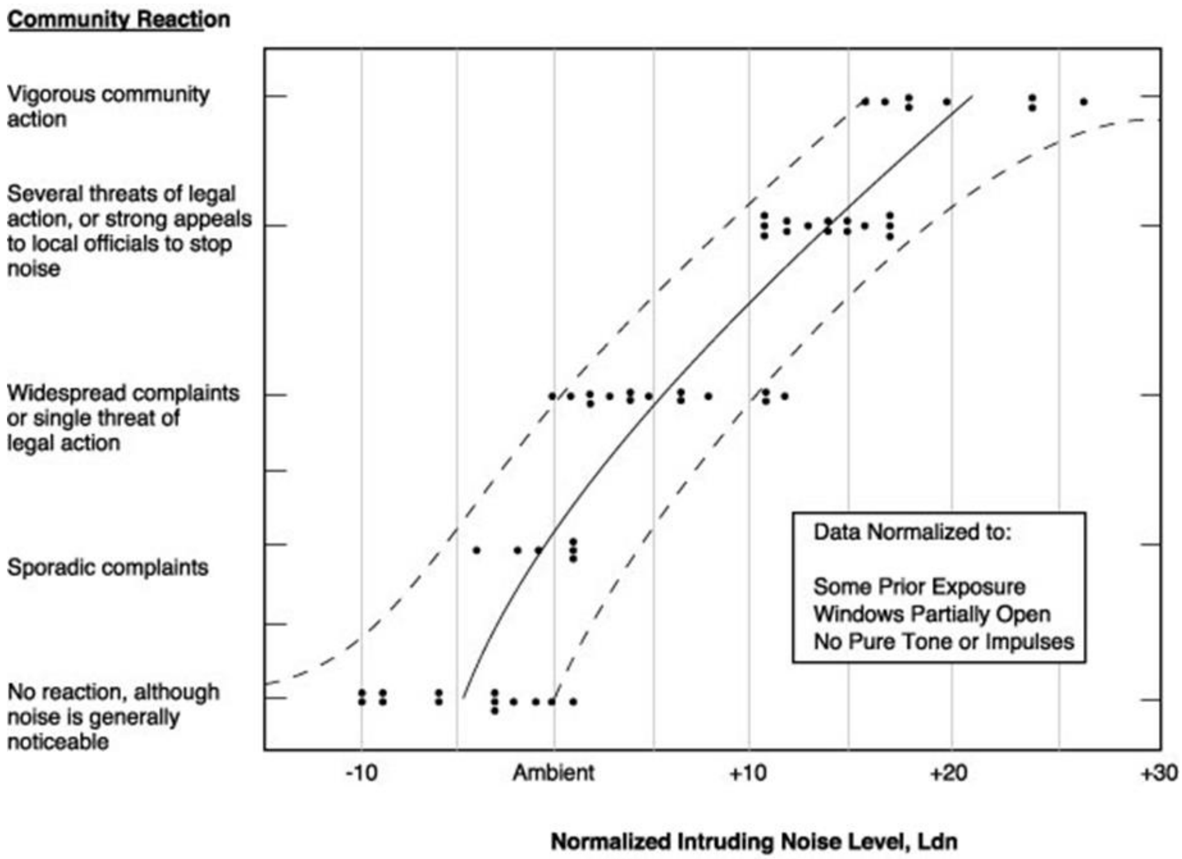
Calculated %HA Points											
USAF	0.41	0.831	1.66	3.31	6.48	12.29	22.1	36.47	53.74	70.16	82.64
SCHULTZ	0.576	1.11	2.12	4.03	7.52	13.59	23.32	37.05	53.25	68.78	81

Source: FICON. "Federal Agency Review of Selected Airport Noise Analysis Issues." August 1992. (From data provided by USAF Armstrong Laboratory). pp. 3-6.

Based on data from 18 surveys conducted worldwide, the curve indicates that at levels as low as DNL 55, approximately five percent of the people will still be highly annoyed, with the percentage increasing more rapidly as exposure increases above DNL 65.

Separate work by the EPA has shown that overall community reaction to a noise environment can also be related to DNL. This relationship is shown in Figure H-11. Levels have been normalized to the same set of exposure conditions to permit valid comparisons between ambient noise environments. Data summarized in Figure H-11 suggest that little reaction would be expected for intrusive noise levels five decibels below the ambient, while widespread complaints can be expected as intruding noise exceeds background levels by about five decibels. Vigorous action is likely when the background is exceeded by 20 dB.

Figure H-11 Community Reaction as a Function of Outdoor DNL



Logan Airport RealContours™ Data Inputs

To relate portions of the foregoing discussion to the specific noise environment around Logan Airport, for this *2012/2013 EDR*, the Massachusetts Port Authority (Massport) has produced a set of DNL noise contours, TA noise metrics, and population counts for 2012 and 2013 using the pair of software packages RealProfiles™ and RealContours™. This software takes radar data from individual flights occurring throughout the year, processes the information and formats it into a form usable as input to the latest version of the FAA's INM, which serves as the computational "engine" for calculating noise. Version 7.0c of the INM was used for 2012, since it was the latest version available at the end of that year, and Version 7.0d was used for 2013, incorporating improvements in the updated version of the INM that became available at the end of that year. The year 2012 was also re-run in Version 7.0d to allow for the evaluation of model changes using the 2012 inputs. The RealProfiles™ and RealContours™ system used the individual flight tracks taken directly from the Massport Noise and Operations Management System (NOMS) rather than relying on consolidated data summaries. For 2012, the NOMS retained suitable data for 298,074 flights; all of these were used in the INM noise model directly. For 2013, the NOMS retained suitable data for 347,216 flights; all of these were used in the noise model directly.

Introduction

Standard INM input methodology involves development of operational inputs and calculation of the DNL for a prototypical average annual day.[3] This approach requires manually collecting, refining, and entering the enormous amount of data averaged over a full year of activity at an airport. Typically, the model inputs may include an aircraft fleet mix with several dozen representative aircraft types, on the order of 100 to 300 representative flight tracks (common for a facility the size of Logan Airport), and runway use and flight track use percentages for three or four categories of aircraft types with similar performance characteristics.

This normal approach to noise modeling meets accepted professional standards, and reduces the effort and cost that would be associated with manually entering the parameters for every actual operation. However, it represents a significant simplification of the extraordinary diversity of actual aircraft operations over a year. It also does not take full advantage of the investment that Massport has made in installing and maintaining a state-of-the-art radar system,[4] which automatically collects flight track data and flight identification data for all operations at the Airport and feeds the NOMS.

Instead, for this report, Massport has utilized an INM pre-processor, RealContours™, which takes maximum possible advantage of both the INM's capabilities and the investment that Massport has made in operations monitoring. RealContours™ automates the process of preparing the INM inputs directly from the actual flight operations, and permits airports to model the full diversity of activity as precisely as possible, at a cost equivalent to the more simplified manual approach. RealContours™ improves the precision of modeling by utilizing operations monitoring results in five key areas:

- Directly converts the flight track for every identified aircraft operation to an INM track, rather than assigning multiple operations to a limited number of prototypical tracks.
- Models each operation on the specific runway that it actually used, rather than applying a generalized distribution to broad ranges of aircraft types.
- Models each operation in the period that it occurred, which takes into account delays at the Airport during the year.

3 FAA INM Version 7.0 User's Guide, April 2007, p. 12.

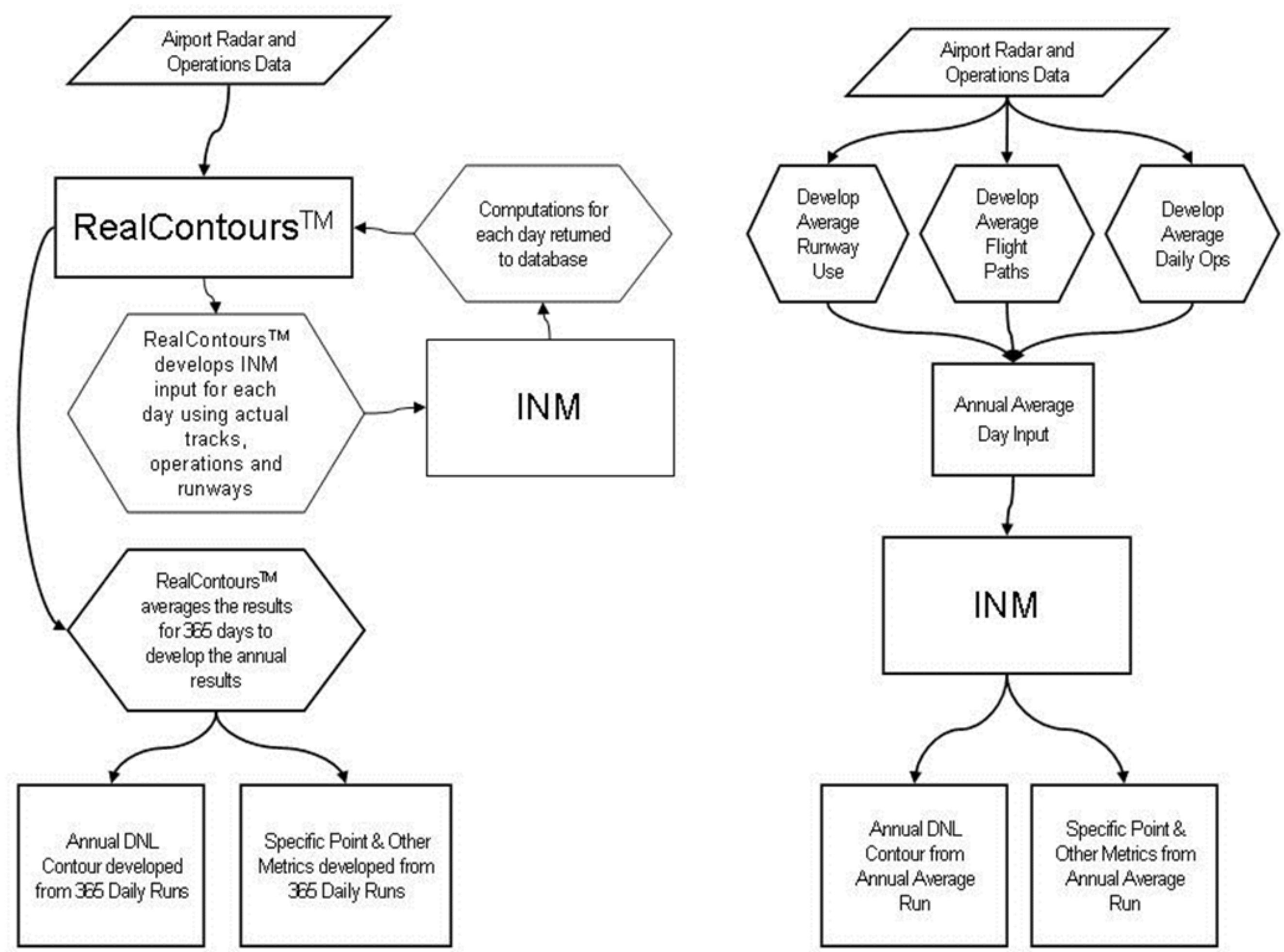
4 Starting in 2010, the Massport system utilized the Airscene.com product of Era Corporation. The radar data remains the same but the system is now provided by Exelis.

- Selects the specific airframe and engine combination to model, on an operation-by-operation basis, based on the registration data for each flight wherever possible; otherwise, the published compositions of the fleets of the specific airlines operating at Logan Airport are used.
- Uses each aircraft's actual performance and altitude profile to develop inputs to the model, which define the actual climb, descent, and speed profile for every operation.

RealContours™ completes the task of computing noise by running the INM in the middle of the night to obtain DNL or other noise metrics for the previous day's operations, and then averages the results to obtain the annual contour.

Figure H-12 provides a schematic representation of the RealContours™ noise modeling process compared to the standard INM process.

Figure H-12 Schematic Noise Modeling Process (Standard INM vs. RealContours™)



INM v7.0d Improvements

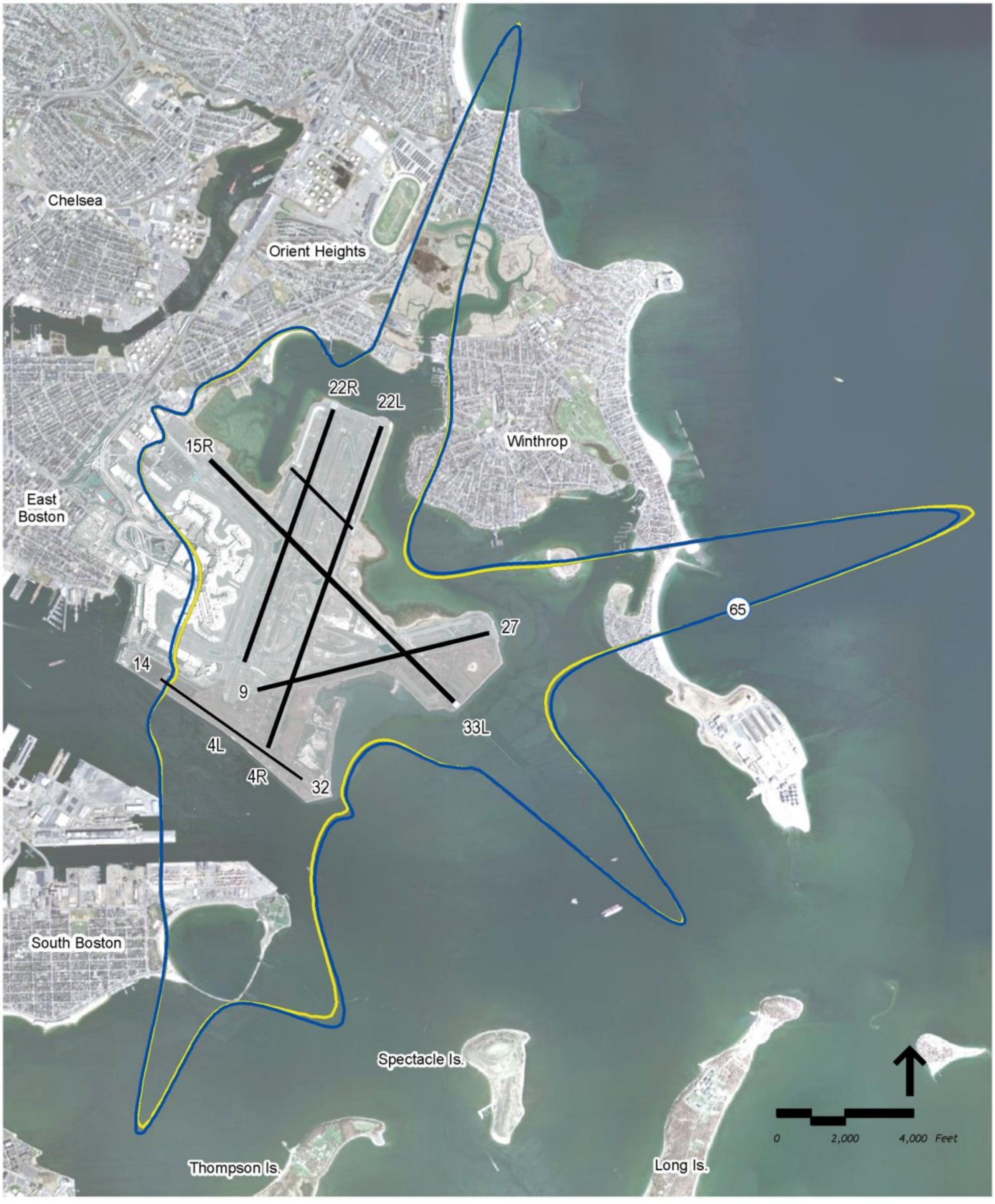
The FAA's INMv7.0d was released for general use on May 23, 2013 with a Software Service Update on September 24, 2013. The latest version has been used for the 2013 DNL contour in this report as the primary analytical tool to assess the noise environment at Logan Airport. The new version of the model included data for the Boeing 787-8R, Embraer E170 and Embraer E190 all types in use at Logan Airport. The Embraer E170 and E190 being the types in the fleet that changed with the largest numbers (over 66,000 operations in 2013) and the 787-8 have almost 500 operations.

These aircraft were modeled for 2012 in INM version 7.0c using recommended FAA substitutes:

- The new Boeing 787-8 in INM 7.0d was modeled using the A330-343 in INM 7.0c. The 787-8 type in INM 7.0d is approximately 3 dB less on arrival and 5 dB lower on departure than its substitute however there were only 478 operations so this change had little effect on the annual contour.
- The new Embraer 170 in INM 7.0d was modeled using the FAA approved substitute Boeing 737-500 in INM 7.0c. The EMB170 type in INM 7.0d is approximately 1 to 2 dB less on arrival and approximately 2 dB lower on departure than its substitute. There were a significant number of these operations in 2012 resulting in a slight reduction in the annual contour.
- The new Embraer 190 in INMv7.0d was modeled using the FAA approved substitute Airbus A319-131 in INMv7.0c. The EMB190 type in INM 7.0d is approximately 1 dB less on arrival close to the runway but shows an increase in levels away from the runway. For departures the new EMB190 is about 1 dB less than its substitute right after takeoff and then approximately 1 dB greater for about a mile or two, this is due to difference in the aircraft performance on takeoff. After approximately 5 miles, the noise levels are similar.
- There were no computational changes between INM version 7.0c and version 7.0d.

Figure H-13 provides a comparison between the 2012 DNL contours generated with both INMv7.0c and INMv7.0d. This graphic allows for the comparison of the results between the two models using the same data inputs. Both contours use the same fleet mix and runway use only the model version has changed. It is these small reductions in arrival and departure noise levels which have resulted in the overall small reduction in the 2012 INMv7.0d contour compared INMv7.0c. The increase in the EMB190 arrival levels is the reason for the small increase in the DNL 65 dB contour lobe east of Winthrop.

The small reductions in the INMv7.0d DNL contour resulted in small reductions in the population counts for 2012 with INMv7.0d compared to 2012 with INMv7.0c.



Path: H:\GIS\USAMA\Logan\304280_004_Logan_2012-13_EDR\304280_004_2012-13_EDR_2012_70c_70d_65db_DNL_Comparison.mxd

Source: HMMH, MassGIS, USDA NAIP 2010

2012 DNL Contour (INM 7.0c)
2012 DNL Contour (INM 7.0d)

Comparison of the DNL 65 dB Contours for 2012 Operations Using INM 7.0c and 7.0d

Figure H-13

2012/2013 Radar Data

Logan Airport's radar data provide the key to the RealContours™ system. Since February 2004, Massport has collected Passive Surveillance Radar System (PASSUR) radar data, which supplies information to the Airport's web-based Airport Monitor software. This dataset was used for the *2004 Environmental Status Planning Report (2004 ESPR)* through the *2008 EDR*. Beginning with the *2009 EDR*, Massport began utilizing the radar data from its new Exelis NOMS system. These radar data are obtained from a multilateration system of eight sensors deployed around the Airport. The positioning data from all of these sensors are correlated to provide better, more accurate coverage of aircraft (in areas where the traditional FAA radar has limitations) and provide a more complete set of points to define each track. Traditional radar provides points every four to five seconds where the multilateration system provides data every second. The new system was able to collect 366 complete days of data for 2012 and 365 complete days of data for 2013 with approximately 87 percent of these tracks usable for the development of the noise exposure contours in 2012 and 97 percent in 2013.

Fleet Mix

The 2012/2013 radar data first were processed to establish a baseline set of operations. After processing 366/365 days of radar data (342,347 and 358,129 operations, respectively), flight tracks with sufficient operational information were identified to use as the baseline for the 2012 and 2013 contours. The operations from these tracks were then scaled upwards by airline and aircraft type to match the reported totals provided by Massport for 2012 and 2013. Tables H-1a and H-1b provide the scaled annual operations, by INM aircraft type. Each INM type listed in Tables H-1a and H-1b is also mapped to a Runway Use group based on its weight and performance characteristics described in the Runway Use section below. For several aircraft types, new data were added to INMv7.0d so that the aircraft no longer needed to be modeled by a substitute. The Embraer 190 is an example of this; in 2012, INM v7.0c required that the aircraft be modeled by a similar type, the A319-131; however, with the updated INMv7.0d, it was modeled by the new EMB190 INM type.

Runway Use

RealContours™ determines which runway was used by each aircraft type and whether it was a daytime or nighttime operation directly from the radar data. The summary of daytime and nighttime runway usages presented here is broken into six representative aircraft groups listed below, grouped in this format to allow comparison with prior years (see Tables H-2a and H-2b):

- Heavy Jet A – B747s, A340s, DC-8s;
- Heavy Jet B – B767s, B777s, A300s, A310s, A330s, DC-10s, L1011s, MD-11s;
- Light Jet A – B717s, B727s, DC-9s, F100s, MD-90s;
- Light Jet B – B737s, B757s, A319s, A320s, B-146s, MD-80s, E190;
- Regional Jet (RJ) – E135, E145, E170, CRJ2, CRJ7, CRJ9, J328 and Corporate Jets; and
- Turboprops and Piston Aircraft (non-jets).

Table H-1a 2012 Annual Modeled Operations

INM Type	Runway Use Group	Arrivals Day	Arrivals Night	Departures Day	Departures Night	Total
Commercial Jet Operations						
747200	Heavy Jet A	0.0	1.5	1.5	0.0	3.0
74720B	Heavy Jet A	1.5	0.0	1.5	0.0	3.0
747400	Heavy Jet A	1,261.0	5.7	764.2	502.4	2,533.3
A340-211	Heavy Jet A	900.9	5.6	678.6	227.9	1,813.0
A340-642	Heavy Jet A	420.3	0.0	404.6	15.6	840.5
DC870	Heavy Jet A	37.4	72.6	1.1	108.9	220.0
767300	Heavy Jet B	518.5	203.3	505.2	216.6	1,443.6
767400	Heavy Jet B	321.7	3.2	317.2	7.6	649.7
767CF6	Heavy Jet B	73.6	72.3	25.2	120.8	291.9
767JT9	Heavy Jet B	9.6	14.4	0.0	23.9	47.9
777200	Heavy Jet B	392.4	78.7	463.1	8.0	942.2
A300-622R	Heavy Jet B	172.7	443.7	299.9	316.5	1,232.8
A310-304	Heavy Jet B	211.9	14.8	58.5	168.3	453.5
A330-301	Heavy Jet B	1,222.4	5.5	1,209.2	18.7	2,455.8
A330-343	Heavy Jet B	543.8	1.7	437.4	108.2	1,091.1
DC1010	Heavy Jet B	450.0	315.0	239.0	526.1	1,530.1
DC1030	Heavy Jet B	67.7	57.8	41.5	84.0	251.0
MD11GE	Heavy Jet B	42.6	27.3	29.4	40.4	139.7
MD11PW	Heavy Jet B	16.7	10.6	13.1	14.2	54.6
717200	Light Jet A	3,741.1	630.3	3,883.4	488.0	8,742.8
727EM2	Light Jet A	63.9	60.5	113.5	10.9	248.8
DC93LW	Light Jet A	6.9	1.5	6.6	1.8	16.8
DC95HW	Light Jet A	27.2	2.1	15.7	13.6	58.6
MD9025	Light Jet A	373.0	32.5	374.1	31.4	811.0
MD9028	Light Jet A	564.8	46.1	587.2	23.7	1,221.8
7373B2	Light Jet B	514.6	136.0	554.1	96.6	1,301.3
737400	Light Jet B	675.8	18.1	661.3	32.6	1,387.8
737500	Light Jet B	1,513.8	151.4	1,463.8	208.8	3,337.8
737700	Light Jet B	5,753.9	1,431.2	6,276.8	908.3	14,370.2
737800	Light Jet B	9,408.6	2,963.5	10,818.0	1,554.1	24,743.1
737N17	Light Jet B	1.2	0.0	1.2	0.0	2.4
757300	Light Jet B	13.8	9.3	14.7	8.4	46.2
757PW	Light Jet B	3,765.1	761.0	3,976.2	549.8	9,052.1
757RR	Light Jet B	5,734.6	1,528.2	6,111.3	1,151.6	14,525.7
A319-131 (includes EMB190 operations)	Light Jet B	32,832.5	4,039.7	32,749.4	4,122.9	73,744.5

Note: Some totals may not match due to rounding.

Table H-1a 2012 Annual Modeled Operations (Continued)

INM Type	Runway Use Group	Arrivals Day	Arrivals Night	Departures Day	Departures Night	Total
Commercial Jet Operations (Continued)						
A320-211	Light Jet B	3,388.3	1,039.1	4,107.0	320.4	8,853.4
A320-232	Light Jet B	17,515.7	5,482.2	19,591.1	3,406.8	45,995.8
A321-232	Light Jet B	754.6	496.4	946.1	304.9	2,502.0
MD81	Light Jet B	1.1	1.1	1.5	0.7	4.4
MD82	Light Jet B	20.5	0.0	20.5	0.0	41.0
MD83	Light Jet B	1,606.4	102.3	1,579.6	129.1	3,417.4
737500 (sub for EMB170)	RJ	7,630.0	314.6	7,491.8	445.3	15,881.7
CL601	RJ	7,282.4	270.2	7,338.6	214.1	15,105.3
CRJ9-ER	RJ	2,963.6	194.4	2,794.2	363.8	6,316.0
CRJ9-LR	RJ	1,521.7	266.5	1,435.7	352.4	3,576.3
EMB145	RJ	231.4	11.5	216.5	26.3	485.7
EMB14L	RJ	2,291.0	119.0	2,131.0	279.1	4,820.1
FAL20	RJ	1.5	0.0	1.5	0.0	3.0
LEAR35	RJ	0.4	0.1	0.4	0.1	1.0
Commercial Jets Subtotal		**116,864.1**	**21,442.5**	**120,753.0**	**17,553.6**	**276,613.2**
Commercial Non-Jet Operations						
BEC58P	non-jet	17,966.9	625.6	18,452.9	139.5	37,184.9
CNA208	non-jet	206.8	1.1	207.9	0.0	415.8
CNA441	non-jet	5.6	0.0	3.4	2.2	11.2
DHC8	non-jet	1,383.5	2.1	1,372.9	12.6	2,771.1
DHC830	non-jet	2,627.3	44.7	2,496.9	175.2	5,344.1
SF340	non-jet	2,094.8	108.2	2,194.6	8.4	4,406.0
Commercial Non-Jet Operations Subtotal		**24,284.9**	**781.7**	**24,728.6**	**337.9**	**50,133.1**
Commercial Aircraft Total		**141,149.0**	**22,224.2**	**145,481.6**	**17,891.5**	**326,746.3**
General Aviation Operations						
74720B	Heavy Jet A	2.5	1.2	3.7	0.0	7.4
747400	Heavy Jet A	2.5	0.0	2.5	0.0	5.0
DC870	Heavy Jet A	0.0	3.7	0.0	3.7	7.4
767300	Heavy Jet B	11.3	9.7	16.1	4.9	42.0
767400	Heavy Jet B	8.7	0.0	8.7	0.0	17.4
767CF6	Heavy Jet B	7.4	0.0	3.7	3.7	14.8
A300-622R	Heavy Jet B	1.2	27.2	19.0	9.5	56.9
A330-301	Heavy Jet B	8.7	0.0	8.7	0.	17.4
A330-343	Heavy Jet B	2.5	0.0	2.5	0.0	5.0
DC1010	Heavy Jet B	9.7	21.3	8.7	22.3	62.0

Notes: BEC58P is the INM substitution for the Cessna 402.
The CRJ9-ER in the RJ category is the CRJ700 aircraft.
Some totals may not match due to rounding.

Table H-1a 2012 Annual Modeled Operations (Continued)

INM Type	Runway Use Group	Arrivals Day	Arrivals Night	Departures Day	Departures Night	Total
General Aviation Operations (continued)						
717200	Light Jet A	60.4	12.6	56.9	16.1	146.0
727EM2	Light Jet A	4.9	2.5	6.2	1.2	14.8
DC95HW	Light Jet A	2.5	0.0	2.5	0.0	5.0
F10062	Light Jet A	411.9	39.7	424.3	27.2	903.1
MD9025	Light Jet A	3.7	0.0	3.7	0.0	7.4
MD9028	Light Jet A	3.7	0.0	1.9	1.9	7.5
7373B2	Light Jet B	14.8	0.0	14.8	0.0	29.6
737400	Light Jet B	22.3	2.5	22.3	2.5	49.6
737500	Light Jet B	180.1	10.4	174.4	12.4	377.3
737700	Light Jet B	145.0	49.3	165.8	28.5	388.6
737800	Light Jet B	205.3	71.8	225.1	52.0	554.2
757PW	Light Jet B	67.2	34.3	76.7	24.7	202.9
757RR	Light Jet B	91.0	33.9	97.7	27.2	249.8
A319-131	Light Jet B	644.8	111.0	622.2	133.6	1,511.6
A320-211	Light Jet B	53.2	38.4	73.0	18.6	183.2
A320-232	Light Jet B	327.6	143.7	374.8	96.5	942.6
A321-232	Light Jet B	8.2	22.7	19.8	11.1	61.8
MD81	Light Jet B	2.5	0.0	1.2	1.2	4.9
MD83	Light Jet B	21.0	2.5	18.8	4.7	47.0
1900D	non-jet	1.2	0.0	1.2	0.0	2.4
BEC58P	non-jet	542.3	52.7	540.6	54.4	1,190.0
CNA172	non-jet	38.2	1.4	39.6	0.0	79.2
CNA182	non-jet	67.9	1.4	69.3	0.0	138.6
CNA206	non-jet	77.9	0.0	74.2	3.7	155.8
CNA208	non-jet	786.7	92.8	794.2	85.4	1,759.1
CNA20T	non-jet	9.9	0.0	9.9	0.0	19.8
CNA441	non-jet	269.3	26.3	254.8	40.8	591.2
DHC8	non-jet	43.3	0.0	43.3	0.0	86.6
DHC830	non-jet	40.6	1.5	40.8	1.2	84.1
DO228	non-jet	178.0	19.9	167.0	30.9	395.8
DO328	non-jet	1.2	0.0	1.2	0.0	2.4
EMB120	non-jet	2.5	0.0	2.5	0.0	5.0
GASEPF	non-jet	19.8	0.0	19.8	0.0	39.6
GASEPV	non-jet	330.9	11.8	331.5	11.1	685.3
PA28	non-jet	14.8	0.0	14.8	0.0	29.6
PA30	non-jet	2.5	0.0	2.5	0.0	5.0
PA31	non-jet	44.5	2.5	45.7	1.3	94.0
PA42	non-jet	16.1	0.0	16.1	0	32.2

Note: Some totals may not match due to rounding.

Table H-1a 2012 Annual Modeled Operations (Continued)

INM Type	Runway Use Group	Arrivals Day	Arrivals Night	Departures Day	Departures Night	Total
General Aviation Operations (Continued)						
SD330	non-jet	226.6	15.9	232.6	9.9	485.0
SF340	non-jet	63.6	5.7	69.3	0.0	138.6
737500	RJ	8.7	0.0	9.9	2.5	21.1
CIT3	RJ	71.7	1.3	66.8	6.2	146.0
CL600	RJ	911.8	77.8	929.0	60.6	1,979.2
CL601	RJ	1,163.8	94.3	1,157.8	100.2	2,516.1
CNA500	RJ	112.8	60.4	134.8	38.3	346.3
CNA510	RJ	119.8	3.9	113.8	9.9	247.4
CNA55B	RJ	376.0	39.6	367.0	48.6	831.2
CNA750	RJ	653.5	65.2	675.4	43.3	1,437.4
CRJ9-ER	RJ	2.5	0.0	2.5	0.0	5.0
CRJ9-LR	RJ	43.1	7.6	40.8	9.9	101.4
ECLIPSE500	RJ	24.7	7.4	21.9	10.2	64.2
EMB145	RJ	84.1	3.7	81.5	6.4	175.7
EMB14L	RJ	54.4	4.9	48.2	11.1	118.6
FAL20	RJ	0.0	1.2	1.2	0.0	2.4
GII	RJ	3.7	0.0	3.7	0.0	7.4
GIIB	RJ	38.9	8.1	42.1	4.9	94.0
GIV	RJ	711.6	92.5	717.5	86.6	1,608.2
GV	RJ	633.9	71.2	634.6	70.5	1,410.2
IA1125	RJ	95.8	8.1	96.5	7.4	207.8
LEAR25	RJ	8.7	0.0	8.7	0.0	17.4
LEAR35	RJ	1,544.2	167.8	1,543.8	168.2	3,424.0
MU3001	RJ	662.7	52.3	661.8	53.2	1,430.0
General Aviation Total		**12,428.8**	**1,637.6**	**12,585.9**	**1,480.2**	**28,132.5**
Grand Total		**153,577.8**	**23,861.8**	**158,068.6**	**19,371.7**	**354,879.9**

Source: HMMH, 2013.
Notes: Annual operations modeled in the 2012 Annual contour.
Some totals may not match due to rounding.

Table H-1b 2013 Annual Modeled Operations

INM Type	Runway Use Group	Arrivals Day	Arrivals Night	Departures Day	Departures Night	Total
Commercial Jet Operations						
747400	Heavy Jet A	1,026.0	8.9	966.1	68.8	2,069.8
A340-211	Heavy Jet A	629.1	4.4	380.0	253.6	1,267.1
A340-642	Heavy Jet A	428.8	0.0	404.5	24.4	857.7
A380-841	Heavy Jet A	1.6	0.0	1.6	0.0	3.2
767300	Heavy Jet B	363.0	206.1	359.6	209.5	1,138.2
767400	Heavy Jet B	99.1	3.2	97.3	5.1	204.7
767CF6	Heavy Jet B	94.0	74.3	14.2	154.1	336.6
767JT9	Heavy Jet B	40.0	60.5	0.0	100.5	201.0
777200	Heavy Jet B	899.1	150.7	754.0	295.9	2,099.7
777300	Heavy Jet B	1.6	0.0	1.6	0.0	3.2
7773ER (New INMv7.0d type)	Heavy Jet B	14.0	0.0	5.7	8.2	27.9
7878R (New INMv7.0d type)	Heavy Jet B	227.1	0.0	227.1	0.0	454.2
A300-622R	Heavy Jet B	174.2	485.0	308.8	350.4	1,318.4
A310-304	Heavy Jet B	241.6	4.0	43.6	202.1	491.3
A330-301	Heavy Jet B	1,466.7	8.6	1,394.9	80.4	2,950.6
A330-343	Heavy Jet B	644.6	5.4	556.3	93.7	1,300.0
DC1010	Heavy Jet B	190.8	177.5	60.9	307.4	736.6
DC1030	Heavy Jet B	52.2	59.9	22.4	89.7	224.2
MD11GE	Heavy Jet B	198.5	155.3	175.9	177.9	707.6
MD11PW	Heavy Jet B	117.0	84.1	98.4	102.7	402.2
717200	Light Jet A	2,963.4	836.4	3,042.2	757.6	7,599.6
727EM2	Light Jet A	9.4	3.9	7.4	5.8	26.5
DC95HW	Light Jet A	6.1	0.0	6.1	0.0	12.2
F10062	Light Jet A	36.5	1.0	36.8	6.0	80.3
MD9025	Light Jet A	710.8	23.3	708.1	26.0	1,468.2
MD9028	Light Jet A	341.1	15.8	339.7	17.2	713.8
737300	Light Jet B	1,303.8	199.2	1,348.1	154.9	3006
7373B2	Light Jet B	79.6	12.3	77.9	14.0	183.8
737400	Light Jet B	173.0	38.4	171.2	40.2	422.8
737500	Light Jet B	42.3	0.0	38.3	4.0	84.6
737700	Light Jet B	5,808.8	1,553.0	6,626.2	735.7	14,723.7
737800	Light Jet B	12,504.3	4,214.7	14,542.0	2,177.1	33,438.1
737N17	Light Jet B	0.0	1.6	1.6	0.0	3.2
757300	Light Jet B	86.2	23.7	104.6	5.2	219.7
757PW	Light Jet B	2,853.7	692.6	2,975.0	570.2	7,091.5
757RR	Light Jet B	4,480.5	1,275.4	4,918.8	838.1	11,512.8
A319-131	Light Jet B	8,683.6	2,311.1	9,265.6	1,729.1	21,989.4
A320-211	Light Jet B	4,569.1	778.9	4,718.2	629.8	10,696.0
A320-232	Light Jet B	17,358.8	5,674.2	19,869.9	3,163.1	46,066.0
A321-232	Light Jet B	1,507.9	585.4	1697.0	396.3	4,186.6
EMB190 (New INMv7.0d type)	Light Jet B	25,687.9	2,380.4	24,967.2	3,101.1	56,136.6
EMB195 (New INMv7.0d type)	Light Jet B	15.2	1.1	13.2	3.0	32.5
MD82	Light Jet B	11.1	0.0	10.1	1.0	22.2

Note: Some totals may not match due to rounding.

Table H-1b 2013 Annual Modeled Operations (Continued)

INM Type	Runway Use Group	Arrivals Day	Arrivals Night	Departures Day	Departures Night	Total
Commercial Jet Operations (Continued)						
MD83	Light Jet B	994.1	43.8	966.5	71.4	2,075.8
CIT3	RJ	2.2	0.0	1.0	1.0	4.2
CL600	RJ	14.0	2.0	21.1	0.0	37.1
CL601	RJ	6,256.2	361.0	6,426.7	191.5	13,235.4
CNA525C	RJ	6.0	1.0	7.3	0.0	14.3
CNA55B	RJ	10.0	1.0	10.2	1.0	22.2
CNA560E	RJ	5.0	0.0	5.4	0.0	10.4
CNA560U	RJ	3.0	1.0	2.4	1.2	7.6
CNA560XL	RJ	7.3	0.0	4.0	1.0	12.3
CNA680	RJ	3.0	0.0	3.0	0.0	6.0
CNA750	RJ	3.0	0.0	3.0	0.0	6.0
CRJ9-ER	RJ	3,514.5	143.1	3,228.5	429.0	7,315.1
CRJ9-LR	RJ	986.6	51.9	907.2	131.2	2,076.9
EMB145	RJ	96.8	1.0	91.1	6.7	195.6
EMB14L	RJ	2,141.9	41.5	1,968.0	215.4	4,366.8
EMB170 (New INMv7.0d type)	RJ	5,315.0	395.8	5,208.1	502.7	11,421.6
EMB175 (New INMv7.0d type)	RJ	3,998.2	212.3	3,789.2	421.3	8,421.0
GIIB	RJ	2.0	0.0	2.3	0.0	4.3
GIV	RJ	30.0	2.0	28.8	3.0	63.8
GV	RJ	19.0	2.1	19.0	2.0	42.1
IA1125	RJ	3.1	0.0	3.0	0.0	6.1
LEAR25	RJ	0.0	1.0	0.0	0.0	1.0
LEAR35	RJ	34.9	30.0	43.4	29.0	137.3
MU3001	RJ	6.0	1.0	6.0	0.0	13.0
Commercial Jets Subtotal		**119,591.7**	**23401.8**	**124,102.3**	**18,906.2**	**286,002.0**
Commercial Non-Jet Operations						
BEC58P	non-jet	17,981.3	627.2	18,445.8	163.2	37,217.5
CNA206	non-jet	0.0	1.0	0.0	0.0	1.0
CNA208	non-jet	230.6	2.1	226.8	1.0	460.5
CNA441	non-jet	51.3	19.5	62.0	6.0	138.8
DHC6	non-jet	8.4	9.6	14.0	3.0	35.0
DHC8	non-jet	1,326.8	10.4	1,323.8	13.4	2,674.4
DHC830	non-jet	2,193.6	71.5	2,083.2	181.9	4,530.2
DO228	non-jet	4.2	0.0	5.0	1.0	10.2
DO328	non-jet	4.2	0.0	4.2	0.0	8.4
GASEPF	non-jet	1.0	0.0	0.0	1.0	2.0
PA31	non-jet	1.0	2.0	2.4	3.6	9.0
SF340	non-jet	2,147.3	44.7	2,183.7	8.3	4,384.0
Commercial Non-Jet Operations Subtotal		**23,951.9**	**788.0**	**24,351.9**	**383.4**	**49,475.2**
Commercial Aircraft Total		**143,543.6**	**24,189.8**	**148,454.2**	**19,289.6**	**335,477.2**

Table H-1b 2013 Annual Modeled Operations (Continued)

INM Type	Runway Use Group	Arrivals Day	Arrivals Night	Departures Day	Departures Night	Total
General Aviation Operations						
747200	Heavy Jet A	1.1	0.0	1.1	0.0	2.2
74720B	Heavy Jet A	2.2	0.0	2.2	0.0	4.4
767300	Heavy Jet B	4.3	0.0	2.2	2.2	8.7
767CF6	Heavy Jet B	1.1	0.0	1.1	0.0	2.2
A330-301	Heavy Jet B	2.2	0.0	2.2	0.0	4.4
C17	Heavy Jet B	4.3	0.0	4.3	0.0	8.6
KC135R	Heavy Jet B	1.1	0.0	1.1	0.0	2.2
727EM2	Light Jet A	1.1	2.2	0.0	3.3	6.6
DC93LW	Light Jet A	0.0	3.3	0.0	3.3	6.6
DC95HW	Light Jet A	1.1	0.0	0.0	1.1	2.2
737400	Light Jet B	13.0	0.0	6.5	6.5	26.0
737500	Light Jet B	1.1	0.0	1.1	0.0	2.2
737700	Light Jet B	19.4	1.2	17.4	3.3	41.3
737800	Light Jet B	21.7	6.5	26.0	2.2	56.4
757PW	Light Jet B	4.4	0.0	5.4	0.0	9.8
757RR	Light Jet B	7.6	0.0	4.4	2.2	14.2
A319-131	Light Jet B	4.3	0.0	4.3	0.0	8.6
A320-232	Light Jet B	8.0	4.0	10.9	1.1	24.0
A321-232	Light Jet B	6.2	2.5	5.4	3.3	17.4
EMB190	Light Jet B	34.7	3.3	34.6	3.4	76.0
MD81	Light Jet B	5.4	1.1	3.3	3.3	13.1
MD83	Light Jet B	0.0	2.2	0.0	2.2	4.4
1900D	non-jet	2.2	0.0	2.2	0.0	4.4
BEC58P	non-jet	474.0	37.6	465.5	45.6	1,022.7
C130	non-jet	1.1	0.0	1.1	0.0	2.2
CIT3	non-jet	53.8	3.5	51.0	6.5	114.8
CNA172	non-jet	40.1	0.0	40.1	0.0	80.2
CNA182	non-jet	62.9	1.2	64.0	0.0	128.1
CNA206	non-jet	76.0	2.2	78.0	1.2	157.4
CNA208	non-jet	760.2	91.9	761.6	95.5	1,709.2
CNA20T	non-jet	2.2	0.0	2.2	0.0	4.4
CNA441	non-jet	269.0	14.6	265.7	20.6	569.9
DHC6	non-jet	0.0	0.0	1.0	0.0	1.0
DHC8	non-jet	3.3	0.0	3.3	0.0	6.6
DHC830	non-jet	18.1	1.4	15.2	4.3	39.0
DO228	non-jet	190.4	10.1	178.0	20.6	399.1
DO328	non-jet	5.4	0.0	5.4	0.0	10.8
EMB120	non-jet	2.2	0.0	1.1	1.1	4.4
GASEPF	non-jet	4.3	0.0	4.3	0.0	8.6
GASEPV	non-jet	335.2	25.0	341.8	18.4	720.4
PA28	non-jet	20.6	1.1	20	1.7	43.4
PA30	non-jet	4.3	0.0	4.3	0.0	8.6
PA31	non-jet	36.8	1.1	31.0	3.9	72.8

Table H-1b 2013 Annual Modeled Operations (Continued)

INM Type	Runway Use Group	Arrivals Day	Arrivals Night	Departures Day	Departures Night	Total
PA42	non-jet	2.2	0.0	2.2	0.0	4.4
SD330	non-jet	82.9	11.5	85.7	8.7	188.8
SF340	non-jet	0.0	1.1	0.0	1.1	2.2
CL600	RJ	986.1	86.8	963.2	104.6	2,140.7
CL601	RJ	941.7	84.7	931.0	94.4	2,051.8
CNA500	RJ	84.9	29.0	84.6	29.3	227.8
CNA510	RJ	65.1	9.8	68.4	6.5	149.8
CNA525C	RJ	323.3	17.4	324.6	15.8	681.1
CNA55B	RJ	289.7	39.1	284.1	44.4	657.3
CNA560E	RJ	540.4	43.4	546.0	37.4	1,167.2
CNA560U	RJ	36.9	2.2	37.0	2.6	78.7
CNA560XL	RJ	932.4	68.9	923.3	80.3	2,004.9
CNA680	RJ	491.0	47.1	508.9	29.3	1,076.3
CNA750	RJ	684.7	81.4	694.5	71.5	1,532.1
ECLIPSE500	RJ	22.8	4.3	24.7	2.5	54.3
EMB145	RJ	61.9	9.8	67.3	4.3	143.3
F-18	RJ	1.1	0.0	1.1	0.0	2.2
F10062 (sub for the FA50 and F900)	RJ	405.1	39.8	401.7	38.0	884.6
FAL20	RJ	2.2	0.0	2.2	0.0	4.4
GII	RJ	2.2	0.0	2.2	0.0	4.4
GIIB	RJ	49.9	3.3	49.1	3.8	106.1
GIV	RJ	621.0	66.7	609.8	78.1	1,375.6
GV	RJ	540.3	61.8	550.1	52.1	1,204.3
IA1125	RJ	105.0	12.2	113.9	3.3	234.4
LEAR25	RJ	2.2	0.0	3.2	0.0	5.4
LEAR35	RJ	1,445	146.5	1,431.0	153.0	3,175.5
MU3001	RJ	586.8	40.4	577.2	51.0	1,255.4
General Aviation Total		**11,813.2**	**1,123.2**	**11,757.3**	**1,168.8**	**25,862.5**
Grand Total		**155,356.8**	**25,313.0**	**160,211.5**	**20,458.4**	**361,339.7**

Source: HMMH, 2014.
Notes: BEC58P is the INM substitution for the Cessna 402.
The CRJ9-ER in the RJ category is the CRJ700 aircraft.
Annual operations modeled in the 2013 Annual contour.
Some totals may not match due to rounding.

RJs are defined as those aircraft with 90 or less seats, consistent with the categorization in *Chapter 2, Activity Levels*.[5] For years prior to 2010, the RJs in this report were classified as aircraft with less than 100 seats. When RJs first started gaining popularity, the aircraft types available were typically 50 seats or less with the traditional air carrier jet being 100 seats and higher. As newer aircraft types have become available, the smaller 35 to 50 seat types have been replaced by 70 to 99-seat types, with the 90 and above seat types flying many of the traditional air carrier routes. The majority of the newer types fall into two categories: the 70 to 75-seat

5 U.S. Code, 2006 Edition, Supplement 3, Title 49 – Transportation Subtitle VII – Aviation Programs Part A – Air Commerce and Safety, Subpart II, Economic Regulation, Chapter 417 - Operations or Carriers, Subchapter III - Regional Air Service Incentive Program, Sec. 41762 – Definitions – defines RJ air carrier service to be aircraft with a maximum of 75 seats. Therefore, this report categorizes aircraft with 70-75 seats and below as RJ and aircraft with 90 seats and higher aircraft as air carrier (Note: there are no types with 75 to 90 seats).

category, which remain categorized as RJs, and the 91- to 99-seat category, which are categorized as air carrier jets. The Embraer 190 falls into this category and is now in the Light Jet B group.

Table H-2a shows the runway use that was used to model the 2012 noise conditions. Table H-2b shows the runway used to model the 2013 noise conditions. As described above, turbojet aircraft in the table were grouped into different categories for reporting purposes. Because the 2012 and 2013 contour developed using RealContours™ reflects the individual use of the runways by each INM aircraft type, it accurately represents Logan Airport's noisiest aircraft by modeling them on the actual runways that they used during the year. The modeled runway use for each particular aircraft type may be different from the overall group runway use presented in Table H-2a for 2012 and Table H-2b for 2013.

Like 2011, 2012 included a summer closure of Runway 15R-33L due to the on-going Runway Safety Area (RSA) project. The closure resulted in Runway 15R-33L not being available for use, which especially had an effect on nighttime usage. In general, there was a higher use of the southwest runway configuration, which includes arrivals on 27 and 22R and departures on 22L and 22R. Comparing Table H-2a with the similar Table H-2 in the *2011 ESPR*, departure use increased on Runways 22L and 22R in 2012 in most aircraft categories compared to 2011. Runway use by RJs increased on Runway 33L for both day and night. The largest increase in departures was by Heavy Jet A aircraft at night from Runway 22L. Departure use decreased on Runways 9, 15R, 27, and 33L compared to 2011 with the largest decrease being RJs on Runway 9. Arrivals by most categories of aircraft declined on Runway 4R and 33L with the most significant decline by Heavy Jet A and Light Jet A on Runway 4R at night. The largest increases were on Runway 15R and on Runway 27 with the majority of the increases on Runway 27.

The changes in runway use from 2012 to 2013 are dominated by the completion of the RSA project in 2012. All runway configurations were in use in 2013 resulting in a return to historical average use of most runways. Comparing Table H-2b (2013) with the similar Table H-2a (2012) in this *2012/2013 EDR*, departure use of Runway 33L, 27, and 15R increased in almost all categories and decreased for Runways 4R, 9, 22L, and 22R. For departures, the largest increase at night was a 10.0 percent increase for Heavy Jet A departures on 15R and a 9.4 percent increase on 15R for Light Jet A departures. Runway 27 also had sizable increases at night for the Light Jet A and Light Jet B groups compared to 2012. For arrivals, Runways 4L, 4R, and 27 show decreases in almost all aircraft categories between 2013 and 2012. Runways 15R and 33L show increases in almost all aircraft categories. Runway 32 shows increases by RJ and non-jets in 2013 and Runway 33R by non-jet traffic in 2013. The most significant increases are to Runway 33L, especially at night. For example, Heavy Jet A arrivals increased 23.3 percent and Heavy Jet B 15.6 percent at night on Runway 33L.

Table H-2a 2012 Modeled Runway Use by Aircraft Group

ARRIVALS

Runway	Heavy Jets - Group A		Heavy Jets - Group B		Light Jets - Group A		Light Jets - Group B		Regional Jets		Turboprops (Non-jets)	
	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
04L	0.18%	0.00%	0.72%	0.34%	6.71%	1.20%	5.53%	0.86%	12.75%	3.60%	26.87%	9.64%
04R	46.80%	18.72%	42.49%	26.90%	38.58%	26.40%	36.35%	25.02%	29.29%	22.70%	16.29%	20.83%
09	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
14	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
15L	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
15R	0.48%	1.22%	0.97%	0.51%	0.70%	0.77%	0.66%	1.02%	0.54%	1.08%	0.46%	0.43%
22L	29.71%	34.33%	18.50%	33.46%	8.48%	32.15%	12.56%	33.28%	14.47%	33.39%	21.36%	31.83%
22R	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.90%	2.81%
27	14.17%	7.31%	30.75%	11.73%	38.95%	22.27%	37.46%	19.68%	34.05%	21.13%	21.34%	21.06%
32	0.00%	0.00%	0.00%	0.00%	0.22%	0.00%	0.20%	0.00%	1.75%	0.00%	4.74%	0.00%
33L	8.66%	38.43%	6.57%	27.05%	6.36%	17.22%	7.24%	20.13%	7.16%	18.10%	5.03%	12.45%
33R	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.01%	0.94%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

DEPARTURES

Runway	Heavy Jets - Group A		Heavy Jets - Group B		Light Jets - Group A		Light Jets - Group B		Regional Jets		Turboprops (Non-jets)	
	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
04L	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	23.46%	14.20%
04R	22.15%	11.69%	17.99%	3.84%	5.77%	3.91%	6.71%	5.22%	2.73%	3.20%	4.66%	3.33%
09	10.73%	8.28%	21.48%	18.03%	39.35%	25.91%	33.75%	22.65%	39.21%	23.90%	11.72%	9.63%
14	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.17%	0.00%
15L	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.04%	0.00%
15R	9.58%	26.45%	4.25%	21.62%	0.79%	20.62%	1.67%	25.30%	0.82%	27.10%	1.60%	19.39%
22L	14.34%	17.28%	8.76%	3.03%	1.75%	2.05%	3.48%	2.82%	1.40%	1.03%	1.97%	2.12%
22R	28.35%	25.68%	33.35%	38.31%	39.64%	35.98%	39.45%	30.27%	41.19%	30.77%	46.77%	40.63%
27	0.57%	1.02%	3.21%	3.18%	4.98%	8.05%	6.10%	7.87%	6.07%	7.19%	2.06%	1.40%
32	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
33L	14.29%	9.60%	10.95%	11.99%	7.73%	3.47%	8.84%	5.86%	8.58%	6.80%	7.53%	9.30%
33R	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.03%	0.00%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Source: Massport, HMMH. 2013.

Notes: Night for noise modeling is defined as 10:00 PM to 7:00 AM.
Nighttime runway restrictions are from 11:00 PM to 6:00 AM.
Values may not add to 100 percent due to rounding.

Table H-2b 2013 Modeled Runway Use by Aircraft Group

ARRIVALS

	Heavy Jets - Group A		Heavy Jets - Group B		Light Jets - Group A		Light Jets - Group B		Regional Jets		Turboprops (Non-jets)	
Runway	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
04L	0.34%	0.00%	0.39%	0.00%	5.83%	1.13%	4.91%	0.64%	12.39%	3.16%	24.57%	6.83%
04R	37.24%	0.00%	37.61%	21.96%	31.68%	23.09%	31.63%	23.00%	24.33%	22.95%	11.48%	18.12%
09	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
14	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
15L	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.16%	0.00%
15R	1.09%	0.00%	1.37%	1.30%	1.10%	0.33%	1.16%	0.52%	1.02%	0.70%	0.84%	0.45%
22L	28.46%	33.08%	19.40%	24.80%	9.12%	31.85%	12.59%	30.44%	14.02%	28.25%	23.14%	31.61%
22R	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%	0.02%	0.03%	0.00%	2.52%	1.67%
27	17.25%	5.26%	27.42%	9.31%	39.44%	20.97%	36.78%	16.46%	32.33%	17.62%	17.87%	15.05%
32	0.00%	0.00%	0.00%	0.00%	0.49%	0.00%	0.42%	0.01%	3.15%	0.00%	6.92%	0.60%
33L	15.62%	61.65%	13.80%	42.63%	12.35%	22.61%	12.48%	28.92%	12.74%	27.31%	8.37%	20.60%
33R	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	4.13%	5.09%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

DEPARTURES

	Heavy Jets - Group A		Heavy Jets - Group B		Light Jets - Group A		Light Jets - Group B		Regional Jets		Turboprops (Non-jets)	
Runway	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
04L	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%	0.04%	20.02%	12.34%
04R	17.36%	7.93%	13.79%	3.89%	3.68%	0.48%	5.21%	3.17%	1.78%	2.63%	5.46%	3.28%
09	12.62%	2.39%	17.41%	18.25%	33.75%	22.66%	30.60%	21.21%	35.81%	23.11%	12.97%	7.70%
14	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.04%	0.04%	0.20%
15L	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.07%	0.00%
15R	14.00%	36.45%	7.71%	20.33%	1.12%	29.98%	1.97%	24.75%	0.57%	22.90%	0.88%	21.14%
22L	12.29%	11.01%	8.20%	1.42%	0.46%	0.48%	2.27%	1.22%	0.19%	0.15%	0.90%	1.32%
22R	26.79%	24.65%	28.84%	34.08%	37.26%	23.67%	35.76%	24.29%	37.87%	26.73%	43.29%	33.58%
27	1.09%	0.58%	6.03%	4.33%	11.94%	15.32%	11.65%	14.98%	11.79%	13.94%	3.94%	3.72%
32	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
33L	15.85%	16.98%	18.01%	17.70%	11.80%	7.41%	12.54%	10.38%	11.97%	10.47%	12.38%	16.72%
33R	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.04%	0.00%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Source: Massport, HMMH. 2014.
Notes: Night for noise modeling is defined as 10:00 PM to 7:00 AM.
Nighttime runway restrictions are from 11:00 PM to 6:00 AM.
Values may not add to 100 percent due to rounding.

While Tables H-2a and H-2b present runway use by aircraft groups, Tables H-3a and H-3b present the total runway use (jets and non-jets) by runway and time of day. The first section of the table displays the operations by runway and time of day for an average day. The second section displays the same information for the year and the last section displays the percent that each runway is used by operation type and time of day.
Table H-3a shows that on an average day Runway 22R has the most departures (176.09 per day) and Runway 27 has the most arrivals (140.32 per day). At night, Runway 22R has the most departures (16.58 per night) but Runway 22L has the most arrivals (21.65 per night). Table H-3b shows that on an average day Runway 22R has the most departures (163.23 per day) and Runway 27 has the most arrivals (137.03 per day). At night, Runway 22R has the most departures (14.53 per night) but Runway 22L has the most arrivals (20.82 per night). Overall, the Airport continued to favor a north-south operating flow in 2012 and 2013 as shown with the percentage of jet departures by operating direction in Figure 6-4 of *Chapter 6, Noise Abatement.*

Table H-3a Summary of Jet and Non-Jet Aircraft Runway Use: 2012

	Runway												
	4L	**4R**	**9**	**14[2]**	**15L**	**15R**	**22L**	**22R**	**27**	**32**	**33L**	**33R**	**Total**
2012 Daily Operations													
Departures Day	17.63	26.08	131.92	0.13	0.03	7.02	13.09	176.09	22.55	--	37.32	0.02	431.88
Departures Night	0.22	2.67	11.37	0.00	0.00	13.19	1.70	16.58	3.64	--	3.55	--	52.92
Arrivals Day	44.01	133.80	--	--	0.00	2.55	62.04	2.14	140.32	5.41	28.59	0.75	419.61
Arrivals Night	0.94	16.15	--	--	0.00	0.63	21.65	0.08	12.69	0.00	13.03	0.03	65.20
Total Daily Operations	62.80	178.71	143.29	0.13	0.03	23.39	98.47	194.89	179.21	5.41	82.49	0.79	969.61
2012 Annual Operations													
Departures Day	6,451	9,547	48,284	47	11	2,569	4,791	64,449	8,253	--	13,659	7	158,068
Departures Night	82	976	4,161	0	0	4,829	622	6,069	1,334	--	1,299	--	19,372
Arrivals Day	16,109	48,971	--	--	0	934	22,706	784	51,358	1,979	10,463	273	153,577
Arrivals Night	343	5,913	--	--	0	230	7,923	29	4,646	0	4,769	10	23,863
Total Annual Operations	22,986	65,407	52,445	47	11	8,563	36,042	71,330	65,590	1,979	30,190	290	354,880
2012 Operations Percentage													
Percentage Departures Day	4%	6%	31%	<1%	<1%	2%	3%	41%	5%	0%	9%	<1%	100%
Percentage Departures Night	<1%	5%	21%	<1%	<1%	25%	3%	31%	7%	0%	7%	0%	100%
Percentage Arrivals Day	10%	32%	0%	0%	<1%	1%	15%	1%	33%	1%	7%	<1%	100%
Percentage Arrivals Night	1%	25%	0%	0%	<1%	1%	33%	<1%	19%	<1%	20%	<1%	100%

Source: Massport Noise Office and HMMH 2013.

Table H-3b Summary of Jet and Non-Jet Aircraft Runway Use: 2013

	Runway												
	4L	4R	9	14[2]	15L	15R	22L	22R	27	32	33L	33R	Total
2013 Daily Operations													
Departures Day	14.70	21.53	123.79	0.03	0.05	7.81	8.13	163.23	44.49	0.00	55.14	0.03	438.93
Departures Night	0.21	1.76	11.48	0.01	0.00	13.64	0.69	14.53	7.36	0.00	6.36	0.00	56.04
Arrivals Day	40.78	114.92	0.00	0.00	0.11	4.61	63.83	1.89	137.03	8.77	50.72	2.99	425.65
Arrivals Night	0.75	15.77	0.00	0.00	0.00	0.40	20.82	0.05	11.26	0.02	20.14	0.14	69.35
Total Daily Operations	56.44	153.98	135.27	0.04	0.17	26.45	93.47	179.70	200.14	8.78	132.36	3.16	989.96
2013 Annual Operations													
Departures Day	5,367	7,860	45,182	12	19	2,850	2,969	59,578	16,238	0	20,125	12	160,212
Departures Night	77	644	4,192	2	0	4,978	252	5,304	2,687	0	2,322	0	20,458
Arrivals Day	14,884	41,946	0	0	42	1681	23,296	690	50,015	3,200	18,512	1090	155,356
Arrivals Night	272	5,755	0	0	0	145	7,600	20	4,112	7	7,352	50	25,313
Total Annual Operations	20,600	56,204	49,374	14	61	9,655	34,117	65,591	73,052	3,207	48,311	1152	361,338
2013 Operations Percentage													
Percentage Departures Day	3%	5%	28%	<1%	<1%	2%	2%	37%	10%	<1%	13%	<1%	100%
Percentage Departures Night	<1%	3%	20%	<1%	<1%	24%	1%	26%	13%	<1%	11%	<1%	100%
Percentage Arrivals Day	10%	27%	<1%	<1%	<1%	1%	15%	<1%	32%	2%	12%	1%	100%
Percentage Arrivals Night	1%	23%	<1%	<1%	<1%	1%	30%	<1%	16%	<1%	29%	<1%	100%

Source: Massport Noise Office and HMMH 2014.
Notes: The data reflect actual percentages of aircraft operations on each runway end. They should not be confused with effective runway use, which is used by the Preferential Runway Advisory System (PRAS) to derive recommendations for use of a particular runway.
Runway 14-32 is unidirectional.
Values may not add to 100 percent due to rounding.

Runway use can also be presented in terms of total operations as shown in Table H-4 for 2011, 2012, and 2013. Tables H-2a and H-2b total the runway use by aircraft group and time of day. Tables H-3a and H-3b total the runway use by operation type and time of day. Table H-4 presents the 2011, 2012, and 2013 Runway use for all operations which use Logan Airport. In 2011, Runway 4R was the runway with the highest activity (primarily by jet arrivals), whereas in 2012, Runway 22R was the runway with the highest activity (primarily by jet departures). In 2013, with runway use returning to pre-construction levels, Runway 27 was the runway with the highest activity (primarily by jet arrivals).

Each year, non-jet activity makes up approximately eight percent of the arrivals and eight percent of the departures at Logan Airport.

Table H-4 Total 2011, 2012 and 2013 Modeled Runway Use by All Operations

	Jet Arrivals		Non-Jet Arrivals		Jet Departures		Non-Jet Departures		
	Day	Night	Day	Night	Day	Night	Day	Night	
Runway	**2012 Operations**								**Total**
04L	2.7%	<0.1%	2.2%	<0.1%	0.0%	0.0%	1.9%	<0.1%	6.9%
04R	13.7%	1.8%	1.3%	<0.1%	2.2%	<0.1%	<0.1%	<0.1%	19.5%
9	0.0%	0.0%	0.0%	0.0%	13.9%	1.2%	1.2%	<0.1%	16.3%
14	0.0%	0.0%	0.0%	0.0%	<0.1%	0.0%	<0.1%	0.0%	<0.1%
15L	0.0%	0.0%	<0.1%	0.0%	0.0%	0.0%	<0.1%	<0.1%	<0.1%
15R	<0.1%	<0.1%	<0.1%	<0.1%	0.9%	1.4%	<0.1%	<0.1%	2.6%
22L	4.9%	2.0%	1.5%	<0.1%	0.7%	<0.1%	<0.1%	<0.1%	9.5%
22R	0.0%	0.0%	<0.1%	<0.1%	13.5%	1.4%	3.2%	<0.1%	18.4%
27	11.2%	0.8%	1.5%	<0.1%	2.6%	<0.1%	<0.1%	<0.1%	16.8%
32	<0.1%	<0.1%	<0.1%	<0.1%	0.0%	0.0%	0.0%	0.0%	0.6%
33L	3.2%	1.4%	<0.1%	<0.1%	3.0%	0.5%	0.6%	<0.1%	9.4%
33R	0.0%	0.0%	<0.1%	<0.1%	0.0%	0.0%	0.0%	0.0%	<0.1%
Total	**36.1%**	**6.0%**	**7.5%**	**<0.1%**	**36.8%**	**5.3%**	**7.7%**	**<0.1%**	**100.0%**
Runway	**2012 Operations**								**Total**
04L	2.5%	<0.1%	2.0%	<0.1%	0.0%	0.0%	1.8%	<0.1%	6.5%
04R	12.6%	1.6%	1.2%	<0.1%	2.3%	<0.1%	<0.1%	<0.1%	18.4%
9	0.0%	0.0%	0.0%	0.0%	12.7%	1.2%	0.9%	<0.1%	14.8%
14	0.0%	0.0%	0.0%	0.0%	<0.1%	0.0%	<0.1%	0.0%	<0.1%
15L	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	<0.1%	0.0%	<0.1%
15R	<0.1%	<0.1%	<0.1%	<0.1%	0.6%	1.3%	<0.1%	<0.1%	2.4%
22L	4.8%	2.1%	1.6%	<0.1%	1.2%	<0.1%	<0.1%	<0.1%	10.2%
22R	0.0%	0.0%	<0.1%	<0.1%	14.5%	1.6%	3.6%	<0.1%	20.1%
27	12.8%	1.2%	1.6%	<0.1%	2.2%	<0.1%	<0.1%	<0.1%	18.5%
32	<0.1%	0.0%	<0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.6%
33L	2.6%	1.3%	<0.1%	<0.1%	3.3%	<0.1%	0.6%	<0.1%	8.5%
33R	0.0%	0.0%	<0.1%	<0.1%	0.0%	0.0%	<0.1%	0.0%	<0.1%
Total	**35.7%**	**6.4%**	**7.6%**	**<0.1%**	**36.8%**	**5.3%**	**7.7%**	**<0.1%**	**100.0%**
Runway	**2013 Operations**								**Total**
04L	2.3%	<0.1%	1.8%	<0.1%	<0.1%	<0.1%	1.5%	<0.1%	5.7%
04R	10.8%	1.5%	0.8%	<0.1%	1.8%	<0.1%	<0.1%	<0.1%	15.6%
9	0.0%	0.0%	0.0%	0.0%	11.5%	1.1%	1.0%	<0.1%	13.7%
14	0.0%	0.0%	0.0%	0.0%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
15L	0.0%	0.0%	<0.1%	0.0%	0.0%	0.0%	<0.1%	0.0%	<0.1%
15R	<0.1%	<0.1%	<0.1%	<0.1%	0.7%	1.3%	<0.1%	<0.1%	2.7%
22L	4.8%	2.0%	1.7%	<0.1%	0.8%	<0.1%	<0.1%	<0.1%	9.4%
22R	<0.1%	<0.1%	<0.1%	<0.1%	13.3%	1.4%	3.2%	<0.1%	18.2%
27	12.5%	1.1%	1.3%	<0.1%	4.2%	0.7%	<0.1%	<0.1%	20.2%
32	<0.1%	<0.1%	0.5%	<0.1%	0.0%	0.0%	0.0%	0.0%	0.9%
33L	4.5%	2.0%	0.6%	<0.1%	4.7%	0.6%	0.9%	<0.1%	13.4%
33R	0.0%	0.0%	<0.1%	<0.1%	0.0%	0.0%	<0.1%	0.0%	<0.1%
Total	**35.7%**	**6.7%**	**7.3%**	**<0.1%**	**36.9%**	**5.5%**	**7.4%**	**<0.1%**	**100.0%**

Flight Tracks

RealContours™ converts each radar track to an INM model track and then models the scaled aircraft operation on that track. This method keeps the lateral and vertical dispersion of the aircraft types consistent with the radar data, and ensures that anomalies in the departure paths are captured in the RealContours™ system. Table H-5 lists the number of flight tracks used in the RealContours™ modeling system for 2012 and 2013. Flight tracks from October and November 2012 and October 2013 are displayed in Figures 6-4 through 6-10 in *Chapter 6, Noise Abatement.*

Table H-5 Total Count of Flight Tracks Modeled in RealContours™ (2012 and 2013)

	Runway											
	4L	4R	9	14	15L	15R	22L	22R	27	32	33L	33R
2012												
Departures	5,097	9,161	44,951	33	8	6,376	4,668	59,562	8,205	0	12,782	5
Arrivals	12,655	46,438	0	0	0	982	25,503	539	46,636	1,454	12,835	184
2013												
Departures	4,838	8,180	47,822	12	16	7,624	3,121	62,126	18,400	0	21,644	10
Arrivals	14,111	46,200	0	0	36	1,768	29,528	619	52,211	2,928	25,045	977

Source: HMMH, 2013/2014; Exelis NOMS data.

Flight Profiles

To enhance the results from RealContours™, Massport elected to use the companion RealProfiles™ software. By using the actual radar information along with the equations developed for the INM, RealProfiles™ develops an altitude profile for each aircraft operation. This profile is then modeled in the RealContours™ system. As a result, the modeled aircraft follows both the actual radar track on the ground and the actual radar altitude profile in the sky.

RealProfiles™ provides several advantages over the standard INM profile modeling. The standard INM modeling uses a "Stagelength" to identify an aircraft's departure weight and then models a standard departure profile for that Stagelength. Using RealProfiles™, the RealContours™ system selects a weight similar to the standard modeling but then develops a profile to allow the INM aircraft to follow the actual path flown for that route. For example, if aircraft departing from a particular runway are required to remain level at 3,000 feet for a certain distance, RealProfiles™ will develop a profile that remains level for that distance along the track. In contrast, the standard modeling would use the standard INM profile and would not model the level segment.

For 2012, RealProfiles™ was able to compute profiles based on the actual radar data for 97.4 percent of the available departure tracks and 87.8 percent of the available arrivals. For 2013, RealProfiles™ was able to compute profiles based on the actual radar data for 98.8 percent of the available departure tracks and 88.3 percent of the available arrivals. RealProfiles™ uses the INM supplied aircraft performance database to develop its unique profiles; however, for several aircraft in the INM database the aircraft performance data are not available. For those profiles, the INM database contains fixed profiles, which are not modified and are used as supplied with the INM data.

Fleet Mix

As in the past, operations by aircraft types have been summarized into several key categories: commercial (passenger and cargo) operations, Stage 2 or Stage 3 jet aircraft, and turboprop and propeller (non-jet) aircraft. In addition, the operations are split into daytime and nighttime periods, where nighttime hours are defined as 10:00 PM to 7:00 AM, consistent with the definition of DNL. Table H-6 summarizes the numbers of operations by categories of aircraft operating at Logan Airport from 1990 through 2013. General aviation (GA) operations were not included in the noise modeling prior to 1998 and commercial jet operations were not separated until 1999.

Table H-6 Modeled Daily Operations by Commercial and General Aviation (GA) Aircraft[1] – 1990 to 2013

(Data for the years 2003 to 2013 are shown on the next page)

		1990	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Commercial Aircraft													
Stage 2 Jets[2]	Day	312.40	228.89	203.34	189.40	156.90	132.40	108.46	84.93	83.30	5.13	1.18	0.05
	Night	19.99	13.13	7.44	10.10	5.50	4.79	7.75	5.92	6.66	0.26	0.05	0.00
	Totals	**332.39**	**242.02**	**210.78**	**199.50**	**162.40**	**137.19**	**116.21**	**90.85**	**89.96**	**5.39**	**1.23**	**0.05**
Stage 3 Jets	Day	288.89	384.49	418.99	425.70	429.40	439.81	505.08	541.43	597.28	727.09	756.24	740.75
	Night	57.25	58.29	65.47	62.80	69.00	80.16	85.06	95.54	98.59	103.66	109.77	97.04
	Totals	**346.14**	**442.78**	**484.46**	**488.50**	**498.40**	**519.97**	**590.14**	**636.97**	**695.87**	**830.75**	**866.01**	**837.79**
Air Carrier Jets	Day	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	569.18	648.95	569.99	500.70
	Night	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	96.21	99.79	101.30	83.52
	Totals	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	**665.39**	**748.74**	**671.29**	**584.22**
Regional Jets	Day	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	28.10	78.14	186.25	240.05
	Night	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	2.38	3.87	8.47	13.52
	Totals	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	NA[3]	**30.48**	**82.01**	**194.72**	**253.57**
Non-Jets	Day	444.41	411.84	598.16	541.97	526.85	505.31	514.70	552.56	448.82	409.62	317.62	165.45
	Night	11.72	69.32	46.84	13.59	11.14	13.73	27.27	21.86	16.63	21.58	10.97	3.45
	Total	**456.13**	**481.16**	**645.00**	**555.56**	**537.99**	**519.04**	**541.97**	**574.42**	**465.45**	**431.20**	**328.58**	**168.89**
Total Commercial Operations	Day	1045.70	1025.22	1220.49	1157.07	1113.15	1077.52	1128.24	1178.92	1129.90	1141.84	1075.04	906.25
	Night	88.96	140.74	119.75	86.49	85.64	98.68	120.08	123.32	121.88	125.51	120.79	100.49
	Total	**1134.66**	**1165.96**	**1340.24**	**1243.56**	**1198.79**	**1176.20**	**1248.32**	**1302.24**	**1251.78**	**1267.35**	**1195.82**	**1006.73**
GA Aircraft													
Stage 2 Jets[2]	Day	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	5.25	9.89	7.29	5.15	3.65
	Night	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	0.40	0.74	0.64	0.50	0.41
	Total	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	5.65	10.63	7.93	5.65	4.08
Stage 3 Jets	Day	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	30.54	48.46	40.08	34.23	37.83
	Night	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	4.21	6.55	3.21	3.28	6.42
	Total	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	34.75	55.01	43.29	37.51	44.25
Non-Jets	Day	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	37.29	19.36	34.57	37.31	17.36
	Night	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	16.28	18.89	1.83	1.92	4.45
	Total	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	53.57	38.25	36.40	39.23	21.81
Total GA	Day	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	73.08	77.71	81.94	76.68	58.84
	Night	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	20.89	26.17	5.68	5.71	11.29
	Total	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	93.97	103.88	87.62	82.39	70.13
Total	Day	1045.70	1025.22	1220.49	1157.07	1113.15	1077.52	1128.24	1252.00	1207.61	1223.78	1151.72	965.09
	Night	88.96	140.74	119.75	86.49	85.64	98.68	120.08	144.21	148.05	131.19	126.50	111.78
	Total[3]	**1134.66**	**1165.96**	**1340.24**	**1243.56**	**1198.79**	**1176.20**	**1248.32**	**1396.21**	**1355.66**	**1354.97**	**1278.21**	**1076.86**

Table H-6 Modeled Daily Operations by Commercial and General Aviation (GA) Aircraft[1] – 1990 to 2013 (Continued)

(Data for the years 1990 to 2002 are shown on the prior page)

		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Commercial Aircraft												
Stage 2 Jets[2]	Day	0.08	0.03	0.05	0.03	0.03	0.01	0.00	0.01	0.01	0.01	0.01
	Night	0.00	0.01	0.01	0.00	0.01	0.01	0.00	0.01	0.00	0.00	0.00
	Totals	**0.08**	**0.05**	**0.06**	**0.03**	**0.04**	**0.02**	**0.00**	**0.02**	**0.01**	**0.01**	**0.01**
Stage 3 Jets	Day	717.85	772.39	765.76	767.55	748.13	699.39	668..32	674.25	684.19	649.22	667.65
	Night	92.69	113.24	113.66	114.81	118.29	114.30	103.11	107.92	109.38	106.55	115.91
	Totals	**810.54**	**885.63**	**879.42**	**882.36**	**866.42**	**813.69**	**771.43**	**782.17**	**793.57**	**755.77**	**783.56**
Air Carrier	Day	461.06	518.96	505.48	490.63	472.39	443.15	421.51	521.64	571.03	530.76	546.27
	Night	72.69	89.24	91.99	92.71	96.28	89.89	82.19	93.98	99.17	98.68	107.17
	Totals	**533.75**	**608.20**	**597.47**	**583.34**	**568.66**	**533.04**	**503.70**	**615.62**	**670.20**	**629.44**	**653.44**
Regional	Day	256.80	253.43	260.34	276.95	275.77	256.24	246.81	152.61	113.16	118.46	121.38
	Night	19.99	24.00	21.68	22.11	22.03	24.40	20.93	13.94	10.21	7.87	8.74
	Totals	**276.79**	**277.43**	**282.01**	**299.06**	**297.80**	**280.64**	**267.73**	**166.55**	**123.37**	**126.33**	**130.12**
Non-Jets	Day	135.18	133.24	148.77	140.81	145.27	132.52	136.45	138.53	135.18	133.92	132.33
	Night	2.41	3.03	3.02	3.26	3.47	4.00	5.54	5.21	4.73	3.06	3.21
	Total	**137.59**	**136.28**	**151.79**	**144.07**	**148.73**	**136.52**	**141.99**	**143.74**	**139.91**	**136.98**	**135.54**
Total Commercial Operations	Day	853.10	905.66	914.59	908.41	893.43	831.92	804.77	812.78	819.39	783.14	799.99
	Night	95.10	116.29	116.68	118.09	121.77	118.31	108.65	113.13	114.11	109.62	119.12
	Total	**948.20**	**1021.95**	**1031.27**	**1026.51**	**1015.19**	**950.23**	**913.42**	**925.91**	**933.50**	**892.76**	**919.12**
GA Aircraft												
Stage 2	Day	2.84	0.94	2.29	1.90	1.24	0.36	0.09	0.27	0.08	0.25	0.31
	Night	0.26	0.14	0.25	0.17	0.19	0.03	0.01	0.04	0.00	0.04	0.02
	Total	**3.10**	**1.08**	**2.54**	**2.07**	**1.43**	**0.38**	**0.10**	**0.30**	**0.08**	**0.29**	**0.33**
Stage 3 Jets	Day	46.21	53.72	58.84	61.08	54.82	43.98	22.31	27.80	52.51	52.93	51.21
	Night	6.98	8.37	9.33	6.57	6.39	4.52	2.28	3.21	5.35	7.20	5.10
	Total	**53.19**	**62.09**	**68.16**	**67.65**	**61.21**	**48.49**	**23.59**	**31.01**	**57.87**	**60.13**	**56.31**
Non-Jets	Day	17.81	16.95	14.00	15.05	11.98	15.13	8.19	8.19	18.18	15.16	13.06
	Night	4.40	5.20	4.75	1.39	3.61	1.08	0.74	0.72	1.29	1.29	1.15
	Total	**22.21**	**22.14**	**18.75**	**16.44**	**15.58**	**16.20**	**8.93**	**8.92**	**19.48**	**16.45**	**14.22**
Total GA	Day	66.88	71.60	75.12	78.03	68.04	59.46	29.58	36.26	70.78	68.35	64.58
	Night	11.64	13.71	14.33	8.13	10.19	5.62	3.04	3.97	6.65	8.52	6.28
	Total	**78.52**	**85.31**	**89.46**	**86.15**	**78.22**	**65.05**	**32.62**	**40.22**	**77.43**	**76.86**	**70.85**
Total	Day	919.98	977.27	989.71	986.43	961.46	891.39	834.35	849.03	890.16	851.49	864.57
	Night	106.74	130.00	131.02	126.22	131.96	123.93	111.69	117.10	120.76	118.13	125.40
	Total[3]	**1026.72**	**1107.26**	**1120.73**	**1112.66**	**1093.42**	**1015.31**	**946.04**	**966.13**	**1010.92**	**969.61**	**989.97**

Source: Massport's Noise Monitoring System and Revenue Office numbers, HMMH 2014.
Notes: Data from 1991 not available.
1 Includes scheduled and unscheduled operations.
2 Stage 2 aircraft are exempt from meeting newer federal Stage 3 noise limits when their maximum gross takeoff weight is less than or equal to 75,000 pounds.
3 RJ operations were not tracked separately prior to 1999.
4 Totals prior to 1998 do not include GA operations.
5 The definition of RJ for the EDR changed between 2009 and 2010. A RJ in 2010 is a jet in commercial service with less than 80 seats. Prior to 2010, a RJ was a jet in commercial service with 100 seats or less.

Commercial Jet Aircraft by Part 36 Stage Category

Jet aircraft currently operating at Logan Airport are categorized by the FAA into two groups: Stage 2 and Stage 3. As described in *Chapter 6, Noise Abatement*, the designation refers to a noise classification specified in Federal Aviation Regulation Part 36 that sets noise emission standards at three measurement locations – takeoff, landing, and sideline – based on an aircraft's maximum certificated weight. The heavier the aircraft, the more noise it is permitted to make within limits. Because of the substantial differences in noise between Stage 2, re-certificated Stage 3, and new Stage 3 aircraft, Massport tracks operations by these separate categories to follow their trends. Table H-7 shows the percentage of commercial jet operations by stage category from 1999 through 2013. One of the most significant changes occurring after the economic downturn in 2001 was the almost immediate retirement of the re-certificated aircraft from airlines' fleets due to their high operating costs. This type of accelerated retirement is not as prevalent during the 2008 to 2009 economic downturn since it is no longer the major airlines, which are operating these aircraft. However, these aircraft still suffer from high operating costs and are being replaced wherever possible.

Table H-7 Percentage of Commercial Jet Operations by Part 36 Stage Category – 1999 to 2013

	New Stage 3[1]	Recertificated Stage 3[2]	Stage 2	Total
1999	70.0%	21.0%	9.0%	100%
2000	75.0%	24.0%	1.0%	100%
2001	86.3%	13.6%	0.1%	100%
2002	92.8%	7.2%	0.0%	100%
2003	95.8%	4.1%	0.0%	100%
2004	97.8%	2.2%	0.0%	100%
2005	98.0%	2.0%	0.0%	100%
2006	98.6%	1.4%	0.0%	100%
2007	98.9%	1.1%	0.0%	100%
2008	99.1%	0.9%	0.0%	100%
2009	99.1%	0.9%	0.0%	100%
2010	98.9%	1.1%	0.0%	100%
2011	99.5%	0.5%	0.0%	100%
2012	99.9%	0.1%	0.0%	100%
2013	100.0%	<0.1%	<0.1%	100%

Source: Massport and FAA radar data.
Notes:
1 New Stage 3 aircraft are aircraft originally manufactured as a certified Stage 3 aircraft under Federal Regulation Part 36.
2 Recertificated Stage 3 aircrafts are aircrafts originally manufactured as a certified Stage 1 or 2 aircrafts under Federal Regulation Part 36, which either have been treated with hushkits or have been re-engineered to meet Stage 3 requirements.

Nighttime Operations

Massport tracks flights that operate between the broader DNL nighttime periods of 10:00 PM to 7:00 AM, when each flight is penalized 10 dB in calculations of noise exposure. Table H-8 shows this nighttime activity by different groups of aircraft. Nighttime flights by commercial jet operators have decreased by 2.6 percent at Logan Airport in 2012 compared to 2011 and increased 8.8 percent in 2013 compared to 2012. In 2012, commercial non-jet operations decreased 35.3 percent and GA traffic went up 28.1 percent at night compared to 2011. In 2013, commercial non-jet operations increased by 4.9 percent and GA traffic went down 26.4 percent at night compared to 2012. Overall, nighttime operations at Logan Airport decreased 2.2 percent in 2012 and increased 6.2 percent in 2013. The majority of nighttime operations (between 10:00 PM and 7:00 AM) occurred either before midnight or after 5:00 AM.

Table H-8 Modeled Nighttime Operations at Logan Airport – 1990 to 2013

	Commercial Jets	Commercial Non-Jets	General Aviation	Total
1990	77.24	11.72	NA	88.96
1991	NA	NA	NA	NA
1992	71.42	69.32	NA	140.74
1993	72.91	46.84	NA	119.75
1994	72.90	13.59	NA	86.49
1995	74.50	11.14	NA	85.64
1996	84.95	13.73	NA	98.68
1997	92.81	27.27	NA	120.08
1998	101.46	21.86	NA	123.32
1999	105.25	16.63	26.17	148.05
2000	103.92	21.58	5.68	131.19
2001	109.82	10.97	5.71	126.50
2002	97.04	3.45	11.29	111.78
2003	92.69	2.41	11.64	106.74
2004	113.26	3.03	13.71	130.00
2005	113.67	3.02	14.33	131.02
2006	114.81	3.26	8.13	126.22
2007	118.30	3.47	10.19	131.96
2008	114.31	4.00	5.62	123.93
2009	103.05	5.56	3.08	111.70
2010	107.93	5.21	3.97	117.10
2011	109.38	4.73	6.65	120.76
2012	106.55	3.06	8.52	118.13
Change (2011 to 2012)	**(2.83)**	**(1.67)**	**1.87**	**(2.63)**
Percent Change	**(2.59%)**	**(35.31%)**	**28.12%**	**(2.18%)**
2013	115.91	3.21	6.28	125.40
Change (2012 to 2013)	**9.36**	**0.15**	**(2.24)**	**7.27**
Percent Change	**8.79%**	**4.79%**	**(26.32%)**	**6.15%**

Source: Massport, HMMH, 2014.
Note: NA = Not available.

Jet Runway Use

Table H-9 presents a summary of runway use by jets. Since 2009, the radar data have been analyzed with Massport's Exelis Noise and Operational Monitoring System (NOMS), data from 2001 through 2008 was compiled with Massport's PreFlight™ software. PreFlight™ was an analysis package used to compile fleet, day/night splits, and runway use information from radar data. Data prior to 2001 were derived from Massport's original noise monitoring system, supplemented with field records. Note that Logan Airport Noise Rules prevent arrivals to Runway 22R and departures from Runway 4L by jet aircraft.

Table H-9 Summary of Jet Aircraft Runway Use – 1990 to 2013

	Runway									
	4L	4R	9	14[1]	15R	22L	22R	27	32[1]	33L
1990										
Departures	0%[2]	3%	21%	NA	10%	2%	36%	20%	NA	7%
Arrivals	1%	25%	0%	NA	2%	14%	0%	28%	NA	29%
1992[2]										
Departures	0%	6%	31%	NA	7%	2%	38%	10%	NA	6%
Arrivals	1%	37%	0%	NA	3%	12%	0%	30%	NA	17%
1993										
Departures	0%	9%	33%	NA	7%	3%	40%	4%	NA	4%
Arrivals	2%	44%	0%	NA	1%	11%	0%	28%	NA	15%
1994										
Departures	0%	9%	33%	NA	4%	3%	32%	12%	NA	5%
Arrivals	3%	42%	0%	NA	1%	8%	0%	27%	NA	19%
1995										
Departures	0%	8%	36%	NA	5%	5%	29%	11%	NA	5%
Arrivals	3%	41%	0%	NA	2%	8%	0%	27%	NA	17%
1996										
Departures	0%	8%	32%	NA	5%	6%	33%	12%	NA	5%
Arrivals	2%	38%	0%	NA	2%	11%	0%	29%	NA	18%
1997										
Departures	0%	8%	30%	NA	5%	6%	31%	15%	NA	5%
Arrivals	2%	36%	0%	NA	2%	9%	0%	30%	NA	20%
1998										
Departures	0%	8%	35%	NA	6%	5%	28%	14%	NA	5%
Arrivals	2%	41%	0%	NA	2%	7%	0%	28%	NA	19%
1999										
Departures	0%	8%	31%	NA	5%	4%	30%	15%	NA	6%
Arrivals	3%	37%	0%	NA	2%	10%	0%	28%	NA	21%
2000										
Departures	0%	8%	35%	NA	4%	3%	30%	15%	NA	6%
Arrivals	4%	40%	0%	NA	1%	7%	0%	28%	NA	20%

Table H-9 Summary of Jet Aircraft Runway Use – 1990 to 2013 (Continued)

	Runway									
	4L	4R	9	14[1]	15R	22L	22R	27	32[1]	33L
2001										
Departures	0%	7%	34%	NA	4%	3%	35%	12%	NA	5%
Arrivals	5%	36%	0%	NA	1%	8%	0%	32%	NA	18%
2002										
Departures	0%	4%	31%	NA	6%	3%	35%	16%	NA	6%
Arrivals	6%	31%	0%	NA	1%	12%	0%	30%	NA	21%
2003										
Departures	0%	4%	33%	NA	7%	2%	34%	14%	NA	6%
Arrivals	7%	33%	0%	NA	1%	14%	0%	28%	NA	18%
2004										
Departures	0%	5%	34%	NA	10%	4%	24%	18%	NA	6%
Arrivals	6%	34%	0%	NA	1%	12%	0%	24%	NA	23%
2005										
Departures	0%	5%	36%	NA	7%	1%	31%	13%	NA	7%
Arrivals	8%	33%	0%	NA	1%	11%	0%	29%	NA	17%
2006										
Departures	0%	4%	33%	0%	3%	1%	40%	13%	-	6%
Arrivals	7%	29%	0%	-	1%	14%	0%	33%	0.2%	16%
2007										
Departures	0%	5%	31%	0%	4%	1%	33%	7%	-	19%
Arrivals	5%	31%	0%	-	1%	15%	0%	36%	2%	11%
2008										
Departures	0%	6%	33%	<1%	3%	<1%	36%	6%	-	16%
Arrivals	6%	30%	-	-	2%	17%	-	33%	2%	11%
2009										
Departures	0%	7%	32%[3]	0%	3%	2%	34%	6%[3]	-	16%
Arrivals	7%	31%	-	-	3%	17%	0%	30%[3]	1%	11%
2010										
Departures	0%	4%	28%	<1%	8%	2%	31%	10%	-	17%
Arrivals	5%	28%	-	-	1%	15%	0%	32%	1%	16%
2011										
Departures	0%	6%	36%	<1%	5%[4]	2%	36%	7%	-	7%[4]
Arrivals	7%	37%	-	-	<1%[4]	16%	0%	28%	1%	11%[4]
2012										
Departures	0%	6%	33%	<1%	5%[4]	3%	38%	6%	-	9%[4]
Arrivals	6%	34%	-	-	1%[4]	16%	0%	33%	<1%	9%[4]
2013										
Departures	<1%	5%	30%	<1%	5%	2%	35%	12%	--	12%
Arrivals	6%	29%	--	--	1%	16%	<1%	32%	1%	15%

Source: HMMH 2014, Massport Noise Office.

Notes: The data reflect actual percentages of jet aircraft operations on each runway end. They should not be confused with effective runway use, which is used by the PRAS to derive recommendations for use of a particular runway. Effective runway percentages include a factor of 10 applied to nighttime operations so that use of a runway at night more closely reflects its effect on total noise exposure.
Jet aircraft are not able to use Runway 15L or 33R due to its length of only 2,557 feet.
Values may not add to 100 percent due to rounding. NA = Not available.

1 Runway 14-32 opened in late November 2006. (Runway 14-32 is unidirectional with no arrivals to Runway 14 and no departures from Runway 32).

2 The *1990 Final Generic Environmental Impact Report* was published and submitted to the Secretary of Environmental Affairs in July 1993. It included modeled operations and resulting noise contours for 1987, 1990, and a 1996-forecast year. The *1993 Annual Update* published in July 1994 included operations and contours for 1992 and 1993. 1991 data are not available.

3 Runway 9-27 had extended weekend closings for resurfacing during 2009.

4 Runway 15R-33L was closed for 3 months in 2011 and in 2012.

Annual Model Results and Status of Mitigation Programs

Noise Exposed Population

Table H-10 presents the noise-exposed population by community through 2013. This table includes population within the DNL 60-65 dB contours, although a DNL of 65 dB is the federally-defined noise criterion used as a guideline to identify when residential land use is considered incompatible with aircraft noise.

Table H-10 Noise-Exposed Population by Community

Year	Census Data	80+ dB DNL	75+ dB DNL	70-75 dB DNL	65-70 dB DNL[1]	Total (65+)	60-65 dB DNL
BOSTON[2]							
1990	1980	0	0	1,778	28,970	30,748	NA
1992	1980	0	0	800	4,316	5,116	NA
1993	1980	0	0	264	2,820	3,084	NA
1994	1990	0	106	265	7,698	8,069	30,895
1995	1990	0	106	851	8,815	9,772	33,765
1996	1990	0	106	374	8,775	9,255	40,992
1997	1990	0	106	719	13,857	14,682	54,804
1998	1990	0	58	580	10,877	11,515	52,201
1999[3]	1990	0	58	364	11,632	12,054	45,948
2000[3]	1990	0	58	183	7,880	8,121	32,474
2000[3]	2000	0	0	234	9,014	9,248	35,785
2001[3]	2000	0	0	315	6,515	6,700	27,778
2002[3]	2000	0	0	132	2,625	2,757	23,225
2003[3]	2000	0	0	164	1,730	1,894	21,763
2004[3,4]	2000	0	65	192	4,142	4,399	24,473
2005[3,4]	2000	0	65	104	2,020	2,189	17,661
2006[4]	2000	0	65	99	1,054	1,218	14,866
2007 (INMv7.0a)	**2000**	**0**	**0**	**169**	**4,094**	**4,263**	**21,446**
2008 (INMv7.0b)	**2000**	**0**	**5**	**0**	**3,487**	**3,492**	**18,890**
2009 (INMv7.0b)	**2000**	**0**	**5**	**67**	**937**	**1,009**	**12,284**
2010 (INMv7.0b)	**2000**	**0**	**0**	**67**	**644**	**711**	**14,900**
2010 (INMv7.0b)	**2010**	**0**	**0**	**0**	**689**	**689**	**17,646**
2011 (INMv7.0c)[4]	**2010**	**0**	**0**	**0**	**331**	**331**	**11,600**
2012 (INMv7.0c)[4]	**2010**	**0**	**0**	**0**	**439**	**439**	**12,076**
2012	**2010**	**0**	**0**	**0**	**421**	**421**	**11,037**
2013	**2010**	**0**	**0**	**0**	**612**	**612**	**14,835**
CHELSEA							
1990	1980	0	0	0	4,813	4,813	NA
1992	1980	0	0	0	3,952	3,952	NA
1993	1980	0	0	0	0	0	NA
1994	1990	0	0	0	0	0	8,510
1995	1990	0	0	0	95	95	9,750
1996	1990	0	0	0	0	0	8,744
1997	1990	0	0	0	0	0	10,001
1998	1990	0	0	0	0	0	9,222
1999	1990	0	0	0	95	95	9,249
2000	1990	0	0	0	0	0	5,622
2000	2000	0	0	0	0	0	7,361
2001	2000	0	0	0	0	0	4,508
2002	2000	0	0	0	0	0	3,995
2003	2000	0	0	0	0	0	3,591
2004[4]	2000	0	0	0	0	0	7,756
2005[4]	2000	0	0	0	0	0	5,772

Table H-10 Noise-Exposed Population by Community (Continued)

Year	Census Data	80+ dB DNL	75-80 dB DNL	70-75 dB DNL	65-70 dB DNL[1]	Total (65+)	60-65 dB DNL
CHELSEA							
2006[4]	2000	0	0	0	0	0	2,477
2007 (INMv7.0a)[4]	**2000**	**0**	**0**	**0**	**0**	**0**	**9,774**
2008 (INMv7.0b)[4]	**2000**	**0**	**0**	**0**	**0**	**0**	**7,793**
2009 (INMv7.0b)[4]	**2000**	**0**	**0**	**0**	**0**	**0**	**5,462**
2010 (INMv7.0b)[4]	**2000**	**0**	**0**	**0**	**0**	**0**	**4,880**
2010 (INMv7.0b)[4]	**2010**	**0**	**0**	**0**	**0**	**0**	**4,897**
2011 (INMv7.0c)[4]	**2010**	**0**	**0**	**0**	**0**	**0**	**0**
2012 (INMv7.0c)[4]	**2010**	**0**	**0**	**0**	**0**	**0**	**0**
2012 (INMv7.0d)[4]	**2010**	**0**	**0**	**0**	**0**	**0**	**0**
2013 (INMv7.0d)[4]	**2010**	**0**	**0**	**0**	**0**	**0**	**3,485**
EVERETT							
1990	1980	0	0	0	0	0	NA
1992	1980	0	0	0	0	0	NA
1993	1980	0	0	0	0	0	NA
1994	1990	0	0	0	0	0	0
1995	1990	0	0	0	0	0	0
1996	1990	0	0	0	0	0	0
1997	1990	0	0	0	0	0	0
1998	1990	0	0	0	0	0	0
1999[3]	1990	0	0	0	0	0	0
2000[3]	1990	0	0	0	0	0	0
2000[3]	2000	0	0	0	0	0	0
2001[3]	2000	0	0	0	0	0	0
2002[3]	2000	0	0	0	0	0	0
2003[3]	2000	0	0	0	0	0	0
2004[3,4]	2000	0	0	0	0	0	0
2005[3,4]	2000	0	0	0	0	0	0
2006[4]	2000	0	0	0	0	0	0
2007 (INMv7.0a)[4]	**2000**	**0**	**0**	**0**	**0**	**0**	**0**
2008 (INMv7.0b)[4]	**2000**	**0**	**0**	**0**	**0**	**0**	**0**
2009 (INMv7.0b)[4]	**2000**	**0**	**0**	**0**	**0**	**0**	**0**
2010 (INMv7.0b)[4]	**2000**	**0**	**0**	**0**	**0**	**0**	**0**
2010 (INMv7.0b)[4]	**2010**	**0**	**0**	**0**	**0**	**0**	**0**
2011 (INMv7.0c)[4]	**2010**	**0**	**0**	**0**	**0**	**0**	**0**
2012 (INMv7.0c)[4]	**2010**	**0**	**0**	**0**	**0**	**0**	**0**
2012 (INMv7.0d)[4]	**2010**	**0**	**0**	**0**	**0**	**0**	**0**
2013 (INMv7.0d)[4]	**2010**	**0**	**0**	**0**	**0**	**0**	**0**
MEDFORD							
1990	1980	0	0	0	0	0	NA
1992	1980	0	0	0	0	0	NA
1993	1980	0	0	0	0	0	NA
1994	1990	0	0	0	0	0	0
1995	1990	0	0	0	0	0	0
1996	1990	0	0	0	0	0	0
1997	1990	0	0	0	0	0	0
1998	1990	0	0	0	0	0	0
1999	1990	0	0	0	0	0	0
2000	1990	0	0	0	0	0	0

Table H-10 Noise-Exposed Population by Community (Continued)

Year	Census Data	80+ dB	75-80 dB	70-75 dB	65-70 dB	Total (65+)	60-65 dB DNL
MEDFORD							
2000	2000	0	0	0	0	0	0
2001	2000	0	0	0	0	0	0
2002	2000	0	0	0	0	0	0
2003	2000	0	0	0	0	0	0
2004[4]	2000	0	0	0	0	0	0
2005[4]	2000	0	0	0	0	0	0
2006[4]	2000	0	0	0	0	0	0
2007 (INMv7.0a)[4]	**2000**	**0**	**0**	**0**	**0**	**0**	**0**
2008	**2000**	**0**	**0**	**0**	**0**	**0**	**0**
2009	**2000**	**0**	**0**	**0**	**0**	**0**	**0**
2010	**2000**	**0**	**0**	**0**	**0**	**0**	**0**
2010	**2010**	**0**	**0**	**0**	**0**	**0**	**0**
2011 (INMv7.0c)[4]	**2010**	**0**	**0**	**0**	**0**	**0**	**0**
2012 (INMv7.0c)[4]	**2010**	**0**	**0**	**0**	**0**	**0**	**0**
2012	**2010**	**0**	**0**	**0**	**0**	**0**	**0**
2013	**2010**	**0**	**0**	**0**	**0**	**0**	**0**
QUINCY							
1990	1980	0	0	0	0	0	NA
1992	1980	0	0	0	0	0	NA
1993	1980	0	0	0	0	0	NA
1994	1990	0	0	0	0	0	0
1995	1990	0	0	0	0	0	0
1996	1990	0	0	0	0	0	0
1997	1990	0	0	0	0	0	0
1998	1990	0	0	0	0	0	0
1999	1990	0	0	0	0	0	0
2000	1990	0	0	0	0	0	0
2000	2000	0	0	0	0	0	636
2001	2000	0	0	0	0	0	610
2002	2000	0	0	0	0	0	610
2003	2000	0	0	0	0	0	610
2004[4]	2000	0	0	0	0	0	610
2005[4]	2000	0	0	0	0	0	610
2006[4]	2000	0	0	0	0	0	610
2007 (INMv7.0a)[4]	**2000**	**0**	**0**	**0**	**0**	**0**	**0**
2008	**2000**	**0**	**0**	**0**	**0**	**0**	**0**
2009	**2000**	**0**	**0**	**0**	**0**	**0**	**0**
2010	**2000**	**0**	**0**	**0**	**0**	**0**	**0**
2010	**2010**	**0**	**0**	**0**	**0**	**0**	**0**
2011 (INMv7.0c)[4]	**2010**	**0**	**0**	**0**	**0**	**0**	**0**
2012 (INMv7.0c)[4]	**2010**	**0**	**0**	**0**	**0**	**0**	**0**
2012	**2010**	**0**	**0**	**0**	**0**	**0**	**0**
2013	**2010**	**0**	**0**	**0**	**0**	**0**	**0**

Table H-10 Noise-Exposed Population by Community (Continued)							
Year	**Census Data**	**80+ dB DNL**	**75-80 dB DNL**	**70-75 dB**	**65-70 dB**	**Total (65+)**	**60-65 dB DNL**
REVERE							
1990	1980	0	0	0	4,274	4,274	NA
1992	1980	0	0	0	3,848	3,848	NA
1993	1980	0	0	0	4,617	4,617	NA
1994	1990	0	0	0	3,569	3,569	2,099
1995	1990	0	0	0	3,364	3,364	2,304
1996	1990	0	0	172	3,292	3,464	2,505
1997	1990	0	0	0	3,293	3,293	2,047
1998	1990	0	0	0	3,168	3,168	2,132
1999	1990	0	0	128	3,165	3,293	2,047
2000	1990	0	0	0	2,552	2,552	2,386
2000	2000	0	0	0	2,496	2,496	3,100
2001	2000	0	0	0	2,496	2,496	3,100
2002	2000	0	0	0	2,822	2,822	2,399
2003	2000	0	0	0	2,994	2,994	2,227
2004[4]	2000	0	0	82	2,969	3,051	2,678
2005[4]	2000	0	0	82	2,540	2,622	2,731
2006[4]	2000	0	0	82	2,540	2,622	2,698
2007 (INMv7.0a)[4]	**2000**	**0**	**0**	**0**	**2,450**	**2,450**	**2,853**
2008	**2000**	**0**	**0**	**0**	**2,434**	**2,434**	**1,802**
2009	**2000**	**0**	**0**	**0**	**2,512**	**2,512**	**1,452**
2010	**2000**	**0**	**0**	**0**	**2,505**	**2,505**	**1,385**
2010	**2010**	**0**	**0**	**0**	**2,413**	**2,413**	**2,473**
2011 (INMv7.0c)[4]	**2010**	**0**	**0**	**0**	**2,547**	**2,547**	**3,123**
2012 (INMv7.0c)[4]	**2010**	**0**	**0**	**0**	**2,772**	**2,772**	**3,236**
2012	**2010**	**0**	**0**	**0**	**2,762**	**2,762**	**3,191**
2013	**2010**	**0**	**0**	**0**	**2,505**	**2,505**	**2,791**
WINTHROP							
1990	1980	0	676	1,211	2,420	4,307	NA
1992	1980	0	626	1,146	2,488	4,262	NA
1993	1980	0	648	1,211	1,773	3,632	NA
1994	1990	0	417	1,343	5,154	6,914	7,512
1995	1990	0	482	1,611	5,757	7,850	7,077
1996	1990	0	417	1,376	5,930	7,723	7,333
1997	1990	0	417	1,659	6,386	8,462	6,839
1998	1990	0	519	1,522	6,572	8,613	6,507
1999	1990	0	353	1,408	5,946	7,707	7,135
2000	1990	0	277	991	5,240	6,508	7,296
2000	2000	0	247	1,070	4,684	6,001	7,776
2001	2000	0	244	683	4,123	5,050	8,104
2002	2000	0	2	481	2,247	2,730	7,921
2003	2000	0	0	339	1,956	2,295	7,386
2004[4]	2000	0	2	337	1,649	1,988	6,508
2005[4]	2000	0	39	347	1,280	1,666	6,353
2006[4]	2000	0	39	416	1,288	1,743	6,845
2007 (INMv7.0a)[4]	**2000**	**0**	**0**	**247**	**1,139**	**1,386**	**6,749**
2008	**2000**	**0**	**0**	**244**	**1,409**	**1,653**	**6,547**
2009	**2000**	**0**	**0**	**171**	**643**	**814**	**4,221**
2010	**2000**	**0**	**0**	**131**	**523**	**654**	**3,960**
2010	**2010**	**0**	**0**	**130**	**598**	**728**	**3,720**
2011 (INMv7.0c)[4]	**2010**	**0**	**0**	**130**	**939**	**1069**	**4,303**
2012 (INMv7.0c)[4]	**2010**	**0**	**0**	**200**	**1,325**	**1,525**	**5,564**
2012	**2010**	**0**	**0**	**200**	**1,186**	**1,386**	**5,305**
2013	**2010**	**0**	**0**	**130**	**1,060**	**1,190**	**5,466**

Table H-10 Noise-Exposed Population by Community (Continued)

Year	Census Data	80+ dB DNL	75-80 dB DNL	70-75 dB DNL	65-70 dB DNL[1]	Total (65+)	60-65 dB DNL
All Communities							
1990	1980	0	676	2,989	40,477	44,142	NA
1992	1980	0	628	2,352	14,604	17,584	NA
1993	1980	0	648	1,475	9,210	11,333	NA
1994	1990	0	523	1,608	16,421	18,552	49,016
1995	1990	0	588	2,462	18,031	21,081	52,896
1996	1990	0	523	1,922	17,997	20,442	59,574
1997	1990	0	523	2,378	23,536	26,437	73,691
1998	1990	0	577	2,102	20,617	23,296	70,062
1999	1990	0	411	1,900	20,838	23,149	64,379
2000	1990	0	335	1,174	15,672	17,181	47,778
2000	2000	0	247	1,304	16,194	17,745	54,190
2001	2000	0	244	998	13,004	14,246	43,616
2002	2000	0	2	613	7,694	8,309	38,150
2003	2000	0	0	503	6,680	7,183	35,577
2004[4]	2000	0	67	611	8,760	9,438	41,975
2005[4]	2000	0	104	533	5,840	6,477	33,127
2006[4]	2000	0	104	597	4,882	5,583	27,496
2007(INMv7.01)[4]	**2000**	**0**	**0**	**416**	**7,683**	**8,099**	**40,822**
2008(INMv7.0b)[4]	**2000**	**0**	**5**	**244**	**7,330**	**7,579**	**35,122**
2009	**2000**	**0**	**5**	**238**	**4,092**	**4,335**	**23,419**
2010	**2000**	**0**	**0**	**198**	**3,672**	**3,870**	**25,125**
2010	**2010**	**0**	**0**	**130**	**3,700**	**3,830**	**28,736**
2011 (INMv7.0c)[4]	**2010**	**0**	**0**	**130**	**3,817**	**3,947**	**19,026**
2012 (INMv7.0c)[4]	**2010**	**0**	**0**	**200**	**4,536**	**4,736**	**20,876**
2012	**2010**	**0**	**0**	**200**	**4,369**	**4,569**	**19,533**
2013	**2010**	**0**	**0**	**130**	**4,177**	**4,307**	**26,577**

Source: Data prepared for Massport by HMMH 2014.
Notes: South End is included in Boston totals.
NA = Not available.
1 65 dB DNL is the federally-defined noise criterion.
2 Portions of Dorchester, East Boston, Roxbury, South Boston, and the
3 Boston population by community changed in 1999 due to employment of more accurate hill effects methodology and reporting change.
4 All results since 2004 are from the RealContoursTM modeling system.

Residential Sound Insulation Program (RSIP)

In 2013, Massport completed sound insulation of 45 residential buildings containing 76 dwelling units, resulting in 5,421 residential buildings and 11,409 dwelling units that have been sound insulated since 1986 when the program was first implemented. Federal funding was delayed in 2012, which resulted in no homes being treated in that year. Table H-11 lists the yearly progress of this mitigation effort.

Following the FAA's approval of model adjustments based on the effects of terrain (discussed in the *1999 ESPR*), Massport submitted, and the New England Region of the FAA approved, a new sound insulation program. The revised contour, approved for a two-year period beginning in 1999, included dwelling units in East Boston, South Boston, and Winthrop that previously had not been eligible for insulation. Massport received notice of FAA funding for $5 million. Subsequently, Massport updated its program contour, first with the *2001 EDR* contour and more recently with the Logan Airside Improvements Project approved contour. These updates have allowed Massport to continue the program with additional funds every year since 1999. This latest update takes into account runway use changes due to the new Runway 14-32 which opened in late November 2006. This update expands the focus of the sound insulation program into Chelsea to satisfy the mitigation commitments made in the Airside Improvements Program Record of Decision (ROD). Massport has also utilized a program where they have contacted properties that are still eligible within the RSIP boundaries that had previously declined to participate. They have been offered a second chance to participate in the program.

Table H-11 Residential Sound Insulation Program (RSIP) Status (1986-2013)

Construction Year	Residential Buildings[1]	Dwelling Units[2]
1986	4	8
1987	43	51
1988	102	159
1989	94	133
1990	121	200
1991	175	360
1992	197	354
1993	318	654
1994	310	542
1995	372	753
1996	323	577
1997	364	808
1998	328	806
1999	330	718
2000	195	601
2001	260	278
2002	205	354
2003	230	468
2004	320	791
2005	314	471
2006	286	827
2007	160	548
2008	94	388
2009	111	287
2010	56	83
2011	62	114
2012	0	0
2013	45	76
Total	**5,419**	**11,409**

Source: Massport, 2014.
Notes:
1 Includes multiple units.
2 Individual units.

Table H-12 provides a list of all schools that have been treated under Massport's sound insulation program. To date, Massport has provided sound insulation to 36 schools at a cost of over $8 million.

Table H-12 Schools Treated Under Massport Sound Insulation Program

Boston:			
East Boston		**Winthrop**	
East Boston High	$381,948	Winthrop Jr. High School	$63,756
St. Mary's Star of the Sea	$80,901	E. B. Newton	$184,674
St. Dominic Savio High	$127,879	A. T. Cummings (Ctr.) School	$800,000
St. Lazarus	$46,092	**3 Total Winthrop Schools**	**$1,048,430**
James Otis	$46,092		
Samuel Adams	$120,650		
Curtis Guild	$180,572	**Revere**	
Dante Alighieri	$97,750	Beachmont School	$854,864
P.J. Kennedy	$127,637	**1 Total Revere School**	**$854,864**
Donald McKay	$231,754		
Hugh Roe O'Donnell	$113,564	**Chelsea**	
E Boston Central Catholic	$391,768	Shurtleff School	$292,207
Manassah Bradley	$237,500	Williams School	$486,258
13 East Boston Schools	**$2,184,107**	St. Rose Elementary	$46,396
		St. Stanislaus	$66,298
South Boston:		Chelsea High School	$524,249
St. Augustine	$92,855	**5 Total Chelsea Schools**	**$1,415,408**
Cardinal Cushing	$47,276		
Patrick Gavin	$217,077	**36 Total Schools**	**$8,159,020**
St. Bridgid's	$112,100		
Oliver Hazard Perry	$337,538		
Condon School	$294,481		
6 South Boston Schools	**$1,101,327**		
Roxbury and Dorchester:			
Samuel Mason	$192,401		
Dearborn Middle	$248,238		
Ralph Waldo Emerson	$155,851		
Lewis Middle	$202,092		
Nathan Hale Elem.	$92,302		
Phillis Wheatley Elem.	$290,794		
Davis Ellis Elem.	$253,663		
Henry L. Higginson	$119,543		
8 Roxbury and Dorchester Schools	**$1,554,884**		
27 Total Boston Schools	**$4,840,318**		

Source: Massport, 2014.

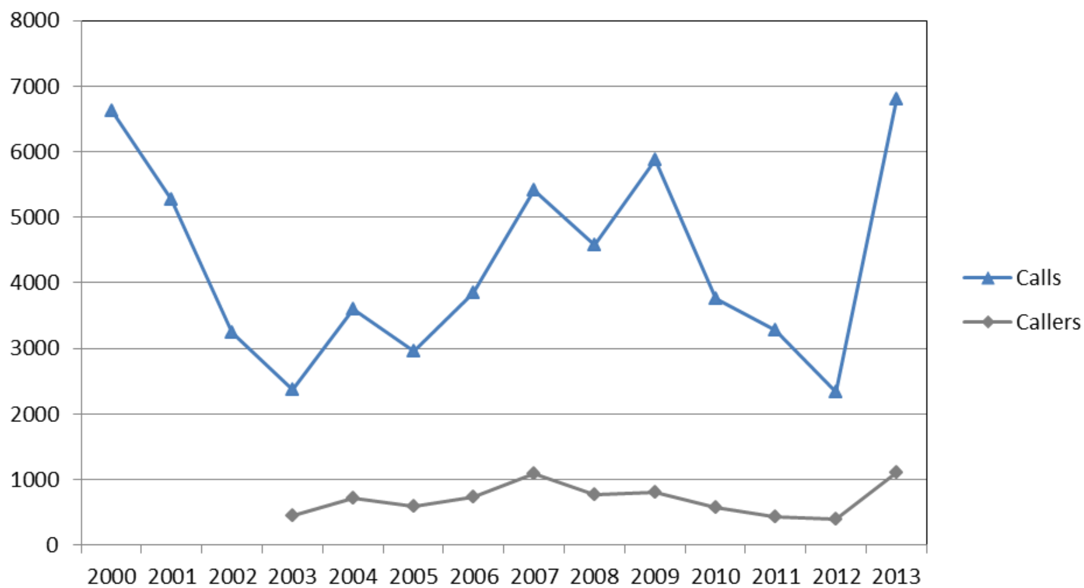
Noise Complaints

Table H-13 presents a detailed list by community of the total complaints made in 2012 and 2013, which can be filed either on Massport's Noise Complaint Line, through a form on Massport's website or through the PublicVue flight track portal. The Noise Complaint Line provides individuals the ability to express their concerns about aviation noise (activities) or to ask questions regarding noise at Logan Airport. Callers ask a range of questions such as "Why is this runway in use?"; "What times do the planes stop flying?" and "Was that aircraft off-course?"

The Noise Abatement Office (NAO) staff documents noise line complaints by obtaining information from the caller about the nature of the complaint, time of the occurrence, location of caller's residence, and the activity that was disturbed. The NAO uses the collected information to determine the probable activity responsible for the complaint and writes a letter report to the complainant. The letter includes the original complaint, a response that identifies the activity responsible for the call (arrivals, departures, run-up, etc.), meteorological information at the time of the call (a major factor in aviation activities), runways in use at the time of the call, and a notice that the FAA will receive a copy of the report.

In 2012, Massport received 2,331 noise complaints from 53 communities, a decrease of 28.9 percent from 2011, when the NAO received 3,280 complaints (Figure H-14). In 2013, Massport received 6,809 noise complaints from 74 communities (Figure H-14) an increase of 292.1 percent. This large rise in complaints is due to the publication of the Runway 33L aRea NAVigation (RNAV) Environmental Assessment and the implementation of the Runway 33L RNAV procedure in June 2013. The RNAV procedure provides precise routing of departures so that they follow a very narrow path thus concentrating the flight track corridor. As a result, communities under these flight paths such as Belmont, Watertown, Cambridge, and Milton had significant increases in noise complaints in 2013. Higher use of Runway 27 and a return to a full year use of Runway 15R-33L most likely caused the increases in complaints from Hull, Jamaica Plain, South Boston, the South End, and Hyde Park.

Figure H-14 Number of Callers and Complaints between 2000 and 2013



Source: Massport, HMMH 2014.
Notes: Number of callers is not available before 2003.

Massport's website, (www.massport.com/environment/environmental-reporting/noise-abatement/noise-complaints/), provides for additional general questions and answers regarding the Noise Complaint Line. The number of complaints received in 2012 is approximately a third the number received in 2000 dropping from 6,631 (the highest in the past twelve years) to 2,331 calls. The number of complaints received in 2013 is approximately the same as the number received in 2000 rising slightly to 6,809 calls.

Table H-13 Noise Complaint Line Summary

Town	2011		2012		Change In Calls from 2011 to 2012	2013		Change In Calls from 2012 to 2013
	Calls	Callers	Calls	Callers		Calls	Callers	
Allston	0	0	0	0	**0**	3	2	**3**
Amesbury	2	1	0	0	**-2**	0	0	**0**
Andover	1	1	0	0	**-1**	0	0	**0**
Arlington	0	0	0	0	**0**	6	6	**6**
Auburn	0	0	0	0	**0**	1	1	**1**
Belmont	0	0	0	0	**0**	605	65	**605**
Beverly	0	0	0	0	**0**	2	2	**2**
Billerica	0	0	0	0	**0**	2	2	**2**
Boston	37	22	26	19	**-11**	103	45	**77**
Braintree	3	3	1	1	**-2**	6	3	**5**
Brighton	0	0	1	1	**1**	1	1	**0**
Brockton	1	1	1	1	**0**	0	0	**-1**
Brookline	0	0	1	1	**1**	3	2	**2**
Cambridge	154	10	127	8	**-27**	266	33	**139**
Canton	2	2	0	0	**-2**	42	7	**42**
Charlestown	4	4	2	2	**-2**	9	8	**7**
Chelsea	27	9	0	0	**-27**	8	6	**8**
Chestnut Hill	0	0	1	1	**1**	0	0	**-1**
Cohasset	5	4	17	2	**12**	34	7	**17**
Danvers	1	1	0	0	**-1**	0	0	**0**
Dedham	3	2	1	1	**-2**	19	11	**18**
Dorchester	6	5	5	5	**-1**	15	11	**10**
Durham	0	0	0	0	**0**	1	1	**1**
Duxbury	1	1	1	1	**0**	2	1	**1**
East Boston	116	34	123	41	**7**	124	42	**1**
Easton	1	1	0	0	**-1**	0	0	**0**
Everett	19	4	11	3	**-8**	50	15	**39**
Framingham	1	1	4	2	**3**	3	2	**-1**
Hanover	1	1	1	1	**0**	10	3	**9**
Hingham	19	3	7	2	**-12**	42	10	**35**
Holbrook	0	0	0	0	**0**	2	1	**2**
Holland	2	1	0	0	**-2**	0	0	**0**
Hope	0	0	1	1	**1**	0	0	**-1**
Hull	5	3	16	12	**11**	923	156	**907**

Table H-13 Noise Complaint Line Summary (Continued)

Town	2011 Calls	2011 Callers	2012 Calls	2012 Callers	Change In Calls from 2011 to 2012	2013 Calls	2013 Callers	Change In Calls from 2012 to 2013
Hyde Park	3	1	0	0	**-3**	189	6	**189**
Jamaica Plain	63	6	54	6	**-9**	169	34	**115**
Kingston	0	0	0	0	**0**	1	1	**1**
Lawrence	0	0	0	0	**0**	1	1	**1**
Leominster	0	0	1	1	**1**	0	0	**-1**
Lexington	0	0	0	0	**0**	1	1	**1**
Lynn	469	2	453	4	**-16**	405	5	**-48**
Malden	1	1	3	3	**2**	1	1	**-2**
Manchester	0	0	0	0	**0**	1	1	**1**
Mansfield	3	2	0	0	**-3**	0	0	**0**
Marblehead	8	4	3	2	**-5**	62	2	**59**
Marlborough	2	1	0	0	**-2**	0	0	**0**
Marshfield	21	6	9	4	**-12**	7	2	**-2**
Medford	297	13	15	10	**-282**	49	33	**34**
Medway	1	1	0	0	**-1**	0	0	**0**
Melrose	0	0	1	1	**1**	1	1	**0**
Milton	177	27	102	24	**-75**	1925	222	**1,823**
Nahant	74	26	70	17	**-4**	17	9	**-53**
Needham	0	0	1	1	**1**	0	0	**-1**
Newton	0	0	0	0	**0**	4	2	**4**
Norfolk	0	0	0	0	**0**	1	1	**1**
North Andover	0	0	28	1	**28**	2	1	**-26**
North Quincy	0	0	2	1	**2**	0	0	**-2**
Norwell	1	1	1	1	**0**	5	2	**4**
Norwood	0	0	0	0	**0**	2	1	**2**
Peabody	3	2	8	5	**5**	9	6	**1**
Pembroke	0	0	1	1	**1**	0	0	**-1**
Quincy	12	9	17	10	**5**	22	14	**5**
Randolph	1	1	2	1	**1**	20	7	**18**
Raynham	0	0	1	1	**1**	0	0	**-1**
Reading	0	0	0	0	**0**	3	3	**3**
Revere	66	20	35	22	**-31**	45	20	**10**
Rockland	0	0	0	0	**0**	1	1	**1**
Roslindale	3	2	2	2	**-1**	48	13	**46**
Roxbury	81	3	77	2	**-4**	74	5	**-3**
Salem	12	1	11	5	**-1**	2	2	**-9**
Saugus	0	0	0	0	**0**	2	2	**2**
Scituate	0	0	0	0	**0**	1	1	**1**

Table H-13 Noise Complaint Line Summary (Continued)

Town	2011		2012		Change In Calls from 2011 to 2012	2013		Change In Calls from 2012 to 2013
	Calls	Callers	Calls	Callers		Calls	Callers	
Sherborn	0	0	0	0	**0**	1	1	**1**
Somerset	0	0	0	0	**0**	1	1	**1**
Somerville	98	45	95	26	**-3**	166	72	**71**
South Boston	53	24	218	22	**165**	438	22	**220**
South End	16	6	21	6	**5**	160	15	**139**
Squantum	0	0	1	1	**1**	0	0	**-1**
Stoughton	3	2	0	0	**-3**	1	1	**1**
Swampscott	5	4	1	1	**-4**	1	1	**0**
Tewksbury	0	0	0	0	**0**	1	1	**1**
Wakefield	0	0	1	1	**1**	1	1	**0**
Walpole	0	0	0	0	**0**	2	2	**2**
Waltham	0	0	0	0	**0**	3	1	**3**
Watertown	16	2	97	3	**81**	196	44	**99**
West Roxbury	1	1	1	1	**0**	8	5	**7**
Weymouth	228	7	346	2	**118**	217	7	**-129**
Wilmington	1	1	0	0	**-1**	0	0	**0**
Winchester	2	1	3	2	**1**	6	4	**3**
Winthrop	1,147	92	303	96	**-844**	252	86	**-51**
Woburn	1	1	0	0	**-1**	2	1	**2**
Worcester	0	0	0	0	**0**	1	1	**1**
Grand Total	**3,280**	**429**	**2,331**	**391**	**-949**	**6,809**	**1,109**	**4,478**

Source: Massport, HMMH 2014.

Cumulative Noise Index (CNI)

Massport reports total annual fleet noise at Logan Airport, defined in the Logan Airport Noise Rules by a metric referred to as the CNI. The CNI is a single number representing the sum of the entire set of single-event noise levels experienced at the Airport over a full year of operation, weighted similarly to DNL so that activity occurring at night is penalized by adding an extra 10 dB to each event. This penalty is mathematically equivalent to multiplying the number of nighttime events by each aircraft by a factor of 10. The Logan Airport Noise Rules define CNI in terms of Effective Perceived Noise Level (EPNL) and require that the index be computed for the fleet of commercial aircraft operating at Logan Airport throughout the year. In addition, in EDRs and ESPRs, Massport reports partial CNI values of noise at Logan Airport, so that various subsets of the fleet (cargo, night operations, passenger jets, etc.) are identified (see Table H-14).

The Noise Rules, adopted by Massport following public hearings held in February 1986, established a CNI limit of 156.5 Effective Perceived Noise Decibels (EPNdB). The CNI generally has decreased since 1990, remaining below that cap, with changes from year to year on the order of a few tenths of a decibel. The 2012 and 2013 CNI remain well below the cap of 156.5 EPNL.

Table H-14 Cumulative Noise Index (EPNL) – 1990 to 2013													
	Logan Airport CNI Cap – 156.5 EPNL												
Full CNI (Entire Commercial Jet Fleet)	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
	156.4	**155.8**	**155.5**	**155.3**	**155.4**	**155.3**	**155.1**	**154.8**	**154.7**	**154.9**	**154.7**	**154.1**	**153.2**
Total Passenger Jets	155.2	154.8	154.6	154.4	154.4	154.2	154.1	153.9	153.7	153.9	153.6	152.9	151.8
Total Cargo Jets	150.1	148.9	148.0	147.9	148.3	148.8	148.6	147.5	147.9	148.0	148.2	147.8	147.4
Total Daytime	152.5	152.1	152.4	152.1	152.1	151.6	151.2	150.8	150.4	150.4	149.5	149.0	148.5
Total Nighttime	154.4	153.4	152.6	152.4	152.6	152.9	152.9	152.5	152.7	153.1	153.1	152.4	151.3
Total Stage 2 Jets	NA	NA	NA	NA	151.0	150.2	149.4	149.2	147.7	147.1	124.7	121.5	114.3
Total Stage 3 Jets	NA	NA	NA	NA	153.4	153.8	153.8	153.4	153.8	154.2	154.7	154.1	153.2
Daytime Stage 2	NA	NA	NA	NA	149.0	148.5	147.6	146.5	145.2	144.1	122.6	119.3	111.2
Nighttime Stage 2	NA	NA	NA	NA	146.7	145.1	144.8	145.8	144.1	144.0	120.5	117.3	111.4
Daytime Stage 3	NA	NA	NA	NA	149.1	148.8	148.7	148.8	148.9	149.2	149.5	149.0	148.5
Nighttime Stage 3	NA	NA	NA	NA	151.4	152.1	152.2	151.5	152.1	152.5	153.1	152.4	151.3
Passenger Jet Stage 2	NA	NA	NA	NA	150.5	149.9	149.2	148.9	147.5	146.8	124.2	116.3	NA
Passenger Jet Stage 3	NA	NA	NA	NA	152.2	152.3	152.3	152.2	152.6	153.0	153.6	152.9	151.8
Cargo Jet Stage 2	NA	NA	NA	NA	141.5	137.4	136.8	137.4	139.0	134.5	114.8	119.9	114.3
Cargo Jet Stage 3	NA	NA	NA	NA	147.3	148.5	148.3	147.0	147.3	147.9	148.2	147.8	147.4
Daytime Passenger	NA	152.0	152.2	152.0	152.0	151.5	151.1	150.6	150.1	150.1	149.3	148.7	148.2
Nighttime Passenger	NA	151.6	150.9	150.6	150.8	151.0	151.0	151.1	151.2	151.6	151.6	150.8	149.4
Daytime Cargo	137.1	137.1	137.6	135.2	136.1	138.0	136.7	136.2	138.0	138.2	137.5	137.1	137.0
Nighttime Cargo	149.9	148.6	147.6	147.6	148.0	148.4	148.3	147.1	147.5	147.6	147.8	147.4	147.0
Daytime Passenger Stage 2	NA	NA	NA	NA	148.9	148.4	147.6	146.5	145.0	143.9	122.3	115.0	NA
Daytime Passenger Stage 3	NA	NA	NA	NA	149.0	148.5	148.4	148.5	148.6	149.0	149.2	148.7	148.2
Nighttime Passenger Stage 2	NA	NA	NA	NA	149.0	148.5	148.4	148.5	142.8	143.7	119.8	110.2	NA
Nighttime Passenger Stage 3	NA	NA	NA	NA	149.4	149.9	150.1	149.8	150.5	150.8	151.6	150.8	149.4
Daytime Cargo Stage 2	NA	NA	NA	NA	128.3	126.7	124.6	126.4	131.6	131.5	111.1	117.3	111.2
Daytime Cargo Stage 3	NA	NA	NA	NA	135.3	137.7	136.4	135.7	136.9	137.1	137.5	137.0	137.0
Nighttime Cargo Stage 2	NA	NA	NA	NA	141.3	137.0	136.5	137.0	138.2	131.5	112.3	116.4	111.4
Nighttime Cargo Stage 3	NA	NA	NA	NA	147.0	148.1	148.0	146.6	146.9	147.5	147.8	147.4	147.0

Table H-14 Cumulative Noise Index (EPNL) – 1990 to 2013 (Continued)

	Logan Airport CNI Cap – 156.5 EPNL												
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Change 2011 to 2012	Change 2012 to 2013
Full CNI (Entire Commercial Jet Fleet)	152.7	153.4	153.2	152.6	152.7	152.9	152.3	151.9	152.1	152.2	152.3	0.1	0.1
Total Passenger Jets	151.3	152.2	152.1	151.4	151.5	151.9	151.1	150.9	150.6	151.3	151.4	0.7	0.1
Total Cargo Jets	147.1	147.0	146.6	146.5	146.4	146.1	145.9	145.1	146.7	144.9	145.1	(1.8)	0.2
Total Daytime	148.0	148.5	148.2	147.5	147.2	147.6	147.1	146.8	146.9	147	147.0	0.1	0.0
Total Nighttime	150.9	151.7	151.6	151.0	151.2	151.4	150.7	150.3	150.6	150.6	150.8	0.0	0.2
Total Stage 2 Jets	114.1	118.1	NA	NA	NA	NA	NA	113.6	110.8	104.9	111.3	(5.9)	6.4
Total Stage 3 Jets	152.7	153.4	153.2	152.6	152.7	152.9	152.3	151.9	152.1	152.2	152.3	0.1	0.1
Daytime Stage 2	113.7	109.4	NA	NA	NA	NA	NA	103.6	NA	104.9	101.4	NA	(3.5)
Nighttime Stage 2	103.2	117.5	NA	NA	NA	NA	NA	113.1	110.8	NA	110.8	NA	NA
Daytime Stage 3	148.0	148.5	148.2	147.5	147.2	147.6	147.1	146.8	146.9	147	147.0	0.1	0.0
Nighttime Stage 3	150.9	151.7	151.6	151.0	151.2	151.4	150.7	150.3	150.6	150.6	150.8	0.0	0.2
Passenger Jet Stage 2	NA	NA	NA	NA	NA	NA	NA	NA	NA	104.9	101.4	NA	(3.5)
Passenger Jet Stage 3	151.3	152.2	152.1	151.4	151.5	151.9	151.1	150.9	150.6	151.3	151.4	0.7	0.1
Cargo Jet Stage 2	114.1	118.1	NA	NA	NA	NA	NA	113.6	110.8	NA	110.8	NA	NA
Cargo Jet Stage 3	147.1	147.0	146.6	146.5	146.4	146.1	145.9	145.1	146.7	144.9	145.1	(1.8)	0.2
Daytime Passenger	147.7	148.2	147.9	147.2	146.9	147.3	146.8	146.6	146.5	146.8	146.8	0.3	0.0
Nighttime Passenger	148.8	150.0	150.1	149.3	149.7	150.0	149.1	149.0	148.5	149.4	149.6	0.9	0.2
Daytime Cargo	136.2	135.7	135.8	135.5	135.8	135.8	135.2	134.5	136.6	134	133.6	(2.6)	(0.4)
Nighttime Cargo	146.8	146.7	146.2	146.1	146.0	145.6	145.5	144.7	146.3	144.5	144.8	(1.8)	0.3
Daytime Passenger Stage 2	NA	NA	NA	NA	NA	NA	NA	NA	NA	104.9	101.4	NA	(3.5)
Daytime Passenger Stage 3	147.7	148.2	147.9	147.2	146.9	147.3	146.8	146.6	146.5	146.8	146.8	0.3	0.0
Nighttime Passenger Stage 2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nighttime Passenger Stage 3	148.8	150.0	150.1	149.3	149.7	150.0	149.1	149.0	148.5	149.4	149.6	0.9	0.2
Daytime Cargo Stage 2	113.7	109.4	NA	NA	NA	NA	NA	103.6	NA	NA	NA	NA	NA
Daytime Cargo Stage 3	136.1	135.7	135.8	135.5	135.8	135.8	135.2	134.4	136.6	134	133.6	(2.6)	(0.4)
Nighttime Cargo Stage 2	103.2	117.5	NA	NA	NA	NA	NA	113.1	110.8	NA	110.8	NA	NA
Nighttime Cargo Stage 3	146.8	146.7	146.2	146.1	146.0	145.6	145.5	144.7	146.3	144.5	144.8	(1.8)	0.3

Source: HMMH, 2014.

Notes: GA and non-jet aircraft are not included in the calculation.
The Stage 2 results are from a Falcon 20 aircraft arrival and departure flown by a Charter Operator during 2012.
NA = Not available.

Flight Track Monitoring Report

Introduction

As part of its ongoing commitment to mitigate noise at Logan Airport, Massport has undertaken evaluating the flight tracks of turbojet aircraft engaged in the implementation of established FAA noise abatement procedures. As is true for any airport operator, however, Massport has no authority to control where individual aircraft actually fly. That remains the responsibility of the FAA, while the individual pilots are responsible for safely executing the FAA's instructions. The flight procedures, which are used by the Air Traffic Control (ATC) staff at Boston Tower to achieve desired noise abatement tracks, are contained in the FAA's Tower Order BOS TWR 7040.1.

This is the twelfth annual report for flight track monitoring. Prior to 2002, Massport had issued semi-annual reports, an outgrowth of the Flight Track Monitoring Program study. That study was contained in the *Generic Environmental Impact Report* filed with Massachusetts Environmental Policy Act (MEPA) in July 1996, and was the subject of two Community Working Group workshops in September and October 1996. The Eleventh annual report was published as Appendix A in the *EDR - 2012 Update*. The information for 2012 is repeated in this report for reference. The period covered by this *2012/2013 EDR* is January 1, 2012 through December 31, 2013.

The purpose of the ongoing monitoring program is to identify any systematic changes in flight tracks that may occur and to reduce flight track dispersion, where appropriate. The next report will cover the period January 1, 2014 through December 31, 2014, and will be included in the next EDR.

FAA Air Traffic Control (ATC) Procedures

FAA Tower Order BOS TWR 7040.1 entitled "Noise Abatement" describes the series of noise abatement policies, rules, regulations, and the procedures to be followed by the FAA air traffic controllers in meeting their designated responsibilities to be "a good neighbor, while meeting our operational objectives/responsibilities to the National Airspace System." Section 7.a.3 of the Order, subtitled "Turbojet Departure Noise Abatement Procedures," states that all turbojet departures shall be issued the Standard Instrument Departure (SID) procedure appropriate for the departure runway. They are paraphrased from the LOGAN SEVEN SID below.

Note in the descriptions that follow that terms such as "BOS 2 DME" are used frequently. Here, BOS refers to an aid to navigation known as the BOSTON VORTAC, a radio beacon physically located on Logan Airport near the eastern shoreline between the ends of Runways 27 and 33L (see Figure H-14). DME refers to "Distance Measuring Equipment," a co-located aid to navigation that provides pilots with a cockpit display of the number of nautical miles that the aircraft is from the designated radio beacon. Thus, BOS 2 DME means an aircraft should be two nautical miles away from the BOS. The term "vectored" means the pilot is assigned to fly a magnetic heading given by and at the discretion of the FAA air traffic controller to maintain the safe separation of aircraft. "MSL" is defined as feet above mean sea level and is the indicator of aircraft altitude used both by the pilot in the cockpit and the air traffic controller on the ground.

During 2010, several of the conventional-only (or radar vector) and RNAV procedures from the Boston Logan Airport Noise Study Categorical Exclusion (CATEX)[6] were implemented. There are eight new RNAV procedures

6 Federal Aviation Administration (FAA) Boston Logan Airport Noise Study Categorical Exclusion Record of Decision (CATEX ROD), Issued October 16, 2007

for departures from Logan Airport. These eight procedures are used by aircraft departing Runways 4R, 9, 15R, 22L, 22R, 27, and 33L (Runways 27 and 33L were added in 2013). These procedures primarily affected departures flying over the North and South shores and were designed to increase the amount of jet traffic crossing back over land above 6,000 feet to minimize noise impacts to communities. A ninth RNAV procedure, which is used by Runway 27, has been in use at the Airport and has been modified several times.

For departures, the conventional procedures (flown by non-RNAV equipped aircraft) from the LOGAN SEVEN SID are:

- For Runway 4R, climb heading 036 degrees to BOS 4 DME, then turn right to a heading of 090 degrees, and then expect radar vectors to assigned route/navaid/fix. Aircraft that are initially vectored over water can expect to cross the coastline above 6,000 MSL before proceeding on course.
- For Runway 9, climb heading 093 degrees, and then expect radar vectors to assigned route/navaid/fix. Aircraft that are initially vectored over water can expect to cross the coastline above 6,000 MSL before proceeding on course.
- For Runway 14, climb heading 142 degrees to BOS 1 DME, then turn left to heading 120 degrees, then expect radar vectors to assigned route/navaid/fix. Aircraft that are initially vectored over water can expect to cross the coastline above 6,000 MSL before proceeding on course.
- For Runway 15R, climb heading 151 degrees to BOS 1 DME then turn left to 120 degrees, then expect radar vectors to assigned route/navaid/fix. Aircraft that are initially vectored over water can expect to cross the coastline above 6,000 MSL before proceeding on course.
- For Runways 22R and 22L, climbing left turn to a heading of 140 degrees, then expect radar vectors to assigned route/navaid/fix. Aircraft that are initially vectored over water can expect to cross the coastline above 6,000 MSL before proceeding on course.
- For Runway 33L, climb heading 331 degrees to BOS 2 DME then turn left to 316 degrees, then expect radar vectors to assigned route/navaid/fix.
- For Runway 27, climb heading 273 to BOS 2.2 DME, then turn left heading 235 degrees, then expect radar vectors to assigned route/navaid/fix.

The RNAV procedures (used only by Turbojets) and the runways they serve:

- BLZZR TWO – Runways 4L, 9, 15R, 22L, 22R, 27, and 33L: This procedure directs most jet traffic in a well-defined flight corridor over the ocean and crossing back over the South Shore near Cohasset and Scituate.
- BRUWN THREE – Runways 4L, 9, 15R, 22L, 22R, 27, and 33L: This procedure directs most jet traffic in a well-defined flight corridor over the ocean towards Cape Cod.
- CELTK THREE – Runways 4L, 9, 15R, 22L, 22R, 27, and 33L: This procedure directs most jet traffic in a well-defined flight corridor over the ocean.
- HYLND THREE – 4L, 9, 15R, 22L, 22R, 27, and 33L: This procedure directs most jet traffic in a well-defined flight corridor over the ocean and crossing back over the North Shore near Beverly.
- LBSTA THREE – 4L, 9, 15R, 22L, 22R, 27, 33L: This procedure directs most jet traffic in a well-defined flight corridor over the ocean and crossing back over the North Shore near Manchester and Gloucester.

- PATSS THREE – 4L, 9, 15R, 22L, 22R, 27, 33L: This procedure directs most jet traffic in a well-defined flight corridor over the ocean and crossing back over the South Shore near Cohasset and Scituate.
- REVSS TWO – 4L, 9, 15R, 22L, 22R, 27, 33L: This procedure directs most jet traffic in a well-defined flight corridor over the ocean and crossing back over the South Shore near Cohasset and Scituate.
- SSOXS THREE – 4L, 9, 15R, 22L, 22R, 27, 33L: This procedure directs most jet traffic in a well-defined flight corridor over the ocean and crossing back over the South Shore over Marshfield.
- WYLYY ONE – 27: This procedure directs most jet traffic in a well-defined flight corridor on a heading of 273 degrees then a turn to 235 degrees over South Boston.

These brief procedural statements form the basis of the verbal instructions and flight clearances that are passed from controller to pilot to achieve reduced noise in the communities surrounding Logan Airport while also maintaining the safe and efficient flow of aircraft in and out of the Airport. However, consistency with which these procedures are used varies due to air traffic demands, controller workloads, weather conditions, and other operational factors, as noted in the Flight Track Monitoring Program Study.

Figure H-15 presents the gates used in the analysis for the Flight Track Monitoring Report. These gates are virtual vertical planes, which are used in the analysis to capture the aircraft flight paths. The gates are defined using a geographic coordinate for each end of the gate along with a floor and a ceiling altitude. The gates also capture direction of flights (in or out). The edges of each gate in Figure H-15 point in the direction that the aircraft is coming from. This information is used to evaluate the performance of the flight procedures off each runway end and is presented below. Figure H-15 also displays the BOS location, which is used for the distance measurements for the conventional procedures.

The RNAV procedures are still captured by the original flight track monitoring gates. Traffic crossing over the North Shore passes through the Marblehead Gate and traffic passing over the South Shore passes through the Hull 2, Hull 3, and Cohasset Gates. Turbojets departing Runway 27 on the RNAV pass through the Runway 27 gates and the new Runway 33L RNAV flight tracks still pass between the Somerville and Everett gates as expected.

Source: HMMH, MassGIS, USDA NAIP 2010

Logan Airport Flight Track Monitor Gates

Logan Flight Gates

Boston VOR/DME

Figure H-15

Statistical Analyses of Flight Tracks - Runway 4R

The Nahant Gate (Figure H-15) monitors aircraft after the first turn at 4 DME. The Swampscott and Marblehead Gates monitor northbound shoreline crossings, while the Hull 2, Hull 3, and Cohasset Gates monitor southbound shoreline crossings.

Table H-15a shows the dispersion of the jet departures on Runway 4R as they pass through the Nahant Gate. Table H-15a also shows that Runway 4R departures for 2012 were concentrated, with 98.8 percent "over the Causeway," and about 0.2 percent over the south end of the gate compared to 96.9 percent over the Causeway in 2011 and 0.1 percent over the south end of the gate. Departures through the north end of the gate decreased from 3.0 percent in 2011 to 1.0 percent in 2012.

Table H-15a Runway 4R Nahant Gate Summary for 2012

	Number of Tracks Through Gate Segment	Total Number of Tracks Through Gate	Percentage of Tracks Through Gate Segment
North End of Gate	92	9,123	1.0%
Over Causeway	9,009	9,123	98.8%
South End of Gate	22	9,123	0.2%
Total	**9,123**	**9,123**	**100.0%**

Source: Massport, HMMH 2013.

Table H-15b shows that Runway 4R departures for 2013 were concentrated, with 99.2 percent "over the Causeway," and about 0.1 percent over the south end of the gate compared to 98.8 percent over the Causeway in 2012 and 0.2 percent over the south end of the gate. Departures through the north end of the gate decreased from 1.0 percent in 2012 to 0.7 percent in 2013.

Table H-15b Runway 4R Nahant Gate Summary for 2013

	Number of Tracks Through Gate Segment	Total Number of Tracks Through Gate	Percentage of Tracks Through Gate Segment
North End of Gate	48	6,835	0.7%
Over Causeway	6,780	6,835	99.2%
South End of Gate	7	6,835	0.1%
Total	**6,835**	**6,835**	**100.0%**

Source: Massport, HMMH 2014.

Table H-16a shows how many of the shoreline crossings from Runway 4R were above 6,000 feet. For 2012, 98.3 percent of the flights were above 6,000 feet compared to 98.4 percent in 2011. The Swampscott gate had 30.1 percent of flights above 6,000 feet compared to 34.1 percent in 2011. The number of flights through the Swampscott gate increased in 2012 (41 in 2011, up to 73 in 2012). For 2013, Table H-16b shows 98.4 percent of the flights were above 6,000 feet compared to 98.3 percent in 2012. The Swampscott gate had 30.0 percent of flights above 6,000 feet compared to 30.1 percent in 2012. The number of flights through the Swampscott gate decreased in 2013 (73 in 2012, down to 60 in 2013). The crossing percentage for this gate is historically lower than most gates due to its proximity to the Nahant gate itself. As seen in Figure H-15, the Swampscott gate is adjacent to the Nahant gate and aircraft would have to climb very quickly to be above 6,000 feet when crossing the Swampscott gate.

Table H-16a Runway 4R Shoreline Crossings Above 6,000 Feet for 2012

	Number of Tracks Through Gate	Number Above 6,000 ft	Percentage Above 6,000 ft
Swampscott Gate	73	22	30.1%
Marblehead Gate	3,537	3,482	98.5%
Hull 2 Gate	792	792	100.0%
Hull 3 Gate	1,393	1,388	99.6%
Cohasset Gate	932	928	99.6%
Total	**6,727**	**6,612**	**98.3%**

Source: Massport, HMMH 2013.

Table H-16b Runway 4R Shoreline Crossings Above 6,000 Feet for 2013

	Number of Tracks Through Gate	Number Above 6,000 ft	Percentage Above 6,000 ft
Swampscott Gate	60	18	30.0%
Marblehead Gate	2,826	2,801	99.1%
Hull 2 Gate	291	291	100.0%
Hull 3 Gate	1,213	1,208	99.6%
Cohasset Gate	223	223	100.0%
Total	**4,613**	**4,541**	**98.4%**

Source: Massport, HMMH 2014.

Statistical Analyses of Flight Tracks - Runway 9

The Winthrop 1 and Winthrop 2 gates (Figure H-15) monitor early turns for departures off Runway 9. The Revere, Swampscott, or Marblehead gates monitor northbound shoreline crossings, while the Hull 2, Hull 3, or Cohasset gates monitor southbound shoreline crossings.

Tables H-17a and H-17b show how many tracks turned prior to the BOS 2 DME. Northbound turns before BOS 2 DME pass through the Winthrop 1 Gate. Southbound traffic would pass through the Winthrop 2 Gate. In 2012, between both gates there were a total of 98 such turns, or less than 0.1 percent. This is similar to 2011 except the number of tracks through the gates is slightly higher. In 2013, there were a total of 52 such turns, or about 0.1 percent.

Table H-17a Runway 9 Gate Summary — Winthrop Gates 1 and 2 for 2012			
	Number of Departure Tracks	**Number of Tracks Through Gate**	**Percent Turning Before BOS 2 DME**
Winthrop 1 Gate	44,951	62	0.1%
Winthrop 2 Gate	44,951	36	0.1%
Total	**44,951**	**98**	**0.2%**

Source: Massport, HMMH 2013.

Table H-17b Runway 9 Gate Summary — Winthrop Gates 1 and 2 for 2013			
	Number of Departure Tracks	**Number of Tracks Through Gate**	**Percent Turning Before BOS 2 DME**
Winthrop 1 Gate	44,851	20	<0.1%
Winthrop 2 Gate	44,851	32	0.1%
Total	**44,851**	**52**	**0.1%**

Source: Massport, HMMH 2014.

Table H-18a indicates that 98.7 percent of Runway 9 departures were above 6,000 feet when crossing the shoreline, as compared with 98.4 percent in 2011. The number of Runway 9 departures crossing back over the South Shore decreased from 37,714 in 2011 to 33,620. A decrease in the percentage above 6,000 feet occurred at the Revere gate (48.5 percent in 2011 to 23.4 percent in 2012) and a slight decrease at the Hull 2 gate (99.1 percent in 2011 to 99.0 percent in 2012).

The number of crossings increased for the Revere gate (33 in 2011 to 47 in 2012) and the Swampscott gate (145 in 2011 to 191 in 2012). The Marblehead gate had a decrease in crossings (from 13,122 in 2011 to 12,069 in 2012), and an increase in the percent above 6,000 feet (from 98.6 percent in 2011 to 99.2 percent in 2012). Both the Hull 2 and Hull 3 gates have an increase in crossings compared to 2011. Hull 2 increased from 881 in 2011 to 1,668 in 2012 and Hull 3 increased from 2,820 in 2011 to 4,133 in 2012. While the Hull 2 crossing percentage remained almost the same as 2011, the Hull 3 gate crossings above 6,000 feet increased from 94.1 percent to 96.6 percent. The crossings through the Cohasset gate decreased (from 34,013 in 2011 to 27,819 in 2012) and the percent above 6,000 feet increased from 98.8 percent in 2011 to 99.0 percent in 2012.

Table H-18a Runway 9 Shoreline Crossings Above 6,000 Feet for 2012			
	Number of Tracks Through Gate	**Number Above 6,000 ft**	**Percentage Above 6,000 ft**
Revere Gate	47	11	23.4%
Swampscott Gate	191	156	81.7%
Marblehead Gate	12,069	11,971	99.2%
Hull 2 Gate	1,668	1,652	99.0%
Hull 3 Gate	4,133	3,994	96.6%
Cohasset Gate	27,819	27,541	99.0%
Total	**45,927**	**45,325**	**98.7%**

Source: Massport, HMMH 2013.

Table H-18b indicates that 99.3 percent of Runway 9 departures were above 6,000 feet when crossing the shoreline, as compared with 98.7 percent in 2012. The number of Runway 9 departures crossing back over the South Shore decreased from 33,620 in 2012 to 23,186. An increase in the percentage above 6,000 feet occurred at the Revere gate (23.4 percent in 2012 to 58.7 percent in 2013) and a slight increase at the Hull 2 gate (99.0 percent in 2012 to 99.6 percent in 2013).

The number of crossings remained almost identical for the Revere gate (47 in 2012 to 46 in 2013) and decreased at the Swampscott gate (191 in 2012 to 165 in 2013). The Marblehead gate had a decrease in crossings (from 12,069 in 2012 to 10,973 in 2013), and a slight increase in the percent above 6,000 feet (from 99.2 percent in 2012 to 99.5 percent in 2013). Both the Hull 2 and Hull 3 gates had a decrease in crossings compared to 2012. Hull 2 decreased from 1,668 in 2012 to 1,607 in 2013 and Hull 3 decreased from 4,133 in 2012 to 3,714 in 2013. The Hull 2 crossing percentage increased slightly from 99.0 percent in 2012 to 99.6 percent in 2013 and the Hull 3 gate crossings above 6,000 feet increased from 96.6 percent to 98.0 percent. The crossings through the Cohasset gate decreased (from 27,819 in 2012 to 17,865 in 2013) and the percent above 6,000 feet increased from 99.0 percent in 2012 to 99.3 percent in 2013.

Table H-18b Runway 9 Shoreline Crossings Above 6,000 Feet for 2013

	Number of Tracks Through Gate	Number Above 6,000 ft	Percentage Above 6,000 ft
Revere Gate	46	27	58.7%
Swampscott Gate	165	141	85.5%
Marblehead Gate	10,973	10,921	99.5%
Hull 2 Gate	1,607	1,600	99.6%
Hull 3 Gate	3,714	3,640	98.0%
Cohasset Gate	17,865	17,802	99.6%
Total	**34,370**	**34,131**	**99.3%**

Source: Massport, HMMH 2014.

Statistical Analyses of Flight Tracks - Runway 15R

After takeoff, Runway 15R departures turn left approximately 30 degrees to avoid Hull, head out over Boston Harbor, and return back over the shore through the Swampscott and Marblehead Gates (Figure H-15) to the north, or through the Hull 2, Hull 3, and Cohasset Gates to the south. Table H-19a indicates that 97.9 percent of Runway 15R departures were above 6,000 feet when crossing the shoreline, as compared with 99.4 percent in 2011. At 92.3 percent, the percent above 6,000 feet for the Swampscott Gate decreased in 2012, as it was 96.3 in 2011. The Marblehead gate had a decrease in crossings (from 1,866 in 2011 to 1,369 in 2012) and a slight decrease in the percent above 6,000 feet (from 99.8 percent in 2011 to 99.6 percent in 2012). The Hull 2 gate increased its percentage from 95.7 percent in 2011 to 100 percent in 2012, and the Hull 3 gate decreased from 92.8 percent in 2011 to 90.5 percent in 2012. The Cohasset gate had a decrease in crossings (from 4,563 in 2011 to 3,584 in 2012) and the percent above 6,000 feet decreased from 99.6 percent to 97.8 percent.

Table H-19a Runway 15R Shoreline Crossings Above 6,000 Feet for 2012

	Number of Tracks Through Gate	Number Above 6,000 ft	Percentage Above 6,000 ft
Swampscott Gate	65	60	92.3%
Marblehead Gate	1,369	1,363	99.6%
Hull 2 Gate	22	22	100.0%
Hull 3 Gate	220	199	90.5%
Cohasset Gate	3,584	3,504	97.8%
Total	**5,260**	**5,148**	**97.9%**

Source: Massport, HMMH 2013.

Table H-19b indicates that 99.5 percent of Runway 15R departures were above 6,000 feet when crossing the shoreline, as compared with 97.9 percent in 2012. The percent above 6,000 feet for the Swampscott Gate increased (from 92.3 percent in 2012 to 95.8 percent in 2013). The Marblehead gate had an increase in crossings (from 1,369 in 2012 to 1,598 in 2013) and a slight increase in the percent above 6,000 feet (from 99.6 percent in 2012 to 99.9 percent in 2013). The Hull 2 gate decreased its percentage from 100 percent in 2012 to 72.7 percent in 2013, and the Hull 3 gate increased from 90.5 percent in 2012 to 93.1 percent in 2013. The Cohasset gate had a decrease in crossings (from 3,584 in 2012 to 2,853 in 2013) and the percent above 6,000 feet increased from 97.8 percent to 99.5 percent.

Table H-19b Runway 15R Shoreline Crossings Above 6,000 Feet for 2013

	Number of Tracks Through Gate	Number Above 6,000 ft	Percentage Above 6,000 ft
Swampscott Gate	71	68	95.8%
Marblehead Gate	1,598	1,596	99.9%
Hull 2 Gate	11	8	72.7%
Hull 3 Gate	159	148	93.1%
Cohasset Gate	2,853	2,848	99.8%
Total	**4,692**	**4,668**	**99.5%**

Source: Massport, HMMH 2014.

Statistical Analyses of Flight Tracks - Runways 22R and 22L

The Squantum 2 and Hull 1 Gates (Figure H-15) are used to monitor the turn to 140 degrees over Boston Harbor and north of Hull. The shoreline gates are used to monitor shoreline crossings, as for Runways 4R, 9, and 15R above.

Table H-20a shows the dispersion of the jet departures from Runways 22R and 22L as they pass through the Squantum 2 Gate. The first segment of the gate is the northernmost segment and is primarily over Boston Harbor. The other segments extend southward toward Quincy. The percentage of tracks passing through the first two segments of this gate dropped from 79.0 percent in 2011 to 77.2 percent in 2012. This is due to an increase in flights over the third segment from 20.9 percent in 2011 to 22.8 percent in 2012.

Table H-20a Runways 22R and 22L Squantum 2 Gate Summary for 2012			
	Number of Tracks Through Gate Segment	Total Number of Tracks Through All Gate Segments	Percentage of Tracks Through Gate Segment
0 - 12,000 ft	19,418	59,678	32.6%
12,000 - 14,000 ft	26,627	59,678	44.6%
14,000 - 21,000 ft	13,585	59,678	22.8%
21,000 - 27,000 ft	48	59,678	0.1%
Total	**59,678**	**59,678**	**100.0%**

Source: Massport, HMMH 2013.
Note: Percentages sum to more than 100 percent due to rounding.

Table H-20b shows the dispersion of the jet departures from Runways 22R and 22L as they pass through the Squantum 2 Gate for 2013. The first segment of the gate is the northernmost segment and is primarily over Boston Harbor. The other segments extend southward toward Quincy. The percentage of tracks passing through the first two segments of this gate increased from 77.2 percent in 2012 to 88.2 percent in 2013. This is due to a decrease in flights over the third segment from 22.8 percent in 2012 to 11.7 percent in 2013. This change reflects the concentration of the departure tracks on the RNAV route through this gate after the procedure was modified in March 2013.

Table H-20b Runways 22R and 22L Squantum 2 Gate Summary for 2013			
	Number of Tracks Through Gate Segment	Total Number of Tracks Through All Gate Segments	Percentage of Tracks Through Gate Segment
0 - 12,000 ft	6,143	55,064	11.2%
12,000 - 14,000 ft	42,424	55,064	77.0%
14,000 - 21,000 ft	6,453	55,064	11.7%
21,000 - 27,000 ft	44	55,064	0.1%
Total	**55,064**	**55,064**	**100.0%**

Source: Massport, HMMH 2014.
Note: Percentages sum to more than 100 percent due to rounding.

Table H-21a shows that 98.9 percent of the tracks were north of the Hull peninsula as they passed through the Hull 1 Gate, which is an increase from 2011 (98.0 percent).

Table H-21a Runways 15R, 22R, and 22L Hull 1 Gate Summary – North of Hull Peninsula for 2012			
	Number of Tracks Through Gate Segment	Total Number of Tracks Through Gate	Percentage of Tracks Through Gate Segment
North of Hull Peninsula	65,081	65,797	98.9%
Over Hull	716	65,797	1.1%
Total	**65,797**	**65,797**	**100.0%**

Source: Massport, HMMH 2013

Table H-21b shows that 98.9 percent of the tracks were north of the Hull peninsula as they passed through the Hull 1 Gate, which remained the same from 2012 (98.9 percent).

Table H-21b Runways 15R, 22R, and 22L Hull 1 Gate Summary – North of Hull Peninsula for 2013

	Number of Tracks Through Gate Segment	Total Number of Tracks Through Gate	Percentage of Tracks Through Gate Segment
North of Hull Peninsula	61,493	62,199	98.9%
Over Hull	706	62,199	1.1%
Total	**62,199**	**62,199**	**100.0%**

Source: Massport, HMMH 2014.

Table H-22a indicates that 99.3 percent of Runway 22R/22L departures were above 6,000 feet when crossing the shoreline, as compared with 99.4 percent in 2011. For the Revere gate, the percent above 6,000 feet increased from 97.5 percent in 2011 to 100 percent in 2012. The Swampscott gate remained the same as 2011 at 99.5 percent. The Marblehead gate had an increase in crossings (from 14,791 in 2011 to 15,715 in 2012) and the percent above 6,000 feet remained the same as 2011 at 99.9 percent. The Hull 2 gate decreased in percent above 6,000 feet from 96.6 percent in 2011 to 95.5 percent. The Hull 3 gate decreased in percent above 6,000 feet from 96.2 in 2011 to 95.5 percent in 2012. The number of crossings for the Cohasset gate increased (34,102 in 2011 versus 35,701 in 2012) and the percentage slightly decreased from 99.3 percent in 2011 to 99.2 percent in 2012.

Table H-22a Runways 22R and 22L Shoreline Crossings Above 6,000 Feet for 2012

	Number of Tracks Through Gate	Number Above 6,000 ft	Percentage Above 6,000 ft
Revere Gate	61	61	100.0%
Swampscott Gate	730	726	99.5%
Marblehead Gate	15,715	15,705	99.9%
Hull 2 Gate	66	63	95.5%
Hull 3 Gate	1,841	1,758	95.5%
Cohasset Gate	35,701	35,429	99.2%
Total	**54,114**	**53,742**	**99.3%**

Source: Massport, HMMH 2013.

Table H-22b indicates that 99.8 percent of Runways 22R and 22L departures were above 6,000 feet when crossing the shoreline, as compared with 99.4 percent in 2012. For the Revere gate, the percent above 6,000 feet decreased from 100 percent in 2012 to 98.1 percent in 2013. The Swampscott gate remained the same as 2012 at 99.5 percent. The Marblehead gate had a decrease in crossings (from 15,715 in 2012 to 14,362 in 2013) and the percent above 6,000 feet increased slightly (form 99.9 percent in 2012 to 100 percent in 2013). The Hull 2 gate increased in percent above 6,000 feet from 95.5 percent in 2012 to 96.3 percent. The Hull 3 gate increased in percent above 6,000 feet from 95.5 in 2012 to 97.1 percent in 2013. The number of crossings for the Cohasset gate decreased (from 35,701 in 2012 to 24,108 in 2013) and the percentage slightly increased from 99.2 percent in 2012 to 99.9 percent in 2013.

Table H-22b Runways 22R and 22L Shoreline Crossings Above 6,000 Feet for 2013			
	Number of Tracks Through Gate	Number Above 6,000 ft	Percentage Above 6,000 ft
Revere Gate	54	53	98.1%
Swampscott Gate	343	338	98.5%
Marblehead Gate	14,362	14,357	100.0%
Hull 2 Gate	27	26	96.3%
Hull 3 Gate	1,027	997	97.1%
Cohasset Gate	24,108	24,072	99.9%
Total	**39,921**	**39,843**	**99.8%**

Source: Massport, HMMH 2014.

Runway 27

On September 15, 1996, the FAA implemented a new departure procedure for Runway 27 called the WYLYY RNAV procedure. In accordance with the provisions of the ROD issued for the Runway 27 Environmental Impact Statement, Massport has been providing on-going radar flight track data and analysis to the FAA with respect to the procedure.

In 2012, for the first time since 1997 when flight track monitoring began, each gate (Gates A through E) averaged over 68 percent for every month the Airport had all runways open and for the annual average. The percent of flight tracks through all gates (a number tracked but not required per the 1996 ROD) rounded up to 68 percent for the last two months of 2011 and continued for all of 2012. The FAA had discussed these data internally and concluded that acceptable flight track dispersion had been achieved and that no subsequent action by FAA is required per the 1996 ROD requirements.[7]

Massport will continue to provide Tables H-23a and H-23b in the subsequent annual reports. Table H-23a presents the conformance results for the Runway 27 corridor for 2012 and Table H-23b for 2013. The average percentage of tracks through the corridor was 75.0 percent for 2013 and 73.9 percent for 2012. The percentage through the corridor for prior years was 59.6 percent for 2011 and 53.5 percent for 2010. Each year, compliance was improving but a change to the way the procedure was defined in 2011, coupled with improved avionics in the aircraft, resulted in the large improvement in 2011.

Each gate is further from the runway and falls along the procedure. The gates also increase in width as the distance is increased along the flight path and they form a noise abatement corridor. A consistent percentage of traffic through each gate means that flights are not entering the corridor late or exiting the corridor too early. The average percent through each gate was 90.5 percent in 2012 and 90.0 percent in 2013, which means that the majority of the traffic remained in the corridor.

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Table H-23a Runway 27 Corridor Percent of Tracks Through Each Gate for 2012

Month	Total # of Tracks	Total # of Tracks Through All Gates	Percent of Tracks Through All Gates	Gate A 1,400 ft[1]	Gate B 2,200 ft[1]	Gate C 2,900 ft[1]	Gate D 4,700 ft[1]	Gate E 6,300 ft[1]	Average Percent Through Each Gate
January	843	605	71.8%	77.6%	86.7%	94.8%	97.0%	96.0%	90.4%
February	1,832	1,373	75.0%	79.3%	90.0%	96.1%	98.4%	96.3%	92.0%
March	1,129	847	75.0%	79.5%	91.1%	96.4%	98.9%	97.3%	92.6%
April	1,866	1,410	75.6%	80.9%	90.2%	96.3%	98.5%	95.4%	92.3%
May	119	91	76.5%	79.8%	89.9%	93.3%	95.0%	94.1%	90.4%
June	139	100	71.9%	75.5%	82.7%	87.8%	89.2%	87.1%	84.5%
July[2]	18	5	27.8%	33.3%	33.3%	33.3%	33.3%	33.3%	33.3%
August[2]	7	0	0.0%	0.0%	0.0%	0.0%	0.0%	14.3%	2.9%
September[2]	65	38	58.5%	61.5%	72.3%	78.5%	81.5%	80.0%	74.8%
October	180	124	68.9%	73.3%	85.0%	90.0%	94.4%	93.9%	87.3%
November	1,208	916	75.8%	82.4%	91.2%	96.6%	98.4%	95.7%	92.9%
December	1,172	875	74.7%	80.4%	89.0%	94.3%	98.0%	97.4%	91.8%
Average[2]	**943**	**705**	**73.9%**	**78.7%**	**88.4%**	**93.9%**	**96.4%**	**94.8%**	**90.5%**

Source: Massport, HMMH 2013.
Notes: Gray shading indicates the Percentage rounds up to 68% or greater.
1 Width of Each Gate in Feet.
2 Runway 33L completely closed June 16, 2012 - October 2, 2012, RSA project, reduced use of Runway 27 departures. Excluded from overall average.

Table H-23b Runway 27 Corridor Percent of Tracks Through Each Gate for 2013

Month	Total # of Tracks	Total # of Tracks Through All Gates	Percent of Tracks Through All Gates	Gate A 1,400 ft[1]	Gate B 2,200 ft[1]	Gate C 2,900 ft[1]	Gate D 4,700 ft[1]	Gate E 6,300 ft[1]	Average Percent Through Each Gate
January	2,409	1,807	75.0%	80.7%	90.5%	95.4%	98.1%	95.6%	92.1%
February	1,152	846	73.4%	79.5%	88.8%	93.8%	97.3%	94.9%	90.9%
March	2,986	2,335	78.2%	82.6%	90.8%	96.2%	98.3%	97.5%	93.1%
April	1,364	1,093	80.1%	83.1%	91.9%	95.6%	97.1%	97.1%	93.0%
May	758	580	76.5%	81.8%	88.8%	95.0%	96.0%	95.7%	91.5%
June	981	728	74.2%	77.4%	85.2%	90.8%	92.1%	92.0%	87.5%
July	439	292	66.5%	67.9%	78.4%	82.7%	86.6%	87.7%	80.6%
August	799	595	74.5%	77.6%	87.9%	92.2%	93.6%	92.9%	88.8%
September	540	394	73.0%	75.0%	85.4%	90.4%	91.9%	90.9%	86.7%
October	1,077	813	75.5%	77.4%	89.5%	93.9%	96.3%	95.8%	90.6%
November	2,454	1,901	77.5%	80.9%	92.2%	95.9%	97.8%	97.2%	92.8%
December	2,853	2,164	75.9%	79.4%	90.7%	96.1%	98.4%	97.7%	92.5%
Average	**1,484**	**1129**	**75.0%**	**78.6%**	**88.3%**	**93.2%**	**95.3%**	**94.6%**	**90.0%**

Source: Massport, HMMH 2014.
Notes: Gray shading indicates the Percentage rounds up to 68% or greater.
1 Width of Each Gate in Feet.

Statistical Analyses of Flight Tracks — Runway 33L

The Somerville and Everett Gates (Figure H-15) extend from BOS 2 DME to BOS 5 DME and are used to monitor the departure procedure for Runway 33L. Turns to the left prior to the BOS 5 DME would pass through the Somerville Gate. Turns to the right prior to the BOS 5 DME would pass through the Everett Gate. Table H-24a shows the results of the analyses for 2012. The table indicates that 7.0 percent of tracks turned prior to reaching the BOS 5 DME. This is a decrease compared to 2011 when 8.0 percent of departures turned early before reaching 5 DME. The total number of tracks decreased from 12,894 in 2011 to 12,782 in 2012. The level of tracks in 2012 is similar to 2011 because Runway 33L was closed again for 3 months during 2012 as it was in 2011.

Table H-24a Runway 33L Gates — Passages Below 3,000 Feet for 2012

	Number of Departure Tracks	Number of Tracks Turning Before BOS 5 DME	Percentage of Tracks Turning Before BOS 5 DME
Everett Gate	12,782	352	2.8%
Somerville Gate	12,782	349	2.7%
Total	**12,782**	**701**	**5.5%**

Source: Massport, HMMH 2013.

Table H-24b shows the results of the analyses for 2013. The table indicates that only 3.5 percent of tracks turned prior to reaching the BOS 5 DME. This is a decrease compared to 2012 when 5.5 percent of departures turned early before reaching 5 DME. The total number of tracks also increased from 12,782 in 2012 to 21,644 in 2013.

Table H-24b Runway 33L Gates — Passages Below 3,000 Feet for 2013

	Number of Departure Tracks	Number of Tracks Turning Before BOS 5 DME	Percentage of Tracks Turning Before BOS 5 DME
Everett Gate	18,643	404	2.2%
Somerville Gate	18,643	357	1.9%
Total	**18,643**	**761**	**4.1%**

Source: Massport, HMMH 2013.

Even with the Runway 33L RNAV being implemented in June 2013 traffic departing Runway 33L in 2013 remained within the defined corridor and a lower percentage of flights than 2012 turned early to the south or the north.

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TECHNICAL MEMORANDUM

Subject:	Runway 22R Departure Analysis for 2010, 2011 and 2013[1]
Prepared for:	Flavio Leo; Massport
Prepared by:	Robert Mentzer Jr., David Crandall, Chris Waite; HMMH
Date:	December 10, 2013
Reference:	HMMH Project 304090.002.005

This memorandum is in response to a request from Massport to analyze Runway 22R departures at Logan International Airport (BOS) under Harris Miller Miller & Hanson Inc.'s (HMMH) on-call contract with the Noise Office. The request was to compare jet departures from Runway 22R at BOS representing different departure procedures from that runway.

The following time periods were selected for this analysis
- March 15, 2010 thru August 15, 2010
- March 15, 2011 thru August 15, 2011
- March 15, 2013 thru August 15, 2013[2]

This request is a follow-up to the RNAV Departure comparison completed in December 2011. The prior study compared jet departures from Runway 22R at Logan Airport from December 2009 to October 2010 and from December 2010 to October 2011. The prior analysis determined that the initial turn from Runway 22R had shifted and one of the recommendations was to convert the initial turn instructions to a runway heading (VI) and then intercept a course to fix (CF). Consequently, the FAA chose to re-evaluate the initial turn and modified it to a VI-CF departure procedure along with a shift in the location of the first navigational fix TJAYY. The updated procedure was published on March 7, 2013.[3]

1. BACKGROUND

A Categorical Exclusion/Record of Decision (CATEX/ROD[4]) for the Boston Overflight Noise Study was issued in October 2007. The CATEX/ROD approved the development of an RNAV-based Standard Instrument Departure (SID) procedure and an updated conventional vector route for non-RNAV equipped aircraft for Runways 22R/L along with similar improvements for other runways at BOS.

The FAA began design of the proposed procedures in early 2009. For Runways 22L/R, the aircraft would depart and turn to a vector heading as they did before, and then join the

[1] No data from 2012 was evaluated because the RNAV procedure evaluated in the 2011 dataset remained in place until March 2013.
[2] All dates in the memorandum are inclusive unless noted otherwise
[3] The December 2011 analysis is documented in HMMH Technical Memorandum "Runway 22R Departure Analysis" dated 12/20/2011. HMMH Project 304090.002.005 and was published as part of the 2011 ESPR
[4] Boston Overflight Noise Study – Phase 1 RNAV Design Updates, June 17, 2009

RNAV procedure north of Hull. The procedure was designed and submitted to FAA in March of 2009. However, the FAA National RNAV office determined that the Vector to RNAV procedure for Runways 22R/L was not feasible due to inadequate Distance Measuring Equipment (DME) coverage in the area.

Following that determination, FAA began the development of a full RNAV SID from Runway 22R/L which would be successful in meeting the spirit and intent of the CATEX/ROD. These were completed and submitted in June of 2009 and the procedures were published and implemented for Runway 22R/L in November of 2010.

A total of eight RNAV SIDs are published for Logan Airport that describe Runway 22R departures: (BLZZR, BRUWN, CELTK, HYLND, LBSTA, PATSS, REVSS, and SSOXS).[5] Prior to March 7, 2013, each of the RNAV procedures developed for Runway 22R consists of a heading to altitude (VA) segment and direct to fix (DF) segment which instruct the aircraft to turn to the fix TJAYY any time after reaching 520 feet MSL.

On March 7, 2013, each of the RNAV procedures were modified and the initial departure instruction consist of maintaining runway heading (VI) and then intercept a course to fix (CF) of 144 degrees magnetic to fix TJAYY.[6] Along with the Procedure change, the navigational fix TJAYY moved approximately 1,900 ft. (~ 1/3 mile) to the southeast.

2. RUNWAY 22R DEPARTURE EVALUATION

Radar data from the Massport Noise and Operations Monitoring System (NOMS) was used for this analysis. This analysis compares three data sets from three different time periods representing different procedures were consider. Each of the three time periods include 154 days.

The conventional vector (pre-RNAV) departures are represented by a data set from March 15, 2010 to August 15, 2010. During this period, 112 days had jet departures from Runway 22R, and included 22,593 jet operations (20,870 daytime jet operations and 1,723 nighttime jet operations).

The first iteration of the RNAV departures (RNAV 2011), as published November 2010 through March 6, 2013 is represented by a data set from March 15, 2011 to August 15, 2011. Out of this sample, 100 days had jet departures from Runway 22R and included 20,925 jet operations (18,693 daytime jet operations and 2,232 nighttime jet operations).

[5] There is another RNAV SID published for BOS named “WYLYY” but it is not used for Runway 22R departures and therefore not part of this analysis.
[6] As it is written in the procedures effective August 22, 2013 to September 19, 2013 “TAKEOFF RUNWAY 22R: Climb heading 216^{o} to intercept course 144^{o} to TJAYY, do not exceed 210K until 520 MSL, thence…” Note that the narrative of the BRUWN procedure says 140^{o} instead of 144^{o} though the graphic does say 144^{o}. This appears to be a typographical error in the BRUWN narrative.

The revised RNAV departures (RNAV 2013), as published March 7, 2013 and are represented by data March 15, 2013 to August 15, 2013. During this period, 111 days had jet departures from Runway 22R, included 22,105 jet operations (19,889 daytime jet operations and 2,216 nighttime jet operations).

Figure 1 shows the area surrounding Logan Airport on which this analysis focuses. Three reference points were used to evaluate the changes in departures and are shown in Figure 1.

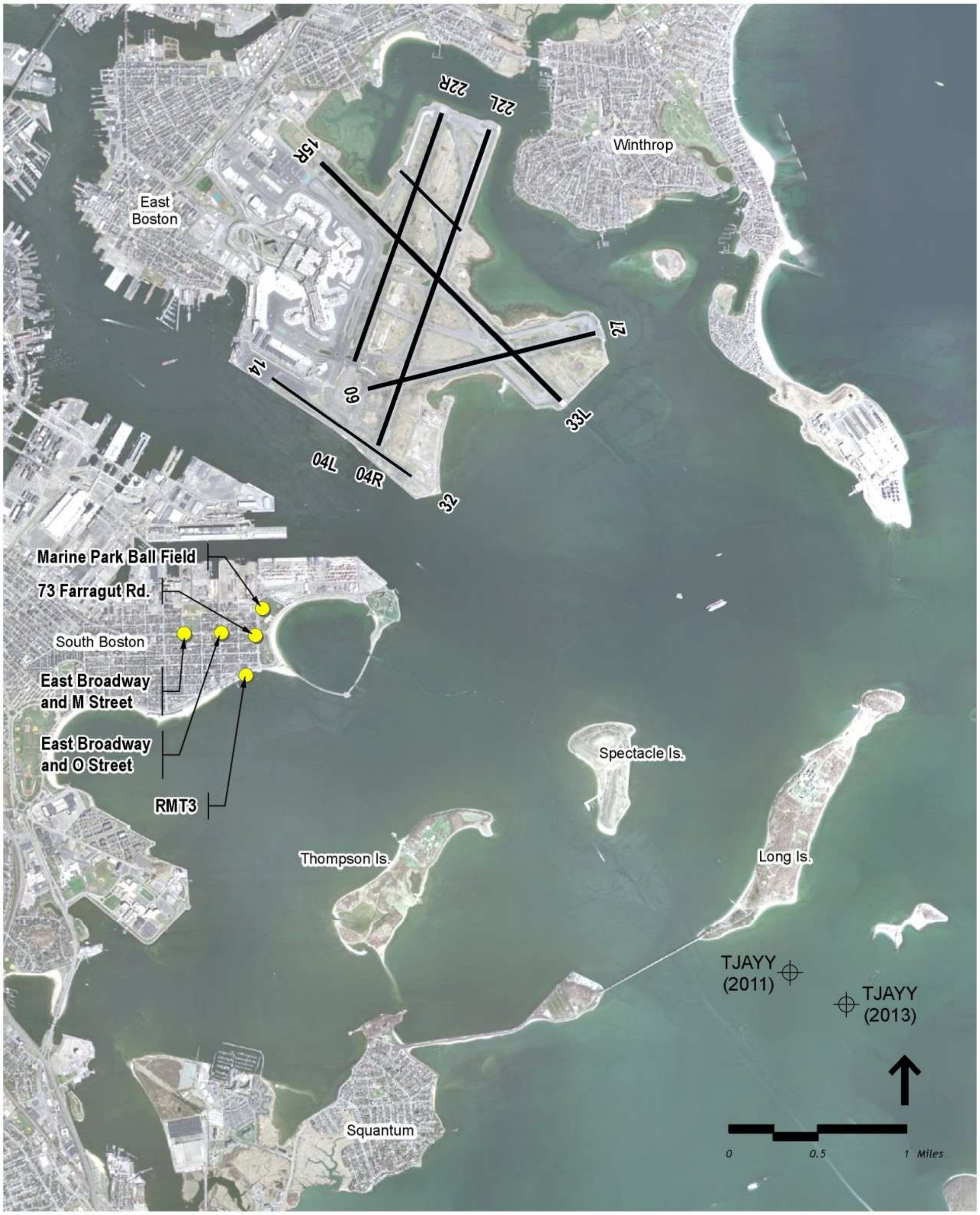
These three sites are:

- The Marine Park Baseball Field
- A private residence at 73 Farragut Road
- RMT3, one of the noise monitoring stations operated by Massport on Day Blvd near Farragut Road

The three sites above are close to the initial turn in the procedure. Two additional sites were evaluated as part of the noise analysis. These sites are located in the residential area of South Boston and are two and four blocks west of Farragut Road.

- The intersection of East Broadway and O-Street
- The intersection of East Broadway and M-Street

For reference, Figure 1 also shows both the 2011 and 2013 location of TJAYY, the first waypoint aircraft must fly-by in either respective iteration of the RNAV departure procedures.



Source: Harris Miller Miller & Hanson Inc. 2013, Massport NOMS / ERA Multi-Lat, Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Environmental Affairs

Waypoint

Receivers

Project Area and Modeling Locations

Figure 1

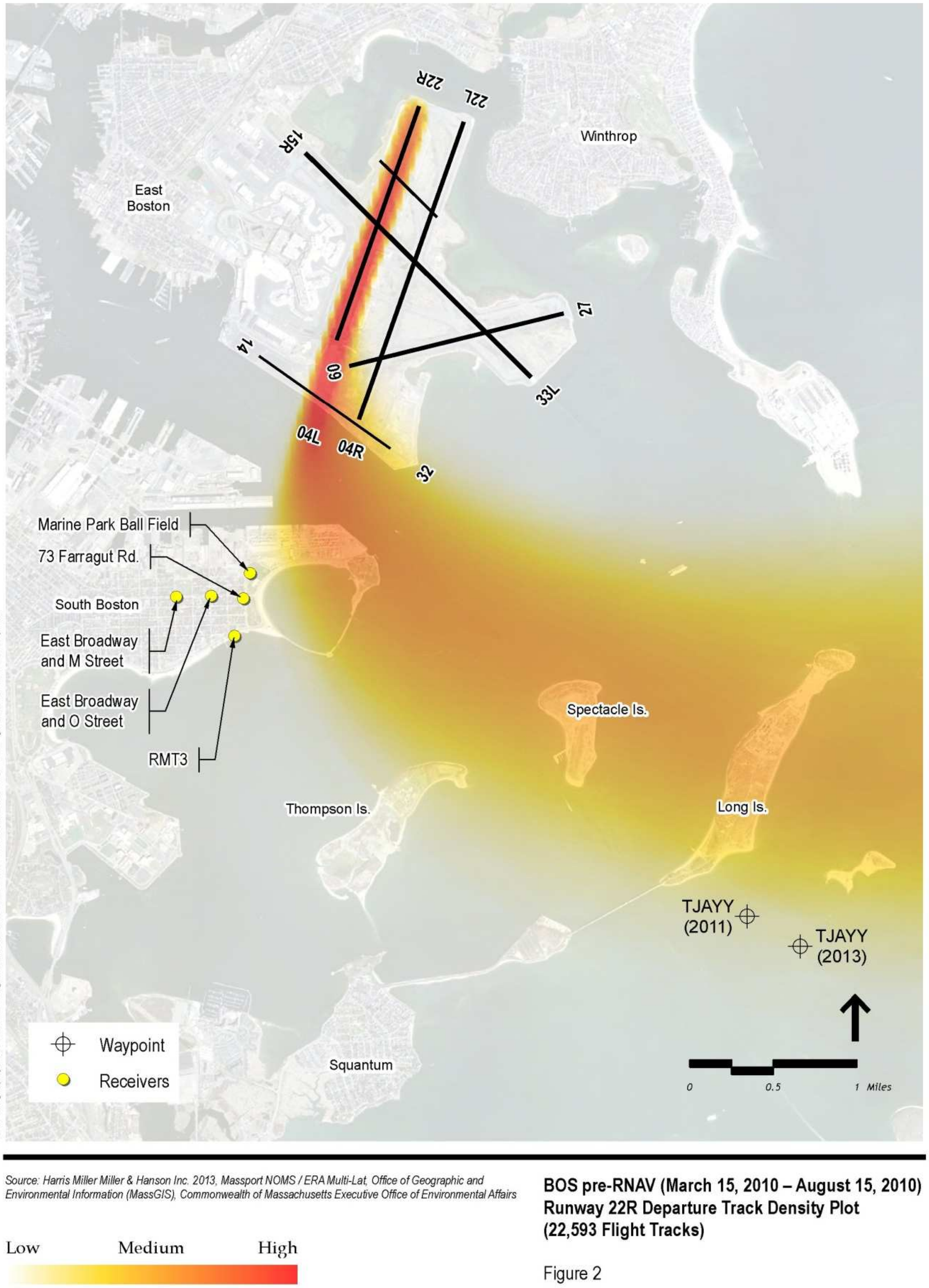
2.1 Density Plots

Figure 2 shows a plot of the density of aircraft departures off of Runway 22R from March 15, 2010 to August 15, 2010, before RNAV procedures were implemented. The figure indicates that the majority of flights turn immediately after reaching the northern shore of Boston Inner Harbor and pass over Castle Island, Spectacle Island and approximately one mile north of waypoint TJAYY (2011) over Long Island.

Figure 3 shows a comparable density plot of aircraft departing Runway 22R from March 15, 2011 to August 15, 2011, after RNAV procedures were implemented. It shows the bulk of the aircraft making a more gradual turn after reaching the northern edge of Boston Inner Harbor, passing to the west of Castle Island and over the southern edge of Spectacle Island heading towards a fly-by of the TJAYY (2011) waypoint.

Figure 4 shows a comparable density plot of aircraft departing Runway 22R from March 15, 2013 to August 15, 2013, after RNAV procedures were revised on March 7, 2013. It shows the bulk of the aircraft making a more gradual turn after reaching the northern edge of Boston Inner Harbor, passing to the southwest of Castle Island and over the southern edge of Spectacle Island heading towards a fly-by of the TJAYY (2013) waypoint.

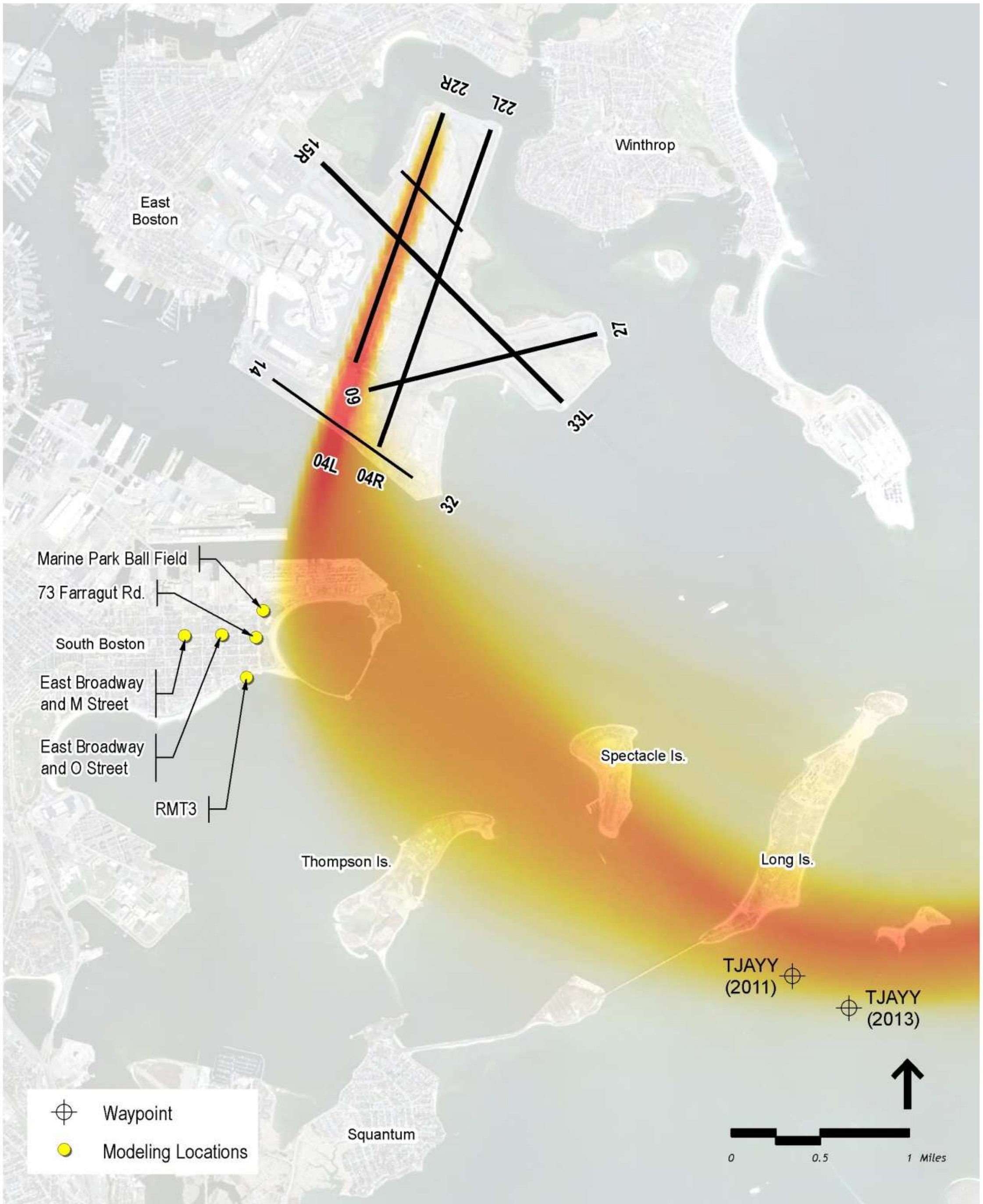
Comparing Figure 3 and Figure 4, the jet operations are more concentrated in the Figure 4 graphic (March 15, 2013 to August 15, 2013) than in the Figure 3 graphic (March 15, 2011 to August 15, 2011). Also, the western edge of the shaded flow has moved east over Pleasure Bay as the tracks are more concentrated over Castle Island.



Source: Harris Miller Miller & Hanson Inc. 2013, Massport NOMS / ERA Multi-Lat, Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Environmental Affairs

BOS pre-RNAV (March 15, 2010 – August 15, 2010) Runway 22R Departure Track Density Plot (22,593 Flight Tracks)

Figure 2

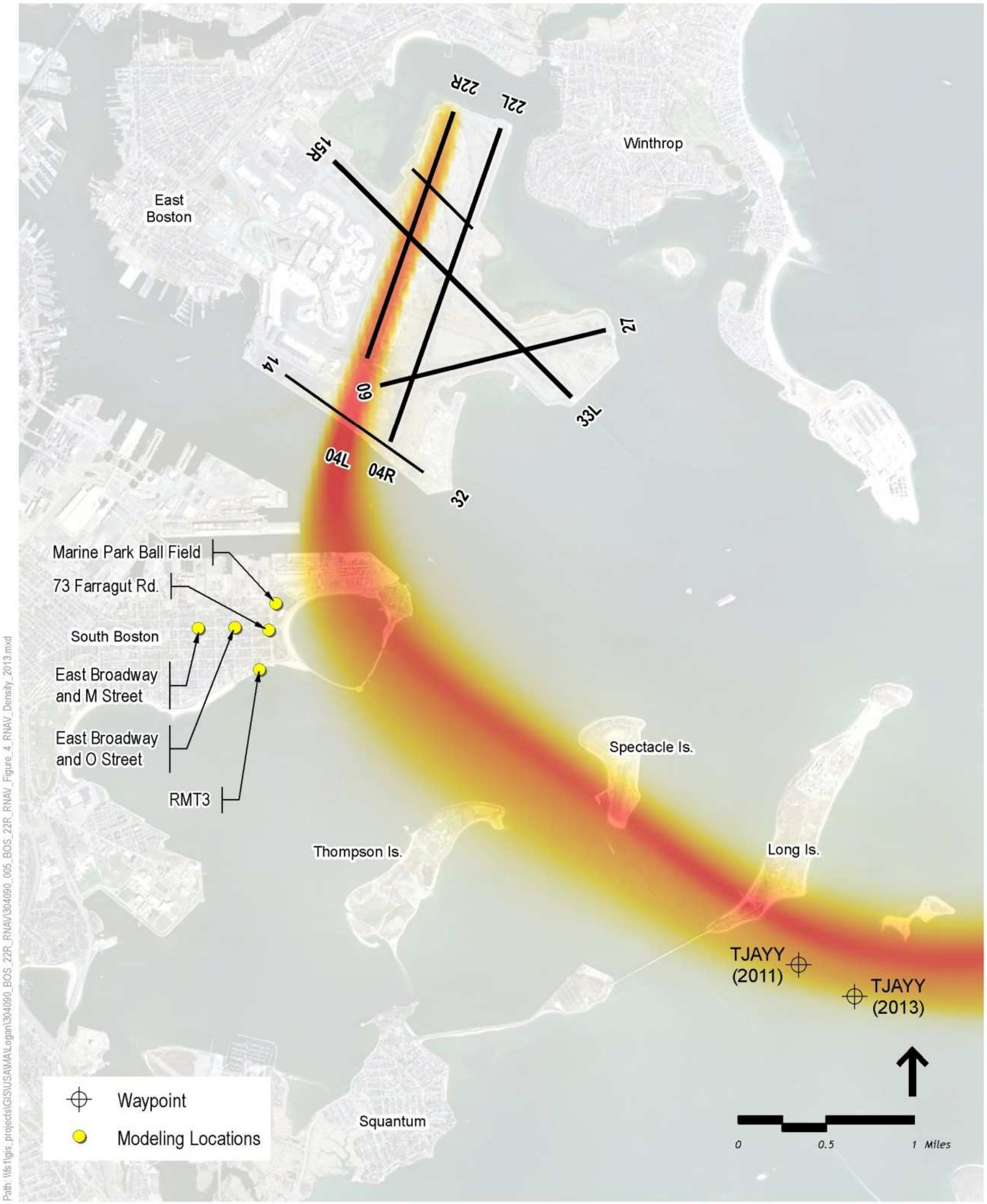


Source: Harris Miller Miller & Hanson Inc. 2013, Massport NOMS / ERA Multi-Lat, Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Environmental Affairs

Low Medium High

BOS RNAV (March 15, 2011 – August 15, 2011) Runway 22R Departure Track Density Plot (20,925 Flight Tracks)

Figure 3



Source: Harris Miller Miller & Hanson Inc. 2013, Massport NOMS / ERA Multi-Lat, Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Environmental Affairs

Low Medium High

BOS RNAV (March 15, 2013 – August 15, 2013)
Runway 22R Departure Track Density Plot
(22,105 Flight Tracks)

Figure 4

2.2 Point of Closest Approach

To compare the three scenarios more quantitatively, a Point of Closest Approach (POCA) analysis was completed to determine whether there were any trends. The slant distance, which is the direct distance between the aircraft and the location, was used for this analysis. The slant distance was used since it will reflect changes in both track position and altitude.

A typical cross section of a procedure can be represented by a bell shaped curve with a small level of tracks on one side of the procedure, rising to the maximum level (flight paths directly on the procedure) and then back down to a small level of tracks on the other side of the procedure. Table 1 summarizes the results and presents the number of operations and the change in the slant distance compared to the Pre-RNAV period at the location of the maximum level of operations. The table also provides the slant distance where the number of operations exceeds 200 on the side closest to the points of interest.

At the location of the maximum level of operations, the number of operations has increased (more than doubled) between the RNAV 2011 period and the RNAV 2013 period. This is due to the tighter concentration of flight tracks on the RNAV 2013 procedure. The Slant distance change compared to the Pre-RNAV period has decreased (by approximately 300') which indicates a shift of the flight paths away from the points of interest and closer to the Pre-RNAV position.

Also the slant distance at the point of 200 operations along the curve nearest the points of interest increased indicating a reduction in the flight path dispersion and a shift away from the points of interest.

Table 1. Slant Distance for Point of Closet Approach between RNAV and Pre-RNAV Operations March 15, 2010 to August 15, 2010

	RNAV 2011 March 15, 2011 to August 15, 2011 (VA-DF)			RNAV 2013 March 15, 2013 to August 15, 2013 (VI-CF)		
	At Location of Maximum Level of Operations		Nearest Distance at 200 Ops(ft.)	At Location of Maximum Level of Operations		Nearest Distance at 200 Ops(ft.)
Site	Number of Operations	Change (ft.) from Pre-RNAV		Number of Operations	Change (ft.) from Pre-RNAV	
Marine Park Ball Field	498	-1100	1600	1094	-700	1950
73 Farragut Rd.	410	-1200	1950	998	-900	2400
Noise Monitor RMT3	357	-1300	2700	957	-1050	3100

Note: A smaller negative distance in the change column means the location of the maximum operations is closer to the Pre-RNAV location

2.3 Noise Evaluation

RealContours™[7] was run on just the Runway 22R jet departures to evaluate possible changes in noise levels due to the implementation of the RNAV. All Runway 22R jet departures were modeled within each time period and adjusted to represent average day conditions.

To allow for the comparison between three sets which are comparable, the two RNAV DNL results were normalized to represent the noise contours with the same equivalent number of operations as the pre-RNAV DNL contours.[8] Figure 5 displays the 2010 pre-RNAV DNL contours (blue) compared to the normalized 2011 RNAV (VA-DF) and normalized 2013 RNAV (VI-CF) DNL contours (orange and yellow, respectively).

The shift of the RNAV DNL contours towards South Boston and the elongation of the contour into Boston Harbor, relative to the pre-RNAV contours, reflect the changes in flight paths due to the implementation of the RNAV procedures. As noted in Sections 0 and 2.2, the RNAV procedures reduces the width of the corridors (i.e. decrease dispersion). This in turn reduces the width and elongates the contour along the flight path.

Table 2 presents the partial DNL results of the modeling at each of the locations evaluated. These values correspond to the contours presented in Figure 5. Each of the three sites are successively farther away from the runway end. The partial DNLs decrease as the majority of aircraft turn to the desired fix. This is also true for the two sites along East Broadway which are successively farther away from the procedure.

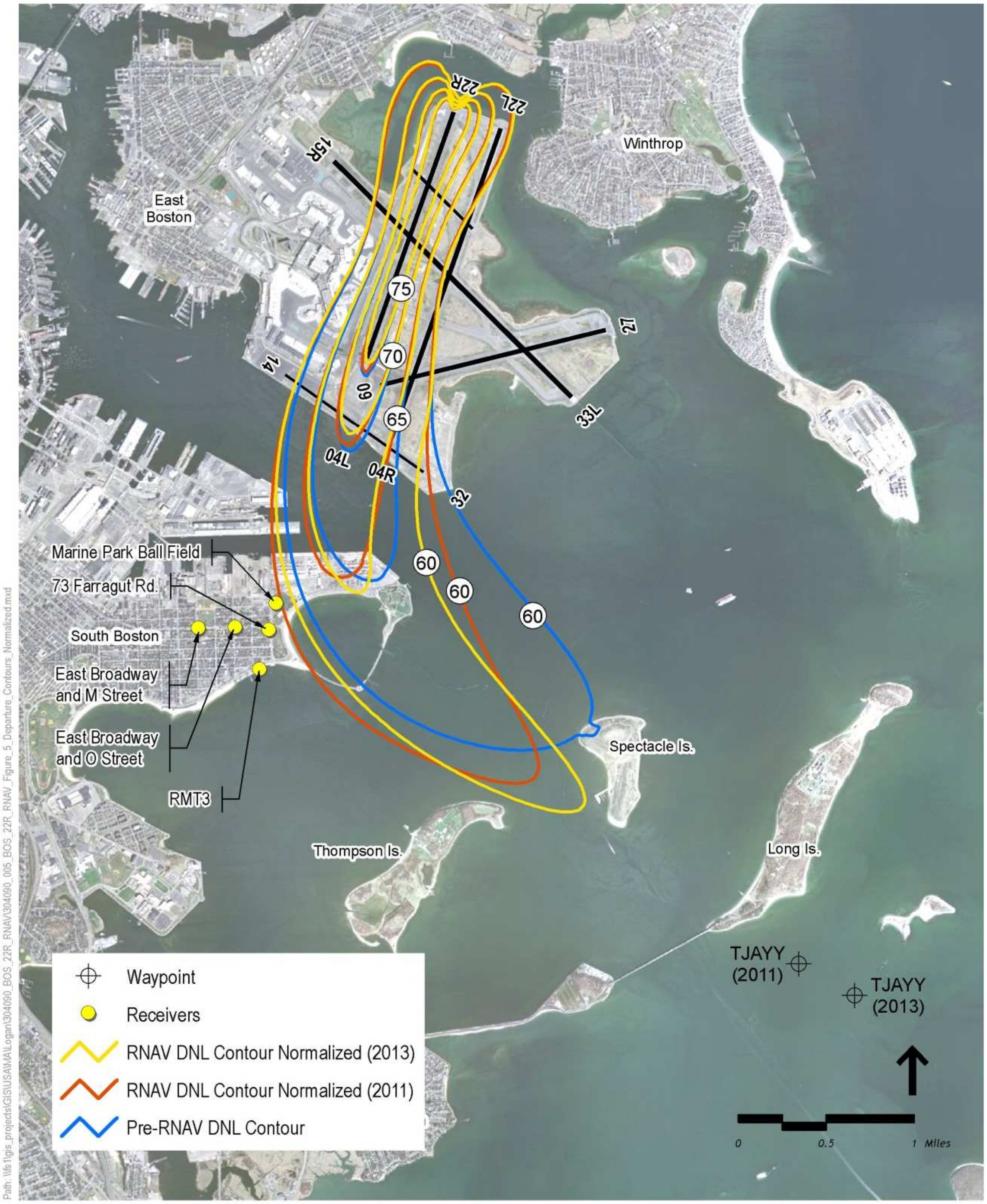
The implementation of the RNAV 2011 procedure had resulted in aircraft turning more gradually from runway heading and falling closer to the modeling locations. This resulted in a noise increase between DNL 1.6 dB at the furthest site (East Broadway and M Street) and DNL 2.9 dB at both 73 Farragut Rd and the Marine Park Baseball field. The implementation of the RNAV 2013 procedure has resulted in aircraft turning in a more concentrated pattern at a further distance from the modeling locations. This resulted in a noise increase between DNL 1.1 dB at RMT 3 and the East Broadway and M Street location to a 1.4 dB increase at the Marine Park Ball Field between the Pre-RNAV period and the RNAV 2013 period.

Overall the RNAV 2013 procedure still shows an increase in noise levels but the increase is approximately half of what it was compared to the RNAV 2011 procedure.

[7] RealContours™ is a pre-processor for the FAA's INM model which converts radar data into model tracks. This allows the actual radar tracks to be modeled instead of a sampled average.
[8] The DNL metric effectively weights one nighttime, defined as 10 PM to 7 AM, noise event as the equivalent of ten daytime (7 AM to 10 PM) operations.

Table 2. Partial DNL levels at Selected Sites for Runway 22R Departures					
Site	Pre-RNAV March 15, 2010 to August 15, 2010	RNAV 2011 March 15, 2011 to August 15, 2011 (VA-DF)		RNAV 2013 March 15, 2013 to August 15, 2013 (VI-CF)	
		Normalized		Normalized	
		RNAV	Change	RNAV	Change
	(a)	(b)	(b-a)	(c)	(c-a)
Marine Park Ball Field	56.4	59.3	2.9	57.8	1.4
73 Farragut Rd.	54.7	57.6	2.9	56.0	1.3
Noise Monitor RMT3	52.5	55.1	2.6	53.6	1.1
E. Broadway and O Street	51.6	53.8	2.2	52.8	1.2
E. Broadway and M Street	48.6	50.2	1.6	49.7	1.1

Notes:
1 Normalized levels correct for the difference in overall operations and day-night split between the two time periods to provide for the best representation of differences due to the departure route changes.
2 FAA Noise level criteria for an annual average DNL is a 1.5 dB increase within the DNL 65 dB contour, a 3.0 dB increase within the DNL 60-65 dB contour or a 5.0 dB increase within the DNL 45-60 dB contour



Source: Harris Miller Miller & Hanson Inc. 2013, Massport NOMS / ERA Multi-Lat, Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Environmental Affairs

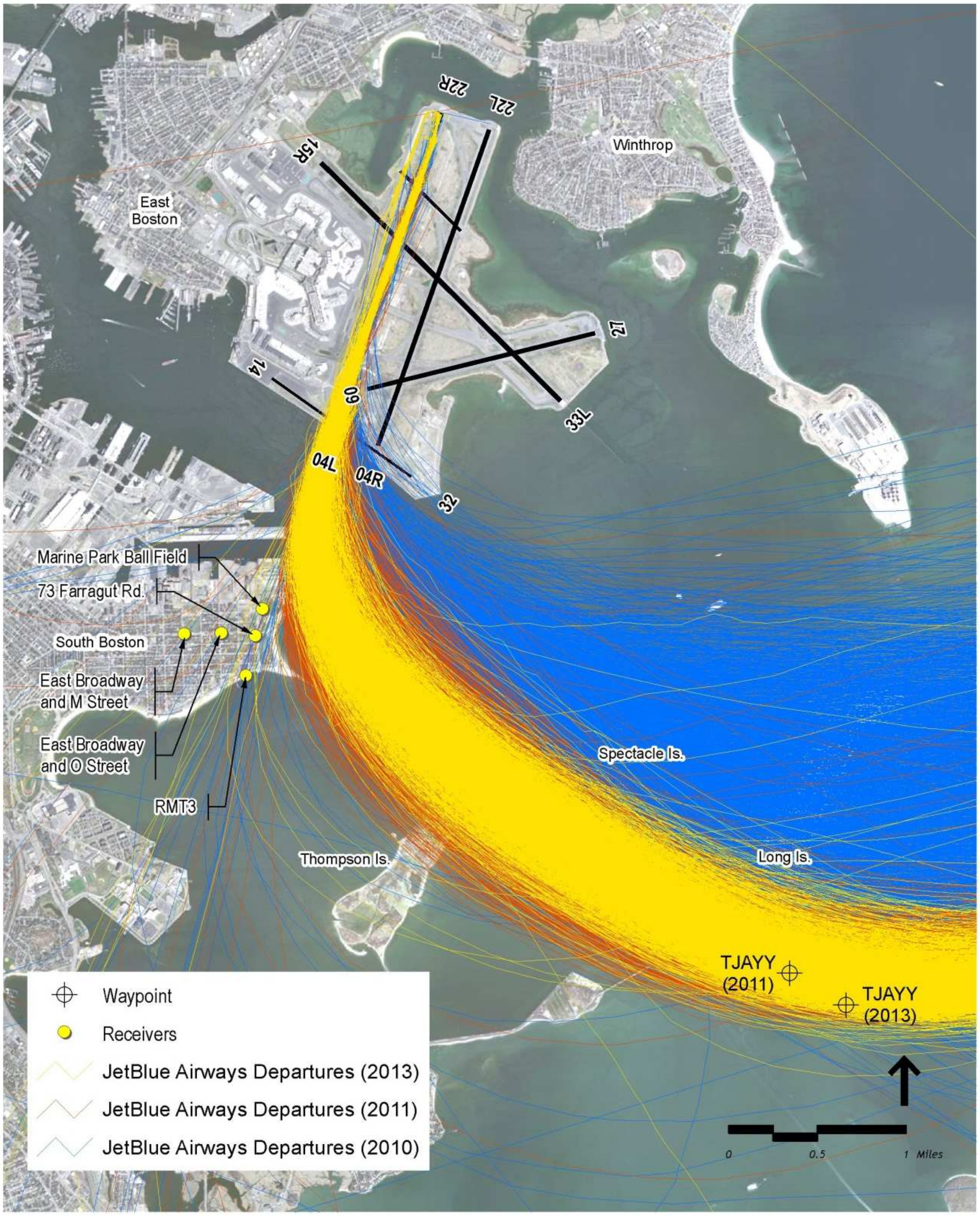
Runway 22R Departure Partial DNL contours, BOS pre-RNAV (March 15, 2010-August 15, 2010) vs. BOS RNAV (March 15, 2011-August 15, 2011) vs. BOS RNAV (March 15, 2013-August 15, 2013) Operations Normalized
Figure 5

2.4 Track Comparison

Figure 6 displays the differences between the pre-RNAV and two RNAV time periods for JetBlue Airways (JetBlue) Airbus A320 aircraft at Logan Airport. The JetBlue A320 used the RNAV procedure during both the 2011 and 2013 sample sets.

During the 2010 pre-RNAV period, the JetBlue A320 departures turned to 140 degrees using the standard LOGAN SID (blue tracks). The flights typically stay east of Pleasure Bay. The orange tracks are the JetBlue departures during the March 15, 2011 to August 15, 2011 RNAV (VA-DF) period and the yellow tracks are the JetBlue departures during the March 15, 2013 to August 15, 2013 RNAV (VI-CF) period. The RNAV procedures clearly shift departures over Pleasure Bay and the concentration of the tracks along the RNAV route. The tracks March 15, 2011 to August 15, 2011 RNAV (VA-DF) period are slightly more dispersed (i.e. a wider corridor than the tracks during the March 15, 2013 to August 15, 2013(VI-CF) period.

The average slant distance at 73 Farragut Rd. for JetBlue (which includes both A320s and E190s) decreased between the RNAV 2011 and RNAV 2013 data sets, from 3,218 ft. to 3,070 ft. (a difference of 147 ft.). For the pre-RNAV period data, JetBlue Runway 22R departures had an average slant distance of 4,086 ft. from 73 Farragut Rd. However, the dispersion of JetBlue flight tracks in the RNAV 2013 data set is reduced concentrating the flight path away from the modeling location.



Source: Harris Miller Miller & Hanson Inc. 2013, Massport NOMS / ERA Multi-Lat, Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Environmental Affairs

A320 JetBlue Airways Runway 22R Departure Tracks (March 15 – August 15)

Figure 6

3. CONCLUSIONS

The overall result of initiating the RNAV SID procedure to Runway 22R departures has caused the majority of jet departures, regardless of aircraft type or operator, to fall closer to the three reference locations at Marine Ball Park, 73 Farragut Road and the noise measurement site RMT3 relative to the pre-RNAV jet departures. This has resulted in an increase in aircraft flights over Pleasure Bay and an increase in modeled noise levels at these sites due to Runway 22R departures.

However, changes to the procedures, effective March 7, 2013, have brought several improvements to the Farragut Road area.

- Jet departures fly a defined route over Pleasure Bay more consistently. This has reduced dispersion and pulled the western edge of flights closer to the defined route and away from the neighborhood.
- The noise values for the RNAV 2013 sample (VI-CF) have reduced bringing the noise levels closer to the 2010 Pre-RNAV noise levels as compared to noise levels during the RNAV 2011 sample (VA-DF).
- The maximum level of operations slant distance has effectively shifted west away from the neighborhood as the track dispersion has reduced over the defined route. The changes that became effective March 7, 2013 have also reduced the number of flights that pass close to the three reference locations[9].

As a result of the implementation of the March 7, 2013 RNAV procedure change departures from Runway 22R consistently fly the procedure and follow the same turn around Castle Island towards Spectacle Island. This has reduced dispersion of flights and effectively reduced noise levels in the Farragut Road area

[9] Actual distances are site specific. See Section 2.2 for further details.

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I

Air Quality/ Emissions Reduction

This appendix provides the following detailed information and data tables in support of *Chapter 7, Air Quality/ Emissions Reduction*:

- Fundamentals of Air Quality
  - Table I-1 National Ambient Air Quality Standards
  - Table I-2 Airport-related Sources of Air Emissions
  - Table I-3 Attainment, Nonattainment, and Maintenance Areas

- Aircraft Fleet and Operational Data Used in EDMS v5.1.3 (2012) and EDMS v5.1.4.1 (2013)
  - Table I-4 2012 Fleet Mix, Annual Landing-and-Takeoff Cycles (LTOs), and Taxi/Delay Time-in-Mode by Aircraft Type
  - Table I-5 2013 Fleet Mix, Annual Landing-and-Takeoff Cycles (LTOs), and Taxi/Idle Time-in-Mode by Aircraft Type

- Ground Service Equipment (GSE)/Alternative Fuels Conversion
  - Table I-6 Ground Service Equipment Alternative Fuel Conversion Summary (kg/day)

- Motor Vehicle Emissions
  - Table I-7 MOBILE6.2.03 Input File for 2012
  - Table I-8 MOBILE6.2.03 Output Files for 2012
  - Table I-9 MOVES2010b Sample Input File for 2013
  - Table I-10 MOVES2010b Sample Output File for 2013

- Fuel Storage and Handling
  - Table I-11 Fuel Throughput by Fuel Category (gallons)

- Stationary Sources
  - Table I-12 Stationary Source Fuel Throughput by Fuel Category (gallons)

Fundamentals of Air Quality

This section contains a general summary of air quality and air emissions with a particular emphasis on airport-related emissions where appropriate. This material is intended to supplement and provide background information for the materials contained in *Chapter 7, Air Quality/Emissions Reduction*.

Pollutant Types and Standards

The United States (U.S.) Environmental Protection Agency (EPA) has established National Ambient Air Quality Standards (NAAQS) for a select group of "criteria air pollutants" designed to protect public health, the environment, and the quality of life from the detrimental effects of air pollution. Listed alphabetically, these pollutants are briefly described below:

- **Carbon monoxide (CO)** is a colorless, odorless, tasteless gas. It may temporarily accumulate, especially in cool, calm weather conditions, when fuel use reaches a peak and CO is chemically most stable due to the low temperatures. CO from natural sources usually dissipates quickly, posing no threat to human health. Transportation sources (e.g., motor vehicles), energy generation, and open burning are among the predominant anthropogenic (i.e., man-made) sources of CO.
- **Lead (Pb)** in the atmosphere is generated from industrial sources including waste oil and solid waste incineration, iron and steel production, lead smelting, and battery and lead manufacturing. The lead content of motor vehicle emissions, which was the major source of lead in the past, has significantly declined with the widespread use of unleaded fuel. Low-lead fuel used in some general aviation (GA) aircraft is still a source of airport-related lead.
- **Nitrogen dioxide (NO_2)**, nitric oxide (NO), and the nitrate radical (NO_3) are collectively called oxides of nitrogen (NO_x). These three compounds are interrelated, often changing from one form to another in chemical reactions, and NO_2 is the compound commonly measured for comparison to the NAAQS. NO_x is generally emitted in the form of NO, which is oxidized to NO_2. The principal man-made source of NO_x is fuel combustion in motor vehicles and power plants – aircraft engines are also a source. Reactions of NO_x with other atmospheric chemicals can lead to formation of ozone (O_3) and acidic precipitation.
- **Ozone (O_3)** is a secondary pollutant, formed from daytime reactions of NO_x and volatile organic compounds (VOCs) in the presence of sunlight. VOCs, which are a subset of hydrocarbons (HC) and have no NAAQS, are released in industrial processes and from evaporation of gasoline and solvents. Sources of NO_x are discussed above.
- **Particulate matter (PM)** comprises very small particles of dirt, dust, soot, or liquid droplets called aerosols. The NAAQS for PM is segregated by sizes (i.e., less than 10 and less than 2.5 microns as PM_{10} and $PM_{2.5}$, respectively). PM is formed as an exhaust product in the internal combustion engine or can be generated from the breakdown and dispersion of other solid materials (e.g., fugitive dust).
- **Sulfur oxides (SO_x)** are primarily composed of sulfur dioxide (SO_2) which is emitted in natural processes and by man-made sources such as combustion of sulfur-containing fuels and sulfuric acid manufacturing.

The NAAQS for these criteria pollutants are subdivided into the Primary Standards (designed to protect human health) and the Secondary Standards (designed to protect the environment and human welfare) and are listed below in Table I-1. Exceedances of these values constitute violations of the NAAQS.

Table I-1 National Ambient Air Quality Standards

Pollutants	Averaging Time	Concentration	Condition of Violation
Ozone (O_3)	8-hour	0.075 ppm	3-year average of the fourth-highest daily maximum 8-hour average.
Carbon Monoxide (CO)	8-hour	9 ppm	No more than once per year.
	1-hour	35 ppm	
Nitrogen Dioxide (NO_2)	Annual Average	53 ppb	Annual mean.
	1-hour	100 ppb	3-year average of the 98th percentile of the daily maximum 1-hour average.
Sulfur Dioxide (SO_2)	3-hour	0.5 ppm	No more than once per year.
	1-hour	75 ppb	Three-year average of the 99th percentile of 1-hour daily maximum concentrations.
Particulate Matter (PM_{10})	24-hour	150 $\mu g/m^3$	Not to be exceeded more than once per year on average over 3 years.
Particulate Matter ($PM_{2.5}$)	Annual (primary)	12 $\mu g/m^3$	Annual mean, averaged over 3 years.
	Annual (secondary)	15 $\mu g/m^3$	Annual mean, averaged over 3 years.
	24-hour	35 $\mu g/m^3$	3-year average of the 98th percentile.
Lead (Pb)	Rolling 3 month average	0.15 $\mu g/m^3$	Not to be exceeded.

Source: U.S. EPA, 2014, http://www.epa.gov/air/criteria.html
Note: ppm - parts per million; ppb – parts per billion; $\mu g/m^3$ - micrograms per cubic meter

Sources of Airport Air Emissions

Almost all large metropolitan airports generate air emissions from the following general source categories: aircraft, ground service equipment (GSE), and motor vehicles traveling to, from, and moving about the airport; fuel storage and transfer facilities; a variety of stationary sources (e.g., steam boilers, back-up generators, snow melters, etc.); an assortment of aircraft maintenance activities (e.g., painting, cleaning, repair, etc.); routine airfield, roadway, and building maintenance activities (e.g., painting, cleaning, repair, etc.); and periodic construction activities for new projects or improvements to existing facilities. Table I-2 provides a summary listing of these sources of air emissions, the pollutants, and their characteristics.

Table I-2 Airport-related Sources of Air Emissions

Sources	Emissions	Characteristics
Aircraft	CO NO_2 PM SO_2 VOCs	Exhaust products of fuel combustion that vary depending on aircraft engine type, number of engines, power setting, and period of operation. Emissions are also emitted by an aircraft's auxiliary power unit (APU).
Motor vehicles	CO NO_2 PM SO_2 VOCs	Exhaust products of fuel combustion from patron and employee traffic approaching, departing, and moving about the airport site. Emissions vary depending on vehicle type, distance traveled, operating speed, and ambient conditions.
Ground service equipment	CO NO_2 PM SO_2 VOCs	Exhaust products of fuel combustion from service trucks, tow tugs, belt loaders, and other portable equipment.
Fuel storage and transfer	VOCs	Formed from the evaporation and vapor displacement of fuel from storage tanks and fuel transfer facilities. Emissions vary with fuel usage, type of storage tank, refueling method, fuel type, vapor recovery, climate, and ambient temperature.
Stationary sources	CO NO_2 PM SO_2 VOCs	Exhaust products of fossil fuel combustion from boilers dedicated to indoor heating requirements and emissions from incinerators used for waste reduction. Emissions are generally well controlled with operational techniques and post-burn collection methods. Sources include boilers and hot water generators, emergency generators, incinerators, paint booth and surface coating operations, welding operations, and fire fighting facilities.
Construction Activities	CO NO_2 PM SO_2 VOCs	Construction projects may have associated emissions from dust generated during excavation and land clearing, exhaust emissions from construction equipment and motor vehicles, and evaporative emissions from asphalt paving and painting. The amount of particulate emissions varies with the material type, the amount of area exposed, and meteorology. The construction of airport and airfield improvement projects at airports represents temporary sources of emissions.

Notes: CO - Carbon monoxide; VOC - Volatile organic compounds; PM - Particulate matter; NO_2 - Nitrogen dioxide; SO_2 - Sulfur dioxide.

The U.S. EPA, state, and local air quality agencies maintain outdoor air monitoring networks to measure air quality conditions and gauge compliance with the NAAQS. Based upon the data collected by these agencies, all areas throughout the country are designated by the U.S. EPA with respect to their compliance with the NAAQS. Table I-3 provides the definitions of each of these designations.

Table I-3 Attainment, Nonattainment, and Maintenance Areas

Attainment/Nonattainment Designations			
Attainment	**Attainment/Maintenance**	**Nonattainment Area**	**Unclassifiable**
Any area that meets the NAAQS established for all of the criteria air pollutants.	Any area that is in transition from formerly being a nonattainment area to an attainment area (also called Maintenance).	Any area that does not meet (or that contributes to ambient air quality in a nearby area that does not meet) one or more of the NAAQS.	Any area that cannot be classified on the basis of available information as meeting or not meeting the NAAQS.

Source: U.S. EPA

For O_3, CO, PM_{10}, and $PM_{2.5}$, the nonattainment designations are further classified by the severity, or degree, of the violation of the NAAQS. For example, in the case of O_3, these classifications range from highest to lowest as extreme, severe, serious, marginal, and moderate.

The nonattainment designation of an area has a bearing on the emission control measures required and the time periods allotted by which a State Implementation Plan (SIP) must demonstrate attainment of the NAAQS. It is also important to note that the degree of nonattainment determines the thresholds of emissions that are considered to be "*de minimis,*" or levels below (i.e., within) which a formal General Conformity determination is not required.

Finally, the boundaries of nonattainment areas are generally determined based on Core Based Statistical Areas (CBSA) as defined by U.S. census data (air monitoring station locations and contributing emission sources also play a role). However, nonattainment areas for localized pollutants such as lead and CO typically only comprise a partial CBSA or a local "hot-spot." By comparison, regional pollutants such as O_3 can encompass multiple CBSAs and can extend across state lines.

State Implementation Plans (SIP)

For the purposes of this summary explanation of SIPs, it is sufficient to characterize SIPs as the principal instrument by which a state formulates and implements its strategies for bringing nonattainment or maintenance areas into compliance with the NAAQS. In equally broad terms, the SIP contains the necessary emission limitations, control measures and timetables for achieving this objective. Therefore, the SIP development process is delegated to state air quality agencies that may in turn rely on regional, county, and local agencies to help prepare emission inventories that include airport-related emissions.

Aircraft Fleet and Operational Data used in EDMS Version 5.1.3 (2012) and Version 5.1.4.1 (2013)

The Federal Aviation Administration (FAA) Emissions Dispersion System (EDMS) is the EPA-preferred and the FAA-required model for conducting airport air quality analyses. The most recent version of EDMS (at the time), Version 5.1.3 (EDMS v5.1.3), was used in support of the 2012 air quality analysis. EDMS was later revised to the current version 5.1.4.1 (EDMS v5.1.4.1), and this version was used in support of the 2013 analysis.

Table I-4 contains the data that were used in EDMS v5.1.3 to represent actual conditions at Logan Airport in 2012. These data include aircraft type, engine, landing takeoff cycles (LTOs), and taxi times. The aircraft are divided into four categories: air carrier, cargo, commuter, and GA. Table I-5 contains the fleet mix, LTOs, and taxi time data that were used in EDMS v5.1.4.1 for the year 2013.

Table I-4 2012 Fleet Mix, Annual Landing-and-Takeoff Cycles (LTOs), and Taxi/Delay Time-in-Mode by Aircraft Type

Aircraft Type	Engine	LTOs	Description (Airline)	Taxi Times
Air Carrier Aircraft				
Airbus A310-200 Series	CF6-80A3	206	AC SATA	23.92
Airbus A319-100 Series	CFM56-5A5	147	AC ACA	23.92
Airbus A319-100 Series	CFM56-5A5	3,180	AC DAL	23.92
Airbus A319-100 Series	CFM56-5B5/P	171	AC Frontier	23.92
Airbus A319-100 Series	V2524-A5	1,104	AC Spirit	23.92
Airbus A319-100 Series	V2522-A5	1,214	AC UAL	23.92
Airbus A319-100 Series	CFM56-5B6/P	8,991	AC USA	23.92
Airbus A319-100 Series	CFM56-5B6/P	781	AC Virgin America	23.92
Airbus A320-200 Series	CFM56-5-A1	21	AC ACA	23.92
Airbus A320-200 Series	CFM56-5A3	2,468	AC DAL	23.92
Airbus A320-200 Series	V2527-A5	26,657	AC JBU	23.92
Airbus A320-200 Series	V2527-A5	578	AC Spirit	23.92
Airbus A320-200 Series	V2527-A5	2,308	AC UAL	23.92
Airbus A320-200 Series	CFM56-5B4/P	2,030	AC USA	23.92
Airbus A320-200 Series	V2527-A5	1,168	AC Virgin America	23.92
Airbus A321-100 Series	CFM56-5B3/P	1,607	AC USA	23.92
Airbus A330-200 Series	CF6-80E1A4 Low emissions	209	AC AZA	23.92
Airbus A330-200 Series	CF6-80E1A2 1862M39	191	AC EIN	23.92
Airbus A330-300 Series	PW4168A Talon II	346	AC DAL	23.92
Airbus A330-300 Series	PW4168A Talon II	157	AC DLH	23.92
Airbus A330-300 Series	CF6-80E1A4 Standard	448	AC EIN	23.92
Airbus A330-300 Series	Trent 772 Improved traverse	151	AC SWR	23.92
Airbus A330-300 Series	PW4168A Talon II	4	AC USA	23.92
Airbus A330-300 Series	Trent 772 Improved traverse	30	AC VIR	23.92
Airbus A340-300 Series	CFM56-5C2	135	AC AFR	23.92
Airbus A340-300 Series	CFM56-5C4/P SAC	290	AC DLH	23.92
Airbus A340-300 Series	CFM56-5C4/P SAC	203	AC Iberia	23.92
Airbus A340-300 Series	CFM56-5C4	207	AC SWR	23.92
Airbus A340-300 Series	CFM56-5C4/P SAC	70	AC VIR	23.92
Airbus A340-600 Series	Trent 556-61 Phase 5 tiled	148	AC DLH	23.92
Airbus A340-600 Series	Trent 556-61 Phase 5 tiled	17	AC Iberia	23.92
Airbus A340-600 Series	Trent 556-61 Phase 5 tiled	255	AC VIR	23.92
Boeing 717-200 Series	BR700-715A1-30	4,376	AC TRS	23.92
Boeing 737-300 Series	CFM56-3-B1	596	AC SWA	23.92
Boeing 737-300 Series	CFM56-3-B1	55	AC USA	23.92
Boeing 737-400 Series	CFM56-3B-2	9	AC Miami Air (charter)	23.92
Boeing 737-400 Series	CFM56-3B-2	7	AC Swift Air (charter)	23.92
Boeing 737-400 Series	CFM56-3B-2	666	AC USA	23.92
Boeing 737-400 Series	CFM56-3C-1	12	AC XTRA (charter)	23.92
Boeing 737-500 Series	CFM56-3C-1	3	AC COA	23.92
Boeing 737-500 Series	CFM56-3-B1	395	AC SWA	23.92
Boeing 737-500 Series	CFM56-3C-1	1,265	AC UAL	23.92
Boeing 737-700 Series	CFM56-7B26/2	18	AC DAL	23.92
Boeing 737-700 Series	CFM56-7B22	207	AC Sun Country	23.92
Boeing 737-700 Series	CFM56-7B24	5,322	AC SWA	23.92

Table I-4 2012 Fleet Mix, Annual Landing-and-Takeoff Cycles (LTOs), and Taxi/Delay Time-in-Mode by Aircraft Type (Continued)

Aircraft Type	Engine	LTOs	Description (Airline)	Taxi Times
Air Carrier Aircraft (Cont'd.)				
Boeing 737-700 Series	CFM56-7B22	1,065	AC TRS	23.92
Boeing 737-700 Series	CFM56-7B24	564	AC UAL	23.92
Boeing 737-800 Series	CFM56-7B26	5,701	AC AAL	23.92
Boeing 737-800 Series	CFM56-7B26	924	AC ASA	23.92
Boeing 737-800 Series	CFM56-7B26	3	AC COA	23.92
Boeing 737-800 Series	CFM56-7B26	1,692	AC DAL	23.92
Boeing 737-800 Series	CFM56-7B26	55	AC Miami Air (charter)	23.92
Boeing 737-800 Series	CFM56-7B26	91	AC Sun Country	23.92
Boeing 737-800 Series	CFM56-7B26	79	AC SWA	23.92
Boeing 737-800 Series	CFM56-7B26	2,674	AC UAL	23.92
Boeing 737-900 Series	CFM56-7B26	12	AC ASA	23.92
Boeing 737-900 Series	CFM56-7B26	1,143	AC UAL	23.92
Boeing 747-400 Series	PW4056 Reduced emissions	352	AC AFR	23.92
Boeing 747-400 Series	RB211-524H	614	AC BAW	23.92
Boeing 747-400 Series	CF6-80C2B1F 1862M39	296	AC DLH	23.92
Boeing 747-400 Series	PW4056 Reduced emissions	2	AC UAL	23.92
Boeing 757-200 Series	RB211-535E4B Phase 5	5,569	AC AAL	23.92
Boeing 757-200 Series	PW2037	1,847	AC DAL	23.92
Boeing 757-200 Series	RB211-535E4	469	AC ICE	23.92
Boeing 757-200 Series	RB211-535E4 Phase 5	5	AC Other Charter (international)	23.92
Boeing 757-200 Series	PW2037	117	AC TACV-Cabo Verde	23.92
Boeing 757-200 Series	PW2037	3,617	AC UAL	23.92
Boeing 757-200 Series	RB211-535E4	11	AC USA	23.92
Boeing 757-300 Series	PW2040	14	AC DAL	23.92
Boeing 767-200 Series	CF6-80A1	20	AC AAL	23.92
Boeing 767-200 Series	CF6-80C2B2 1862M39	6	AC USA	23.92
Boeing 767-300 Series	CF6-80C2B6 1862M39	109	AC AAL	23.92
Boeing 767-300 Series	CF6-80C2B6 1862M39	56	AC AZA	23.92
Boeing 767-300 Series	CF6-80A2	297	AC DAL	23.92
Boeing 767-300 Series	CF6-80A2	13	AC Other Charter (domestic)	23.92
Boeing 767-300 Series	PW4060 Reduced emissions	29	AC UAL	23.92
Boeing 767-400 ER	CF6-80C2B7F 1862M39	322	AC DAL	23.92
Boeing 767-400 ER	CF6-80C2B8FA 1862M39	237	AC JAL	23.92
Boeing 777-200 Series	Trent 892	2	AC AAL	23.92
Boeing 777-200 Series	GE90-90B DAC I	461	AC BAW	23.92
Boeing 777-200 Series	PW4077	8	AC UAL	23.92
Boeing DC-9-30 Series	JT8D-9 series Reduced emissions	8	AC USA Jet (charter)	23.92
Boeing DC-9-50 Series	JT8D-17 Reduced emissions	30	AC DAL	23.92
Boeing MD-82	JT8D-217 Environ. Kit (E_Kit)	21	AC AAL	23.92
Boeing MD-83	JT8D-219 Environ. Kit (E_Kit)	17	AC AAL	23.92
Boeing MD-83	JT8D-219 Environ. Kit (E_Kit)	15	AC USA Jet (charter)	23.92
Boeing MD-88	JT8D-219 Environ. Kit (E_Kit)	1,677	AC DAL	23.92
Boeing MD-90	V2525-D5	1,016	AC DAL	23.92
Embraer ERJ135	AE3007A1/3 Type 3 (red. emiss)	5	AC Swift Air (charter)	23.92
Embraer ERJ170	CF34-8E5A1 LEC	1,790	AC ACA	23.92
Embraer ERJ190	CF34-10E5A1 SAC	309	AC ACA	23.92
Embraer ERJ190	CF34-10E6 SAC	7,900	AC JBU	23.92
Embraer ERJ190	CF34-10E6 SAC	5,022	AC USA	23.92
Total Air Carrier Aircraft LTOs		**114,709**		

Table I-4 2012 Fleet Mix, Annual Landing-and-Takeoff Cycles (LTOs), and Taxi/Delay Time-in-Mode by Aircraft Type (Continued)

Aircraft Type	Engine	LTOs	Description (Airline)	Taxi Times
Cargo Aircraft				
Airbus A300F4-600 Series	CF6-80C2A5F 1862M39	220	Cargo FDX	23.92
Airbus A300F4-600 Series	PW4158 Reduced smoke	397	Cargo UPS	23.92
Airbus A310-200 Series	JT9D-7R4E, -7R4E1	21	Cargo FDX	23.92
ATR 42-300	PW120	2	Cargo Mountain Air Cargo	23.92
Boeing 727-200 Series	JT8D-15 Reduced emissions	124	Cargo FDX	23.92
Boeing 757-200 Series	RB211-535E4	111	Cargo FDX	23.92
Boeing 757-200 Series	PW2040	59	Cargo UPS	23.92
Boeing 767-200 Series	CF6-80A	144	Cargo ABX Air	23.92
Boeing 767-300 ER	CF6-80C2B6F	228	Cargo UPS	23.92
Boeing DC-10-10 Series	CF6-6D	889	Cargo FDX	23.92
Boeing DC-8 Series 70	CFM56-2-C5	110	Cargo DHL Airways	23.92
Boeing MD-11	CF6-80C2D1F 1862M39	97	Cargo FDX	23.92
Bombardier Learjet 35	TFE731-2-2B	1	Cargo Royal Air Freight	23.92
Cessna 208 Caravan	PT6A-114	208	Cargo Wiggins	23.92
Raytheon Beech 99	PT6A-36	5	Cargo Wiggins	23.92
Total Cargo Aircraft LTOs		**2,616**		
Commuter Aircraft				
Airbus A319-100 Series	CFM56-5A5	1,671	Comm JZA	23.92
Bombardier CRJ-100	CF34-3A1 LEC II	51	Comm Delta (Comair)	23.92
Bombardier CRJ-100	CF34-3B	397	Comm JZA	23.92
Bombardier CRJ-200	CF34-3B	7	Comm Atlantic Southeast Airlines	23.92
Bombardier CRJ-200	CF34-3B	1,580	Comm Delta (Pinnacle)	23.92
Bombardier CRJ-200	CF34-3B	654	Comm JZA	23.92
Bombardier CRJ-200	CF34-3B	3,333	Comm US Air Express (Air Wis.)	23.92
Bombardier CRJ-700	CF34-8C1	768	Comm Atlantic Southeast Airlines	23.92
Bombardier CRJ-700	CF34-8C1	1,873	Comm Delta (Comair)	23.92
Bombardier CRJ-700	CF34-8C1	9	Comm Mesa	23.92
Bombardier CRJ-900	CF34-8C5 LEC	43	Comm Atlantic Southeast Airlines	23.92
Bombardier CRJ-900	CF34-8C5 LEC	902	Comm Delta (Comair)	23.92
Bombardier CRJ-900	CF34-8C5 LEC	11	Comm Delta (Mesaba)	23.92
Bombardier CRJ-900	CF34-8C5 LEC	1,010	Comm Delta (Pinnacle)	23.92
Bombardier CRJ-900	CF34-8C5 LEC	98	Comm JZA	23.92
Bombardier de Havilland Dash 8 Q100	PW120A	187	Comm JZA	23.92
Bombardier de Havilland Dash 8 Q100	PW120A	1,214	Comm US Airways (Piedmont)	23.92
Bombardier de Havilland Dash 8 Q300	PW123	32	Comm JZA	23.92
Bombardier de Havilland Dash 8 Q400	PW150A	220	Comm Colgan	23.92
Bombardier de Havilland Dash 8 Q400	PW150A	505	Comm JZA	23.92
Bombardier de Havilland Dash 8 Q400	PW150A	1,862	Comm Porter Airlines (Canadian)	23.92
Cessna 402	TIO-540-J2B2	18,592	Comm Hyannis Air Service	23.92
Cessna 750 Citation X	AE3007C1 Type 2	86	Comm Delta (Comair)	23.92
Embraer ERJ135	AE3007A1/3 Type 3 (red. emiss.)	2	Comm EGF	23.92
Embraer ERJ145	AE3007A1P Type 3 (red. emiss.)	437	Comm Atlantic Southeast Airlines	23.92
Embraer ERJ145	AE3007A1E Type 3	1,544	Comm Chautaugua	23.92
Embraer ERJ145	AE3007A1E Type 3	508	Comm Trans States	23.92
Embraer ERJ145-XR	AE3007A1E Type 3	157	Comm Atlantic Southeast Airlines	23.92
Embraer ERJ170	CF34-8E5 LEC	287	Comm Delta (Compass Airlines)	23.92
Embraer ERJ170	CF34-8E5 LEC	1,671	Comm Republic Airlines	23.92

Table I-4 2012 Fleet Mix, Annual Landing-and-Takeoff Cycles (LTOs), and Taxi/Delay Time-in-Mode by Aircraft Type (Continued)

Aircraft Type	Engine	LTOs	Description (Airline)	Taxi Times
Commuter Aircraft (Cont'd.)				
Embraer ERJ170	CF34-8E5 LEC	4089	Comm Shuttle America	23.92
Embraer ERJ190	CF34-10E6 SAC	1	Comm Republic Airlines	23.92
Saab 340-B-Plus	CT7-9B	1069	Comm Colgan	23.92
Saab 340-B-Plus	CT7-9B	1134	Comm Peninsula Air	23.92
Total Commuter Aircraft LTOs		**46,004**		
General Aviation Aircraft				
Airbus A319-100 Series	CFM56-5B6/P	570	GA	23.92
Airbus A320-200 Series	V2527-A5	857	GA	23.92
Boeing 737-700 Series	CFM56-7B22	298	GA	23.92
Boeing 737-800 Series	CFM56-7B26	380	GA	23.92
Boeing 757-200 Series	PW2037	340	GA	23.92
Bombardier Challenger 300	AE3007A1 Type 2	405	GA	23.92
Bombardier Challenger 300	AE3007A1 Type 2	161	GA Bombardier Business Jet	23.92
Bombardier Challenger 300	AE3007A1 Type 2	12	GA Executive Jet	23.92
Bombardier Challenger 600	CF34-3B	767	GA	23.92
Bombardier Challenger 600	ALF 502L-2	42	GA Bombardier Business Jet	23.92
Bombardier Challenger 600	CF34-3B	26	GA Delta Air Elite Business Jets	23.92
Bombardier Challenger 600	ALF 502L-2	20	GA Executive Jet	23.92
Bombardier Learjet 35	TFE731-2-2B	296	GA	23.92
Bombardier Learjet 40	TFE731-2-2B	85	GA Bombardier Business Jet	23.92
Bombardier Learjet 45	TFE731-2-2B	301	GA	23.92
Bombardier Learjet 45	TFE731-2-2B	37	GA Bombardier Business Jet	23.92
Bombardier Learjet 60	TFE731-2/2A	287	GA	23.92
Bombardier Learjet 60	TFE731-2/2A	35	GA Bombardier Business Jet	23.92
Bombardier Learjet 60	PW306A Annular	21	GA Delta Air Elite Business Jets	23.92
Cessna 172 Skyhawk	TSIO-360C	18	GA Angel Flight	23.92
Cessna 182	IO-360-B	52	GA Angel Flight	23.92
Cessna 525 CitationJet	JT15D-1 series	24	GA General Aviation Flying Service	23.92
Cessna 550 Citation II	JT15D-4 series	414	GA	23.92
Cessna 560 Citation V	PW530	31	GA Flight Options	23.92
Cessna 750 Citation X	AE3007C Type 1	392	GA	23.92
Cessna 750 Citation X	AE3007C1 Type 2	23	GA Delta Air Elite Business Jets	23.92
Cessna 750 Citation X	AE3007C Type 1	9	GA Executive Jet	23.92
Cessna 750 Citation X	AE3007C Type 1	58	GA Flight Options	23.92
Cessna 750 Citation X	AE3007C Type 1	377	GA Netjets Aviation	23.92
Cirrus SR22	TIO-540-J2B2	23	GA Air Care Alliance	23.92
Cirrus SR22	TIO-540-J2B2	24	GA Angel Flight	23.92
Dassault Falcon 2000	PW308C Annular	567	GA	23.92
Dassault Falcon 2000	PW308C Annular	178	GA Netjets Aviation	23.92
Dassault Falcon 50	TFE731-3	16	GA Executive Jet	23.92
Dassault Falcon 900	TFE731-3	299	GA	23.92
Dassault Falcon 900	TFE731-3	19	GA Executive Jet	23.92
Embraer ERJ135	AE3007A1/3 Type 3 (red. emiss.)	15	GA Executive Jet	23.92
Embraer ERJ135	AE3007A1/3 Type 3 (red. emiss.)	27	GA Flight Options	23.92
Embraer ERJ190	CF34-10E6 SAC	652	GA	23.92
Gulfstream G400	TAY Mk611-8	1,082	GA	23.92
Gulfstream G400	TAY Mk611-8	52	GA Executive Jet	23.92
Gulfstream G400	TAY Mk611-8	30	GA General Aviation Flying Service	23.92
Gulfstream G400	TAY Mk611-8	11	GA Talon Air	23.92

Table I-4 2012 Fleet Mix, Annual Landing-and-Takeoff Cycles (LTOs), and Taxi/Delay Time-in-Mode by Aircraft Type (Continued)

Aircraft Type	Engine	LTOs	Description (Airline)	Taxi Times
General Aviation Aircraft (Cont'd.)				
Gulfstream G500	BR700-710A1-10	690	GA	23.92
Gulfstream G500	BR700-710A1-10	29	GA Executive Jet	23.92
Israel IAI-1126 Galaxy	PW306A Annular	27	GA Executive Jet	23.92
Israel IAI-1126 Galaxy	PW306A Annular	159	GA Netjets Aviation	23.92
Mooney M20-K	TSIO-360C	28	GA Angel Flight	23.92
Piaggio P.180 Avanti	PT6A-66	197	GA Wanair	23.92
Pilatus PC-12	PT6A-67B	1,188	GA	23.92
Pilatus PC-12	PT6A-67B	19	GA Air Care Alliance	23.92
Piper PA-31 Navajo	TIO-540-J2B2	16	GA Angel Flight	23.92
Piper PA-32 Cherokee Six	TIO-540-J2B2	40	GA Angel Flight	23.92
Piper PA-34 Seneca	IO-360-B	18	GA Angel Flight	23.92
Raytheon Beech Baron 58	TIO-540-J2B2	15	GA Angel Flight	23.92
Raytheon Beech Bonanza 36	TIO-540-J2B2	46	GA Angel Flight	23.92
Raytheon Beechjet 400	JT15D-5, -5A, -5B	681	GA	23.92
Raytheon Beechjet 400	JT15D-5, -5A, -5B	15	GA Delta Air Elite Business Jets	23.92
Raytheon Beechjet 400	JT15D-5, -5A, -5B	142	GA Flight Options	23.92
Raytheon Beechjet 400	JT15D-5, -5A, -5B	74	GA Netjets Aviation	23.92
Raytheon Beechjet 400	JT15D-5, -5A, -5B	30	GA Talon Air	23.92
Raytheon Hawker 4000 Horizon	PW308A Annular	88	GA Talon Air	23.92
Raytheon Hawker 800	TFE731-3	932	GA	23.92
Raytheon Hawker 800	TFE731-3	16	GA Executive Jet	23.92
Raytheon Hawker 800	TFE731-3	29	GA Flight Options	23.92
Raytheon Hawker 800	TFE731-3	36	GA General Aviation Flying Service	23.92
Raytheon Hawker 800	TFE731-3	212	GA Netjets Aviation	23.92
Raytheon Hawker 800	TFE731-3	14	GA Talon Air	23.92
Raytheon Super King Air 200	PT6A-42	14	GA Talon Air	23.92
Rockwell Commander 700	IO-360-B	22	GA Angel Flight	23.92
Total General Aviation Aircraft LTOs		**14,110**		
Total Fleet LTOs		**177,439**		

Source: KBE and Massport.

Notes: Due to rounding of the operations (1 LTO = 2 Operations) there may be some differences (+/-) between the values reported here and those reported in *Chapter 2, Activity Levels.*

Aircraft taxi times are based on Logan Airport data obtained from the FAA Aviation System Performance Metrics (ASPM) database for 2011.

Table I-5 2013 Fleet Mix, Annual Landing-and-Takeoff Cycles (LTOs), and Taxi/Delay Time-in-Mode by Aircraft Type

Aircraft Type	Engine	LTOs	Description (Airline)	Taxi Times
Air Carrier Aircraft				
Airbus A310-200 Series	CF6-80C2A2 1862M39	234	AC SATA	24.98
Airbus A319-100 Series	CFM56-5A5	36	AC ACA	24.98
Airbus A319-100 Series	CFM56-5A5	1,871	AC DAL	24.98
Airbus A319-100 Series	V2524-A5	836	AC Spirit	24.98
Airbus A319-100 Series	V2522-A5	1,510	AC UAL	24.98
Airbus A319-100 Series	CFM56-5B6/P	6,468	AC USA	24.98
Airbus A319-100 Series	CFM56-5B6/P	240	AC Virgin America	24.98
Airbus A320-200 Series	CFM56-5-A1	5	AC ACA	24.98
Airbus A320-200 Series	CFM56-5A3	3,154	AC DAL	24.98
Airbus A320-200 Series	V2527-A5	18,893	AC JBU	24.98
Airbus A320-200 Series	V2527-A5	525	AC Spirit	24.98
Airbus A320-200 Series	V2527-A5	2,284	AC UAL	24.98
Airbus A320-200 Series	CFM56-5B4/P	2,046	AC USA	24.98
Airbus A320-200 Series	V2527-A5	1,440	AC Virgin America	24.98
Airbus A321-100 Series	CFM56-5B3/P	2,090	AC USA	24.98
Airbus A330-200 Series	CF6-80E1A4 Low emissions	271	AC AZA	24.98
Airbus A330-200 Series	PW4168 Talon II	234	AC DAL	24.98
Airbus A330-200 Series	CF6-80E1A2 1862M39	269	AC EIN	24.98
Airbus A330-300 Series	PW4168A Talon II	351	AC DAL	24.98
Airbus A330-300 Series	PW4168A Talon II	126	AC DLH	24.98
Airbus A330-300 Series	CF6-80E1A4 Standard	488	AC EIN	24.98
Airbus A330-300 Series	CF6-80E1A4 Standard	22	AC Iberia	24.98
Airbus A330-300 Series	Trent 772 Improved traverse	166	AC SWR	24.98
Airbus A330-300 Series	PW4168A Talon II	7	AC USA	24.98
Airbus A330-300 Series	Trent 772 Improved traverse	192	AC VIR	24.98
Airbus A340-300 Series	CFM56-5C4/P	274	AC DLH	24.98
Airbus A340-300 Series	CFM56-5C4/P	162	AC Iberia	24.98
Airbus A340-300 Series	CFM56-5C4	194	AC SWR	24.98
Airbus A340-600 Series	Trent 556-61 Phase5 Tiled	249	AC DLH	24.98
Airbus A340-600 Series	Trent 556-61 Phase5 Tiled	18	AC Iberia	24.98
Airbus A340-600 Series	Trent 556-61 Phase5 Tiled	162	AC VIR	24.98
Boeing 717-200 Series	BR700-715A1-30	3,698	AC TRS	24.98
Boeing 727-200 Series	JT8D-9 series Reduced emissions	19	AC Other Charter (dom.)	24.98
Boeing 737-300 Series	CFM56-3-B1	1,594	AC SWA	24.98
Boeing 737-400 Series	CFM56-3B-2	29	AC Miami Air	24.98
Boeing 737-400 Series	CFM56-3B-2	55	AC Swift Air	24.98
Boeing 737-400 Series	CFM56-3B-2	121	AC USA	24.98
Boeing 737-500 Series	CFM56-3-B1	1	AC SWA	24.98
Boeing 737-500 Series	CFM56-3C-1	41	AC UAL	24.98
Boeing 737-700 Series	CFM56-7B24	169	AC Copa	24.98
Boeing 737-700 Series	CFM56-7B26/2	9	AC DAL	24.98
Boeing 737-700 Series	CFM56-7B22	333	AC Sun Country	24.98
Boeing 737-700 Series	CFM56-7B24	5,914	AC SWA	24.98
Boeing 737-700 Series	CFM56-7B22	184	AC TRS	24.98
Boeing 737-700 Series	CFM56-7B24	849	AC UAL	24.98

Table I-5 2013 Fleet Mix, Annual Landing-and-Takeoff Cycles (LTOs), and Taxi/Delay Time-in-Mode by Aircraft Type (Continued)

Aircraft Type	Engine	LTOs	Description (Airline)	Taxi Times
Air Carrier Aircraft (Cont'd.)				
Boeing 737-800 Series	CFM56-7B26 (8CM051)	7,210	AC AAL	24.98
Boeing 737-800 Series	CFM56-7B24	1,007	AC ASA	24.98
Boeing 737-800 Series	CFM56-7B26 (8CM051)	4	AC Copa	24.98
Boeing 737-800 Series	CFM56-7B26 (8CM051)	2,179	AC DAL	24.98
Boeing 737-800 Series	CFM56-7B26 (8CM051)	23	AC Miami Air	24.98
Boeing 737-800 Series	CFM56-7B27	139	AC Sun Country	24.98
Boeing 737-800 Series	CFM56-7B26 (8CM051)	460	AC SWA	24.98
Boeing 737-800 Series	CFM56-7B26 (8CM051)	3,206	AC UAL	24.98
Boeing 737-900 Series	CFM56-7B27	324	AC ASA	24.98
Boeing 737-900 Series	CFM56-7B26 (8CM051)	2,175	AC UAL	24.98
Boeing 747-400 Series	PW4056 Reduced smoke	279	AC AFR	24.98
Boeing 747-400 Series	RB211-524H	539	AC BAW	24.98
Boeing 747-400 Series	CF6-80C2B1F 1862M39	214	AC DLH	24.98
Boeing 747-400 Series	CF6-80C2B1F 1862M39	2	AC VIR	24.98
Boeing 757-200 Series	RB211-535E4B Phase 5	4,212	AC AAL	24.98
Boeing 757-200 Series	PW2037 (4PW072)	1,683	AC DAL	24.98
Boeing 757-200 Series	RB211-535E4 (3RR028)	534	AC ICE	24.98
Boeing 757-200 Series	PW2037 (4PW072)	107	AC TACV-Cabo Verde	24.98
Boeing 757-200 Series	PW2037 (4PW072)	2,533	AC UAL	24.98
Boeing 757-200 Series	RB211-535E4 (3RR028)	12	AC USA	24.98
Boeing 757-300 Series	PW2040 (4PW073)	2	AC DAL	24.98
Boeing 757-300 Series	RB211-535E4B Phase 5	26	AC ICE	24.98
Boeing 767-200 Series	CF6-80A1	12	AC AAL	24.98
Boeing 767-200 Series	CF6-80C2B2 1862M39	2	AC USA	24.98
Boeing 767-300 Series	CF6-80C2B6 1862M39	28	AC AAL	24.98
Boeing 767-300 Series	CF6-80C2B6 1862M39	1	AC ACA	24.98
Boeing 767-300 Series	CF6-80A2	309	AC DAL	24.98
Boeing 767-300 Series	PW4060 Reduced smoke	10	AC UAL	24.98
Boeing 767-400 ER	CF6-80C2B7F 1862M39	95	AC DAL	24.98
Boeing 767-400 ER	CF6-80C2B8FA	7	AC UAL	24.98
Boeing 777-200 Series	Trent 892	2	AC AAL	24.98
Boeing 777-200 Series	GE90-90B DAC I	201	AC AFR	24.98
Boeing 777-200 Series	GE90-90B DAC I	736	AC BAW	24.98
Boeing 777-200 Series	Trent 892	4	AC DAL	24.98
Boeing 777-200 Series	PW4077	96	AC Japan Airlines	24.98
Boeing 777-200 Series	PW4077	4	AC UAL	24.98
Boeing 777-300 ER	GE90-115B	12	AC BAW	24.98
Boeing 777-300 ER	GE90-115B	34	AC Other Charter (int'l.)	24.98
Boeing 787-8 Dreamliner	GEnx-1B64 TAPS	227	AC Japan Airlines	24.98
Boeing DC-9-50 Series	JT8D-17 Reduced emissions	6	AC DAL	24.98
Boeing MD-82	JT8D-217	11	AC AAL	24.98
Boeing MD-83	JT8D-219 Environ. Kit	16	AC AAL	24.98
Boeing MD-88	JT8D-219 Environ. Kit	1,020	AC DAL	24.98
Boeing MD-90	V2525-D5	1,091	AC DAL	24.98
Embraer ERJ170	CF34-8E5 LEC (8GE108)	725	AC ACA	24.98
Embraer ERJ190	CF34-10E5A1 SAC	108	AC ACA	24.98
Embraer ERJ190	CF34-10E6 SAC	20,863	AC JBU	24.98
Embraer ERJ190	CF34-10E6 SAC	7,158	AC USA	24.98
Total Air Carrier Aircraft LTOs		**117,481**		

Table I-5 2013 Fleet Mix, Annual Landing-and-Takeoff Cycles (LTOs), and Taxi/Delay Time-in-Mode by Aircraft Type (Continued)

Aircraft Type	Engine	LTOs	Description (Airline)	Taxi Times
Cargo Aircraft				
Airbus A300F4-600 Series	CF6-80C2A5F	220	Cargo FDX	24.98
Airbus A300F4-600 Series	PW4158	439	Cargo UPS	24.98
Airbus A310-200 Series	JT9D-7R4E, -7R4E1	7	Cargo FDX	24.98
ATR 42-300	PW120	6	Cargo Mountain Air Cargo	24.98
ATR 72-200	PW127	4	Cargo Mountain Air Cargo	24.98
Boeing 727-200 Series	JT8D-15 Reduced emissions	1	Cargo Cargojet (Canada)	24.98
Boeing 727-200 Series	JT8D-15 Reduced emissions	6	Cargo FDX	24.98
Boeing 757-200 Series	RB211-535E4 (3RR028)	250	Cargo FDX	24.98
Boeing 757-200 Series	PW2040 (4PW073)	50	Cargo UPS	24.98
Boeing 767-200 Series	CF6-80A	154	Cargo ABX Air	24.98
Boeing 767-200 Series	JT9D-7R4D, -7R4D1	102	Cargo Atlas Air	24.98
Boeing 767-300 ER	CF6-80C2B6F	215	Cargo UPS	24.98
Boeing DC-10-10 Series	CF6-6D	480	Cargo FDX	24.98
Boeing MD-11	CF6-80C2D1F 1862M39	556	Cargo FDX	24.98
Bombardier Challenger 300	AE3007A1 Type 2	3	Cargo FDX	24.98
Bombardier Challenger 600	CF34-3B	1	Cargo FDX	24.98
Bombardier Learjet 45	TFE731-2-2B	2	Cargo FDX	24.98
Cessna 208 Caravan	PT6A-114	1	Cargo Mountain Air Cargo	24.98
Cessna 208 Caravan	PT6A-114	206	Cargo Wiggins	24.98
Total Cargo Aircraft LTOs		**2,703**		
Commuter Aircraft				
Bombardier Challenger 600	CF34-3B	8	Comm Delta (Pinnacle)	24.98
Bombardier CRJ-100	CF34-3B	113	Comm JZA	24.98
Bombardier CRJ-200	CF34-3B	3	Comm Atlantic Southeast Airlines	24.98
Bombardier CRJ-200	CF34-3B	1,000	Comm Delta (Pinnacle)	24.98
Bombardier CRJ-200	CF34-3B	2,230	Comm JZA	24.98
Bombardier CRJ-200	CF34-3B	11	Comm SkyWest	24.98
Bombardier CRJ-200	CF34-3B	3,220	Comm US Airways (Air Wis.)	24.98
Bombardier CRJ-700	CF34-8C1	1,317	Comm Atlantic Southeast Airlines	24.98
Bombardier CRJ-700	CF34-8C1	442	Comm Mesa	24.98
Bombardier CRJ-700	CF34-8C5 LEC (8GE110)	223	Comm SkyWest	24.98
Bombardier CRJ-900	CF34-8C5 LEC (8GE110)	561	Comm Atlantic Southeast Airlines	24.98
Bombardier CRJ-900	CF34-8C5 LEC (8GE110)	1,906	Comm Delta (Pinnacle)	24.98
Bombardier CRJ-900	CF34-8C5 LEC (8GE110)	222	Comm JZA	24.98
Bombardier de Havilland Dash 8 Q100	PW120A	357	Comm JZA	24.98
Bombardier de Havilland Dash 8 Q100	PW120A	975	Comm US Airways (Piedmont)	24.98
Bombardier de Havilland Dash 8 Q300	PW123	81	Comm JZA	24.98
Bombardier de Havilland Dash 8 Q400	PW150A	208	Comm JZA	24.98
Bombardier de Havilland Dash 8 Q400	PW150A	1,866	Comm Porter Airlines	24.98
Bombardier de Havilland Dash 8 Q400	PW150A	109	Comm Republic Airlines	24.98
Cessna 402	TIO-540-J2B2	18,597	Comm Hyannis Air Service	24.98
Embraer ERJ135	AE3007A1/3 Type 3 (red. emiss.)	1	Comm EGF	24.98
Embraer ERJ145	AE3007A1P Type 3 (red. emiss.)	378	Comm Atlantic Southeast Airlines	24.98
Embraer ERJ145	AE3007A1E	1,693	Comm Chautaugua	24.98
Embraer ERJ145	AE3007A1E	1	Comm EGF	24.98
Embraer ERJ145	AE3007A1E	91	Comm Trans States	24.98
Embraer ERJ145-XR	AE3007A1E	113	Comm Atlantic Southeast Airlines	24.98

Table I-5 2013 Fleet Mix, Annual Landing-and-Takeoff Cycles (LTOs), and Taxi/Delay Time-in-Mode by Aircraft Type (Continued)

Aircraft Type	Engine	LTOs	Description (Airline)	Taxi Times
Commuter Aircraft (Cont'd.)				
Embraer ERJ170	CF34-8E5 LEC (8GE108)	1,571	Comm Air Canada Express	24.98
Embraer ERJ170	CF34-8E5 LEC (8GE108)	7	Comm Delta (Compass)	24.98
Embraer ERJ170	CF34-8E5 LEC (8GE108)	1,596	Comm Republic Airlines	24.98
Embraer ERJ170	CF34-8E5 LEC (8GE108)	6,024	Comm Shuttle America	24.98
Embraer ERJ190	CF34-10E6 SAC	29	Comm Republic Airlines	24.98
Saab 340-B-Plus	CT7-9B	2,192	Comm Peninsula Air	24.98
Total Commuter Aircraft LTOs		**47,145**		
General Aviation Aircraft				
Bombardier Challenger 300	AE3007A1 Type 2	479	GA	24.98
Bombardier Challenger 300	AE3007A1 Type 2	149	GA Bombardier Business Jet	24.98
Bombardier Challenger 300	AE3007A1 Type 2	26	GA Executive Jet	24.98
Bombardier Challenger 300	AE3007A1 Type 2	44	GA Xojet	24.98
Bombardier Challenger 600	CF34-3B	665	GA	24.98
Bombardier Challenger 600	ALF 502L-2	36	GA Bombardier Business Jet	24.98
Bombardier Challenger 600	ALF 502L-2	26	GA Executive Jet	24.98
Bombardier Learjet 35	TFE731-2-2B	235	GA	24.98
Bombardier Learjet 40	TFE731-2-2B	95	GA Bombardier Business Jet	24.98
Bombardier Learjet 45	TFE731-2-2B	275	GA	24.98
Bombardier Learjet 45	TFE731-2-2B	37	GA Bombardier Business Jet	24.98
Bombardier Learjet 45	TFE731-2-2B	10	GA Executive Jet	24.98
Bombardier Learjet 60	TFE731-2/2A	277	GA	24.98
Bombardier Learjet 60	TFE731-2/2A	47	GA Bombardier Business Jet	24.98
Cessna 172 Skyhawk	TSIO-360C	28	GA Angel Flight	24.98
Cessna 182	IO-360-B	46	GA Angel Flight	24.98
Cessna 414	TIO-540-J2B2	268	GA	24.98
Cessna 525 CitationJet	JT15D-1 series	117	GA Superior Air	24.98
Cessna 550 Citation II	JT15D-4 series (1PW036)	354	GA	24.98
Cessna 560 Citation Excel	JT15D-5, -5A, -5B	381	GA	24.98
Cessna 560 Citation Excel	JT15D-5, -5A, -5B	792	GA Netjets Aviation	24.98
Cessna 560 Citation V	JT15D-5, -5A, -5B	357	GA	24.98
Cessna 560 Citation V	PW530	94	GA Flight Options	24.98
Cessna 560 Citation V	PW530	249	GA Netjets Aviation	24.98
Cessna 560 Citation V	JT15D-5, -5A, -5B	11	GA Superior Air	24.98
Cessna 680 Citation Sovereign	PW308C	256	GA	24.98
Cessna 680 Citation Sovereign	PW308C	38	GA Executive Jet	24.98
Cessna 680 Citation Sovereign	PW308C	359	GA Netjets Aviation	24.98
Cessna 750 Citation X	AE3007C Type 2	251	GA	24.98
Cessna 750 Citation X	AE3007C Type 2	10	GA Executive Jet	24.98
Cessna 750 Citation X	AE3007C Type 2	51	GA Flight Options	24.98
Cessna 750 Citation X	AE3007C Type 2	488	GA Netjets Aviation	24.98
Cessna 750 Citation X	AE3007C Type 2	77	GA Xojet	24.98
Cirrus SR22	TIO-540-J2B2	259	GA	24.98
Cirrus SR22	TIO-540-J2B2	16	GA Angel Flight	24.98
Dassault Falcon 2000	PW308C	646	GA	24.98
Dassault Falcon 2000	PW308C	210	GA Netjets Aviation	24.98
Dassault Falcon 50	TFE731-3	15	GA Executive Jet	24.98
Dassault Falcon 900	TFE731-3	345	GA	24.98
Embraer ERJ135	AE3007A1/3 Type 3 (red. emiss.)	29	GA Flight Options	24.98
Gulfstream G400	TAY Mk611-8	839	GA	24.98

Table I-5 2013 Fleet Mix, Annual Landing-and-Takeoff Cycles (LTOs), and Taxi/Delay Time-in-Mode by Aircraft Type (Continued)

Aircraft Type	Engine	LTOs	Description (Airline)	Taxi Times
General Aviation Aircraft (Cont'd.)				
Gulfstream G400	TAY Mk611-8	49	GA Executive Jet	24.98
Gulfstream G400	TAY Mk611-8	121	GA Netjets Aviation	24.98
Gulfstream G400	TAY Mk611-8	13	GA Talon Air	24.98
Gulfstream G500	BR700-710A1-10 (4BR008)	572	GA	24.98
Gulfstream G500	BR700-710A1-10 (4BR008)	33	GA Executive Jet	24.98
Gulfstream G500	BR700-710A1-10 (4BR008)	36	GA Netjets Aviation	24.98
Israel IAI-1126 Galaxy	PW306A	23	GA Executive Jet	24.98
Israel IAI-1126 Galaxy	PW306A	175	GA Netjets Aviation	24.98
Mooney M20-K	TSIO-360C	12	GA Angel Flight	24.98
Pilatus PC-12	PT6A-67B	224	GA	24.98
Pilatus PC-12	PT6A-67B	652	GA Cobalt Air	24.98
Piper PA-31 Navajo	TIO-540-J2B2	11	GA Angel Flight	24.98
Piper PA-32 Cherokee Six	TIO-540-J2B2	32	GA Angel Flight	24.98
Piper PA-34 Seneca	IO-360-B	11	GA Angel Flight	24.98
Raytheon Beech Baron 58	TIO-540-J2B2	16	GA Angel Flight	24.98
Raytheon Beech Bonanza 36	TIO-540-J2B2	44	GA Angel Flight	24.98
Raytheon Beechjet 400	JT15D-5, -5A, -5B	407	GA	24.98
Raytheon Beechjet 400	JT15D-5, -5A, -5B	109	GA Flight Options	24.98
Raytheon Beechjet 400	JT15D-5, -5A, -5B	56	GA Netjets Aviation	24.98
Raytheon Beechjet 400	JT15D-5, -5A, -5B	15	GA Talon Air	24.98
Raytheon Beechjet 400	JT15D-5, -5A, -5B	197	GA Traffic Management Co.	24.98
Raytheon Hawker 4000 Horizon	PW308A	122	GA Talon Air	24.98
Raytheon Hawker 800	TFE731-3	796	GA	24.98
Raytheon Hawker 800	TFE731-3	20	GA Executive Jet	24.98
Raytheon Hawker 800	TFE731-3	15	GA Flight Options	24.98
Raytheon Hawker 800	TFE731-3	194	GA Netjets Aviation	24.98
Raytheon Hawker 800	TFE731-3	9	GA Talon Air	24.98
Raytheon Hawker 800	TFE731-3	153	GA Traffic Management Co.	24.98
Raytheon Super King Air 300	PT6A-60A	218	GA	24.98
Rockwell Commander 700	IO-360-B	19	GA Angel Flight	24.98
Total General Aviation Aircraft LTOs		**13,341**		
Total Fleet LTOs		**180,670**		

Source: KBE and Massport.
Notes: Due to rounding of the operations (1 LTO = 2 Operations) there may be some differences (+/-) between the values reported here and those reported in *Chapter 2, Activity Levels.*
Aircraft taxi times are based on the Total Airspace and Airport Modeler (TAAM).

Ground Service Equipment/Alternative Fuels Conversion

For the 2012/2013 analyses, GSE emissions were calculated using EDMS emission factors which are based on the EPA NONROAD2005 model in combination with the GSE time-in-mode survey and the GSE fuel types obtained from the Logan Airport Vehicle Aerodrome Permit Application as part of the *2011 ESPR*. In this way, the most up-to-date GSE fleet operational, conversion, and emissions characteristics are used.

Table I-6 Ground Service Equipment Alternative Fuel Conversion Summary (kg/day)

Year	Pollutant	Percent Reduction	Calculated Emissions without Reduction	Reduction from AFVs	Calculated Emissions with Reduction
2000	Volatile Organic Compounds (VOCs)	13.72%	178	24	154
	Oxides of Nitrogen (NO_x)	9.87%	369	36	333
	Carbon Monoxide (CO)	12.88%	6,124	789	5,335
2001	VOCs	13.72%	166	23	143
	NO_x	9.87%	338	33	305
	CO	12.88%	5,960	768	5,193
2002	VOCs	13.6%	286	39	247
	NO_x	8.0%	350	28	322
	CO	16.3%	6,174	1,004	5,170
2003	VOCs	13.8%	263	36	227
	NO_x	8.0%	316	25	291
	CO	16.4%	5,692	934	4,758
2004	VOCs	11.9%	212	25	187
	NO_x	6.6%	357	24	333
	CO	15.4%	4,236	650	3,586
2005	VOCs	12.2%	203	25	178
	NO_x	6.9%	335	23	312
	CO	15.4%	4,175	643	3,531
	$PM_{10}/PM_{2.5}$	9.9%	11	1	10
2006	VOCs	10.7%	86	9	77
	NO_x	7.5%	324	24	300
	CO	13.8%	1,841	255	1,586
	$PM_{10}/PM_{2.5}$	10.8%	10	1	9
2007	VOCs	8.2%	85	7	78
	NO_x	5.1%	315	16	299
	CO	10.4%	2,124	220	1,904
	$PM_{10}/PM_{2.5}$	5.9%	10	<1	10
2008	VOCs	8.3%	72	6	66
	NO_x	4.8%	270	13	257
	CO	10.2%	1,792	183	1,609
	$PM_{10}/PM_{2.5}$	5.6%	16	<1	15
2009	VOCs	8.2%	61	5	56
	NO_x	4.8%	230	11	219
	CO	10.0%	1,516	152	1364
	$PM_{10}/PM_{2.5}$	3.5%	14	<1	14

Table I-6 Ground Service Equipment Alternative Fuel Conversion Summary (kg/day) (Continued)					
Year	Pollutant	Percent Reduction	Calculated Emissions without Reduction	Reduction from AFVs	Calculated Emissions with Reduction
2010	VOCs	7.5%	53	4	49
	NO_x	3.9%	206	8	198
	CO	8.5%	1,335	113	1,222
	$PM_{10}/PM_{2.5}$	2.5%	13	<1	13
2011	VOCs	13.2%	38	5	33
	NO_x	7.5%	188	14	173
	CO	16.7%	834	139	694
	$PM_{10}/PM_{2.5}$	5.5%	14	1	13
2012	VOCs	11.8%	34	4	30
	NO_x	6.8%	176	12	164
	CO	16.3%	738	120	618
	$PM_{10}/PM_{2.5}$	4.9%	13	<1	13
2013	VOCs	10.3%	29	3	26
	NO_x	6.5%	155	10	145
	CO	15.9%	634	101	533
	$PM_{10}/PM_{2.5}$	5.0%	12	<1	12

Source: KBE and Massport.

Notes: 2000 and 2001 analyses used EDMS v4.03. 2002 and 2003 analyses used EDMS v4.11, which used updated emission factors from the NONROAD2002 Model.
2004 analyses used EDMS v4.21, which again used emission factors from the EPA NONROAD2002 Model. 2005 analysis used EDMS v4.5, which used emission factors from the EPA NONROAD2002 Model. 2006 analysis used EDMS v5.0.1, which used emission factors from the EPA NONROAD2005 Model. 2007 analysis used EDMS v5.0.2, which used emission factors from the EPA NONROAD2005 Model. 2008 analysis used EDMS v5.1, which used emission factors from the EPA NONROAD2005 Model. 2009 analysis used EDMS v5.1.2, which used emission factors from the EPA NONROAD2005 Model. 2010, 2011, and 2012 analysis used EDMS v5.1.3, which used emission factors from the EPA NONROAD2005 Model. 2013 used EDMS v5.1.4.1, which used emission factors from the EPA NONROAD2005 Model.

Motor Vehicle Emissions

The same methods used in the *2011 ESPR* were also employed to calculate motor vehicle emissions in this *2012/2013 EDR*. For the 2012 analysis, the motor vehicle emission factor model MOBILE6.2.03 was used. For the 2013 analysis, MOVES2010b was used because it became the EPA's replacement for MOBILE6.2.03[1]. In the *2012/2013 EDR*, the resultant emission factors were multiplied by average daily vehicle miles to calculate daily emissions. The on-airport traffic data are summarized in the vehicle miles traveled (VMT) analyses of *Appendix G, Ground Access.* Due to the new roadway configuration of the Ted Williams Tunnel, through-traffic no longer traverses Airport property. Therefore, as of 2003, emissions from these vehicles are no longer included as part of the Logan Airport emissions inventory. Further, MOBILE6.2.03 was used to obtain vehicle emissions at idle to estimate parking and curbside motor vehicle emissions.[2] Idling emissions are determined for a unit of time and multiplied by total idling time to reach the associated emissions. The input and output

1 The U.S. EPA MOVES model is an advancement to the former MOBILE6 model as it contains the most up-to-date emission factors, emission control measures, and other area-specific parameters for motor vehicle fleets nationwide (including the Boston area). For consistency with the Massachusetts State Implementation Plan (SIP), MOVES is also recommended for use by MassDEP when computing motor vehicle emission factors.

2 Idle emissions factors in grams per hour are determined by multiplying the emissions factors at 2.5 miles per hour by 2.5, in accordance with EPA guidance (*MOBILE6 Refers to Mobile5 User Information Sheet #5* EPA, July 30, 1993).

files of MOBILE6.2.03 for 2012 are included as Tables I-7 and I-8. The input and output files of MOVES2010b for 2013 are included as Tables I-9 and I-10.

Table I-7 MOBILE6.2.03 Input File for 2012

```
* Calendar Year 2012 Generic MOBILE6 input file for Mesoscale Build/No-Build Analyses
* Filename MA12_ALL.INP created by Craig Woleader, MADEP 617-348-4046, craig.woleader@state.ma.us and Marc Bennett, MADEP 617-292-5597,
marc.bennett@state.ma.us
* revised 12/2/05 to include actual diesel rebuild effects
* revised 12/17/08 to include new IM program for 2012
* revised 8/22/13 by Wayne Arner, KBE, for specific speeds
*
***************    Header Section    ***************
MOBILE6 INPUT FILE
*
PARTICULATES      :
POLLUTANTS        : HC CO NOX CO2
DATABASE OUTPUT   :
WITH FIELDNAMES   :
AGGREGATED OUTPUT  :
EMISSIONS TABLE   : MA12_MES.tb1 REPLACE
REPORT FILE       : MA12_MES.txt REPLACE
*
RUN DATA
***************    Run Section #1    ***************
> *** Summer 2012 ***

* Pollutant output format
EXPRESS HC AS VOC  :
EXPAND BUS EFS     :

* Mass. specific user inputs -- require external data file
REG DIST          : 2005_REG.D
I/M DESC FILE     : 09NEWIM.D

* Set Diesel Rebuild effects to 10% as per EPA
REBUILD EFFECTS   : 0.10

STAGE II REFUELING :
91 3 84. 84.

* Inputs for LEV II
94+ LDG IMP       : MA_LEV2.D
T2 EXH PHASE-IN   : LEV2EXH.D
T2 EVAP PHASE-IN  : LEV2EVAP.D
T2 CERT           : LEV2CERT.D

* Meteorological inputs
MIN/MAX TEMP      : 70.4 93.7

* Fuel inputs
FUEL RVP          : 6.8
FUEL PROGRAM      : 2 N
```

DIESEL FRACTIONS :

0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003
0.003	0.002	0.002	0.002	0.002	0.001	0.001	0.001	0.000	0.001
0.001	0.003	0.001	0.002	0.000					
0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001	0.001
0.001	0.002	0.002	0.003	0.003					
0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.001	0.001
0.001	0.002	0.002	0.003	0.003					
0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
0.005	0.005	0.005	0.006	0.005	0.012	0.012	0.017	0.015	0.014
0.016	0.017	0.014	0.018	0.016					
0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
0.005	0.005	0.005	0.006	0.005	0.012	0.012	0.017	0.015	0.014
0.016	0.017	0.014	0.018	0.016					
0.176	0.176	0.176	0.176	0.176	0.176	0.176	0.176	0.176	0.170
0.207	0.202	0.206	0.243	0.176	0.285	0.267	0.212	0.255	0.295
0.249	0.251	0.188	0.175	0.182					
0.385	0.385	0.385	0.385	0.385	0.385	0.385	0.385	0.385	0.407
0.433	0.467	0.464	0.480	0.375	0.472	0.480	0.366	0.400	0.344
0.285	0.333	0.314	0.253	0.208					
0.674	0.674	0.674	0.674	0.674	0.674	0.674	0.674	0.674	0.634
0.664	0.719	0.717	0.744	0.715	0.565	0.810	0.803	0.644	0.654
0.605	0.525	0.389	0.356	0.376					
0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.845
0.860	0.840	0.819	0.813	0.610	0.686	0.570	0.733	0.607	0.729
0.685	0.725	0.631	0.350	0.305					
0.884	0.884	0.884	0.884	0.884	0.884	0.884	0.884	0.884	0.840
0.887	0.931	0.917	0.914	0.923	0.901	0.908	0.898	0.903	0.876
0.804	0.844	0.782	0.702	0.679					
0.977	0.977	0.977	0.977	0.977	0.977	0.977	0.977	0.977	0.972
0.953	0.993	0.992	0.992	0.990	0.981	0.976	0.975	0.959	0.982
0.965	0.963	0.945	0.902	0.875					
0.972	0.972	0.972	0.972	0.972	0.972	0.972	0.972	0.972	0.955
0.984	0.995	0.992	0.991	0.995	0.993	0.993	0.995	0.992	0.986
0.995	0.981	0.993	0.971	0.982					
1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1.000	1.000	1.000	1.000	1.000					
0.786	0.786	0.786	0.786	0.786	0.786	0.786	0.786	0.786	0.917
0.884	0.925	0.968	0.961	0.972	0.985	0.971	0.941	0.905	0.965
0.940	0.907	0.964	0.609	0.880					

*************** Scenario Section ***************

SCENARIO RECORD : 2012 Idle Scenario - Summer (multiply g/mi by 2.5 mph to get g/hr)
CALENDAR YEAR : 2012
EVALUATION MONTH : 7
PARTICULATE EF : PMGZML.CSV PMGDR1.CSV PMGDR2.CSV PMDZML.CSV PMDDR1.CSV PMDDR2.CSV

```
PARTICLE SIZE      : 10
DIESEL SULFUR      : 15
AVERAGE SPEED      : 2.5 Arterial 0.0 100.0 0.0 0.0

SCENARIO RECORD    : 2012 5 mph - Summer
CALENDAR YEAR      : 2012
EVALUATION MONTH   : 7
PARTICULATE EF     : PMGZML.CSV  PMGDR1.CSV  PMGDR2.CSV  PMDZML.CSV  PMDDR1.CSV  PMDDR2.CSV
PARTICLE SIZE      : 10
DIESEL SULFUR      : 15
AVERAGE SPEED      : 5 Arterial 0.0 100.0 0.0 0.0

SCENARIO RECORD    : 2012 10 mph - Summer
CALENDAR YEAR      : 2012
EVALUATION MONTH   : 7
PARTICULATE EF     : PMGZML.CSV  PMGDR1.CSV  PMGDR2.CSV  PMDZML.CSV  PMDDR1.CSV  PMDDR2.CSV
PARTICLE SIZE      : 10
DIESEL SULFUR      : 15
AVERAGE SPEED      : 10 Arterial 0.0 100.0 0.0 0.0

SCENARIO RECORD    : 2012 15 mph - Summer
CALENDAR YEAR      : 2012
EVALUATION MONTH   : 7
PARTICULATE EF     : PMGZML.CSV  PMGDR1.CSV  PMGDR2.CSV  PMDZML.CSV  PMDDR1.CSV  PMDDR2.CSV
PARTICLE SIZE      : 10
DIESEL SULFUR      : 15
AVERAGE SPEED      : 15 Arterial 0.0 100.0 0.0 0.0

SCENARIO RECORD    : 2012 20 mph - Summer
CALENDAR YEAR      : 2012
EVALUATION MONTH   : 7
PARTICULATE EF     : PMGZML.CSV  PMGDR1.CSV  PMGDR2.CSV  PMDZML.CSV  PMDDR1.CSV  PMDDR2.CSV
PARTICLE SIZE      : 10
DIESEL SULFUR      : 15
AVERAGE SPEED      : 20 Arterial 0.0 100.0 0.0 0.0

SCENARIO RECORD    : 2012 25 mph - Summer
CALENDAR YEAR      : 2012
EVALUATION MONTH   : 7
PARTICULATE EF     : PMGZML.CSV  PMGDR1.CSV  PMGDR2.CSV  PMDZML.CSV  PMDDR1.CSV  PMDDR2.CSV
PARTICLE SIZE      : 10
DIESEL SULFUR      : 15
AVERAGE SPEED      : 25 Arterial 0.0 100.0 0.0 0.0

SCENARIO RECORD    : 2012 30 mph - Summer
CALENDAR YEAR      : 2012
EVALUATION MONTH   : 7
PARTICULATE EF     : PMGZML.CSV  PMGDR1.CSV  PMGDR2.CSV  PMDZML.CSV  PMDDR1.CSV  PMDDR2.CSV
PARTICLE SIZE      : 10
DIESEL SULFUR      : 15
AVERAGE SPEED      : 30 Arterial 0.0 100.0 0.0 0.0
```

```
SCENARIO RECORD    : 2012 35 mph - Summer
CALENDAR YEAR      : 2012
EVALUATION MONTH   : 7
PARTICULATE EF     : PMGZML.CSV  PMGDR1.CSV  PMGDR2.CSV  PMDZML.CSV  PMDDR1.CSV  PMDDR2.CSV
PARTICLE SIZE      : 10
DIESEL SULFUR      : 15
AVERAGE SPEED      : 35 Arterial 0.0 100.0 0.0 0.0

SCENARIO RECORD    : 2012 50 mph - Summer
CALENDAR YEAR      : 2012
EVALUATION MONTH   : 7
PARTICULATE EF     : PMGZML.CSV  PMGDR1.CSV  PMGDR2.CSV  PMDZML.CSV  PMDDR1.CSV  PMDDR2.CSV
PARTICLE SIZE      : 10
DIESEL SULFUR      : 15
AVERAGE SPEED      : 50 Arterial 0.0 100.0 0.0 0.0

***************    End of This Run    ***************
END OF RUN
```

Table I-8 MOBILE6.2.03 Output Files for 2012

```
*****************************************************************************
* MOBILE6.2.03 (24-Sep-2003)                                    *
* Input file: MA12_ALL.INP (file 1, run 1).                     *
*****************************************************************************
* *** Summer 2012 ***

* Reading Registration Distributions from the following external
* data file: 2005_REG.D
  M 49 Warning:
            1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
           0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
           0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
           0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
            1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
            1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
           0.999     MYR sum not = 1. (will normalize)
  M 49 Warning:
           0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
            1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
           0.999     MYR sum not = 1. (will normalize)
  M 49 Warning:
            1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
            1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
            1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
            1.00     MYR sum not = 1. (will normalize)

* Reading I/M program description records from the following external
* data file: 09NEWIM.D
* 15 Year Exemption Age
* New Annual OBD Exhaust I/M program for Light Duty MY 1996 through 2007 vehicles <=8,500 lb GVWR
* New Annual OBD Exhaust I/M program for Light Duty and Medium duty MY 2008 and later <=14,000 lb GVWR
* New Annual OBD Evap I/M program for Light Duty MY 1996 through 2007 vehicles <=8,500 lb GVWR
* New Annual OBD Evap I/M program for Light Duty and Medium duty MY 2008 and later <=14,000 lb GVWR
  M601 Comment:
          User has enabled STAGE II REFUELING.


* Reading 94+ LEV IMPLEMENTATION SCHEDULE from the following external
* data file: MA_LEV2.D
```

```
Reading User Supplied Tier2 Exhaust bin phase-in fractions

  Data read from file: LEV2EXH.D


Reading User Supplied Tier2 EVAP phase-in fractions

  Data read from file: LEV2EVAP.D


Reading User Supplied Tier2 50K certification standards

  Data read from file: LEV2CERT.D

M616 Comment:
        User has supplied post-1999 sulfur levels.
M614 Comment:
        User supplied diesel sale fractions.

* # # # # # # # # # # # # # # # # # # # # # # # # #
* 2012 Idle Scenario - Summer (multiply g/mi by 2.5 mph to get g/hr)
* File 1, Run 1, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # #

* Reading PM Gas Carbon ZML Levels
* from the external data file PMGZML.CSV

* Reading PM Gas Carbon DR1 Levels
* from the external data file PMGDR1.CSV

* Reading PM Gas Carbon DR2 Levels
* from the external data file PMGDR2.CSV

* Reading PM Diesel Zero Mile Levels
* from the external data file PMDZML.CSV

* Reading the First PM Deterioration Rates
* from the external data file PMDDR1.CSV

* Reading the Second PM Deterioration Rates
* from the external data file PMDDR2.CSV
 M583 Warning:
      The user supplied arterial average speed of  2.5
      will be used for all hours of the day.  100% of VMT
      has been assigned to the arterial/collector roadway
      type for all hours of the day and all vehicle types.
*** I/M credits for Tech1&2 vehicles were read from the following external
   data file: TECH12.D
 M 48 Warning:
        there are no sales for vehicle class HDGV8b
 HDDV DEFEAT DEVICE EFFECTS ARE PRESENT. THE REBUILD FRACTION IS 0.10.
```

```
* Reading Ammonia (NH3) Basic Emission Rates
* from the external data file PMNH3BER.D

* Reading Ammonia (NH3) Sulfur Deterioration Rates
* from the external data file PMNH3SDR.D

 LEV phase-in data read from file MA_LEV2.D
              Calendar Year:  2012
                     Month:  July
                  Altitude:  Low
        Minimum Temperature:  70.4 (F)
        Maximum Temperature:  93.7 (F)
          Absolute Humidity:   75. grains/lb
        Fuel Sulfur Content:   30. ppm

        Exhaust I/M Program:  Yes
           Evap I/M Program:  Yes
                ATP Program:  No
           Reformulated Gas:  Yes

      Vehicle Type:     LDGV   LDGT12   LDGT34     LDGT     HDGV     LDDV     LDDT     HDDV       MC   All Veh
              GVWR:              <6000    >6000    (All)
                        ------   ------   ------   ------   ------   ------   ------   ------   ------   ------
  VMT Distribution:   0.3071   0.4054   0.1595            0.0369   0.0002   0.0015   0.0857   0.0038   1.0000
Fuel Economy (mpg):     24.1     18.5     14.2     17.1      9.9     32.4     18.4      7.3     50.0     16.3
 ----------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
   Composite VOC :     2.631    1.903    2.147    1.972    2.975    0.404    0.458    1.013    12.01    2.165
   Composite CO  :     13.51    10.96    12.13    11.29    28.44    4.047    1.460    5.452   120.29   12.500
   Composite NOX :     0.698    0.585    0.863    0.664    0.840    0.667    0.439    7.794     1.12    1.293
   Composite CO2 :     368.0    478.9    623.9    519.9    895.3    314.0    553.9   1400.7    177.4   561.30
 ----------------------------------------------------------------------------------------------------------
         Veh. Type:   GasBUS    URBAN   SCHOOL
                        ------   ------   ------
           VMT Mix:   0.0003   0.0009   0.0015
Fuel Economy (mpg):      6.4      4.3      6.2
----------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
   Composite VOC :     2.268    0.864    1.193
   Composite CO  :     48.62    7.745    4.910
   Composite NOX :     1.244   13.394    8.817
   Composite CO2 :    1375.1   2340.7   1646.7
----------------------------------------------------------------------------------------------------------

* # # # # # # # # # # # # # # # # # # # # # # # # #
* 2012 5 mph - Summer
* File 1, Run 1, Scenario 2.
* # # # # # # # # # # # # # # # # # # # # # # # # #

* Reading PM Gas Carbon ZML Levels
* from the external data file PMGZML.CSV
```

```
* Reading PM Gas Carbon DR1 Levels
* from the external data file PMGDR1.CSV

* Reading PM Gas Carbon DR2 Levels
* from the external data file PMGDR2.CSV

* Reading PM Diesel Zero Mile Levels
* from the external data file PMDZML.CSV

* Reading the First PM Deterioration Rates
* from the external data file PMDDR1.CSV

* Reading the Second PM Deterioration Rates
* from the external data file PMDDR2.CSV
 M583 Warning:
       The user supplied arterial average speed of  5.0
       will be used for all hours of the day.  100% of VMT
       has been assigned to the arterial/collector roadway
       type for all hours of the day and all vehicle types.
 M 48 Warning:
        there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
              Calendar Year:  2012
                     Month:  July
                  Altitude:  Low
        Minimum Temperature:  70.4 (F)
        Maximum Temperature:  93.7 (F)
          Absolute Humidity:   75. grains/lb
        Fuel Sulfur Content:   30. ppm

        Exhaust I/M Program:  Yes
           Evap I/M Program:  Yes
               ATP Program:  No
          Reformulated Gas:  Yes
```

Vehicle Type:	LDGV	LDGT12	LDGT34	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
GVWR:		<6000	>6000	(All)						
VMT Distribution:	0.3071	0.4054	0.1595		0.0369	0.0002	0.0015	0.0857	0.0038	1.0000
Fuel Economy (mpg):	24.1	18.5	14.2	17.1	9.9	32.4	18.4	7.3	50.0	16.3
Composite Emission Factors (g/mi):										
Composite VOC :	0.976	0.762	0.918	0.806	1.400	0.362	0.410	0.890	8.29	0.915
Composite CO :	7.99	6.98	7.70	7.19	22.73	3.408	1.222	4.450	71.17	8.006
Composite NOX :	0.590	0.511	0.750	0.578	0.862	0.601	0.396	7.035	1.05	1.148
Composite CO2 :	368.0	478.9	623.9	519.9	895.3	314.0	553.9	1400.7	177.4	561.30

Veh. Type:	GasBUS	URBAN	SCHOOL
VMT Mix:	0.0003	0.0009	0.0015
Fuel Economy (mpg):	6.4	4.3	6.2

```
-----------------------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
    Composite VOC :    1.329    0.760    1.048
    Composite CO  :   38.85     6.323    4.008
    Composite NOX :    1.276   12.019    7.907
    Composite CO2 :  1375.1    2340.7   1646.7
-----------------------------------------------------------------------------------------------------------------------

* # # # # # # # # # # # # # # # # # # # # # # # # #
* 2012 10 mph - Summer
* File 1, Run 1, Scenario 3.
* # # # # # # # # # # # # # # # # # # # # # # # # #

* Reading PM Gas Carbon ZML Levels
* from the external data file PMGZML.CSV

* Reading PM Gas Carbon DR1 Levels
* from the external data file PMGDR1.CSV

* Reading PM Gas Carbon DR2 Levels
* from the external data file PMGDR2.CSV

* Reading PM Diesel Zero Mile Levels
* from the external data file PMDZML.CSV

* Reading the First PM Deterioration Rates
* from the external data file PMDDR1.CSV

* Reading the Second PM Deterioration Rates
* from the external data file PMDDR2.CSV
 M583 Warning:
        The user supplied arterial average speed of 10.0
        will be used for all hours of the day.  100% of VMT
        has been assigned to the arterial/collector roadway
        type for all hours of the day and all vehicle types.
 M 48 Warning:
         there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
               Calendar Year:  2012
                     Month:  July
                   Altitude:  Low
         Minimum Temperature:  70.4 (F)
         Maximum Temperature:  93.7 (F)
          Absolute Humidity:   75. grains/lb
         Fuel Sulfur Content:   30. ppm

         Exhaust I/M Program:  Yes
           Evap I/M Program:  Yes
              ATP Program:  No
           Reformulated Gas:  Yes
```

```
     Vehicle Type:     LDGV   LDGT12   LDGT34     LDGT     HDGV     LDDV     LDDT     HDDV       MC   All Veh
           GVWR:              <6000    >6000     (All)
                   ------   ------   ------   ------   ------   ------   ------   ------   ------   ------
   VMT Distribution:   0.3071   0.4054   0.1595           0.0369   0.0002   0.0015   0.0857   0.0038   1.0000
 Fuel Economy (mpg):     24.1     18.5     14.2     17.1      9.9     32.4     18.4      7.3     50.0     16.3
 ---------------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
    Composite VOC :     0.556    0.448    0.552    0.478    0.849   0.297    0.336    0.699     5.46    0.553
    Composite CO  :     5.47     5.07     5.58     5.21    15.12    2.527    0.895    3.069    36.49    5.585
    Composite NOX :     0.456    0.413    0.610    0.468    0.905   0.502    0.330    5.885     1.00    0.947
    Composite CO2 :   368.0    478.9    623.9    519.9    895.3   314.0    553.9   1400.7    177.4   561.30
 ---------------------------------------------------------------------------------------------------------------
        Veh. Type:   GasBUS    URBAN    SCHOOL
                   ------   ------   ------
         VMT Mix:   0.0003   0.0009   0.0015
 Fuel Economy (mpg):      6.4      4.3      6.2
---------------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
    Composite VOC :    0.874    0.596    0.823
    Composite CO  :   25.85     4.360    2.764
    Composite NOX :    1.341    9.938    6.532
    Composite CO2 :  1375.1   2340.7   1646.7
---------------------------------------------------------------------------------------------------------------


* # # # # # # # # # # # # # # # # # # # # # # # # #
* 2012 15 mph - Summer
* File 1, Run 1, Scenario 4.
* # # # # # # # # # # # # # # # # # # # # # # # # #

* Reading PM Gas Carbon ZML Levels
* from the external data file PMGZML.CSV

* Reading PM Gas Carbon DR1 Levels
* from the external data file PMGDR1.CSV

* Reading PM Gas Carbon DR2 Levels
* from the external data file PMGDR2.CSV

* Reading PM Diesel Zero Mile Levels
* from the external data file PMDZML.CSV

* Reading the First PM Deterioration Rates
* from the external data file PMDDR1.CSV

* Reading the Second PM Deterioration Rates
* from the external data file PMDDR2.CSV
  M583 Warning:
          The user supplied arterial average speed of 15.0
          will be used for all hours of the day.  100% of VMT
          has been assigned to the arterial/collector roadway
          type for all hours of the day and all vehicle types.
  M 48 Warning:
```

```
          there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
               Calendar Year:  2012
                      Month:  July
                   Altitude:  Low
          Minimum Temperature:  70.4 (F)
          Maximum Temperature:  93.7 (F)
           Absolute Humidity:   75. grains/lb
          Fuel Sulfur Content:   30. ppm

          Exhaust I/M Program:  Yes
             Evap I/M Program:  Yes
                 ATP Program:  No
             Reformulated Gas:  Yes

     Vehicle Type:     LDGV    LDGT12    LDGT34     LDGT     HDGV     LDDV     LDDT     HDDV       MC   All Veh
           GVWR:                <6000     >6000     (All)
                      ------    ------    ------    ------   ------   ------   ------   ------   ------   ------
  VMT Distribution:   0.3071    0.4054    0.1595              0.0369   0.0002   0.0015   0.0857   0.0038   1.0000
 Fuel Economy (mpg):    24.1      18.5      14.2      17.1       9.9     32.4     18.4      7.3     50.0     16.3
 -------------------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
    Composite VOC :    0.455     0.364     0.445     0.387     0.642    0.251    0.282    0.561     4.49    0.448
    Composite CO  :     4.74      4.45      4.91      4.58     10.63    1.983    0.692    2.214    25.25    4.725
    Composite NOX :    0.376     0.352     0.523     0.400     0.949    0.434    0.285    5.099     1.01    0.818
    Composite CO2 :    368.0     478.9     623.9     519.9     895.3    314.0    553.9   1400.7    177.4   561.30
 -------------------------------------------------------------------------------------------------------------------
        Veh. Type:    GasBUS    URBAN    SCHOOL
                      ------    ------   ------
          VMT Mix:    0.0003    0.0009   0.0015
 Fuel Economy (mpg):     6.4       4.3      6.2
-------------------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
    Composite VOC :    0.665     0.479    0.660
    Composite CO  :    18.17     3.146    1.994
    Composite NOX :    1.406     8.516    5.591
    Composite CO2 :   1375.1    2340.7   1646.7
-------------------------------------------------------------------------------------------------------------------


* # # # # # # # # # # # # # # # # # # # # # # # # #
* 2012 20 mph - Summer
* File 1, Run 1, Scenario 5.
* # # # # # # # # # # # # # # # # # # # # # # # # #

* Reading PM Gas Carbon ZML Levels
* from the external data file PMGZML.CSV

* Reading PM Gas Carbon DR1 Levels
* from the external data file PMGDR1.CSV

* Reading PM Gas Carbon DR2 Levels
```

```
* from the external data file PMGDR2.CSV

* Reading PM Diesel Zero Mile Levels
* from the external data file PMDZML.CSV

* Reading the First PM Deterioration Rates
* from the external data file PMDDR1.CSV

* Reading the Second PM Deterioration Rates
* from the external data file PMDDR2.CSV
 M583 Warning:
        The user supplied arterial average speed of 20.0
        will be used for all hours of the day.  100% of VMT
        has been assigned to the arterial/collector roadway
        type for all hours of the day and all vehicle types.
 M 48 Warning:
         there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
            Calendar Year:  2012
                 Month:  July
               Altitude:  Low
         Minimum Temperature:  70.4 (F)
         Maximum Temperature:  93.7 (F)
          Absolute Humidity:   75. grains/lb
         Fuel Sulfur Content:   30. ppm

         Exhaust I/M Program:  Yes
           Evap I/M Program:  Yes
              ATP Program:  No
           Reformulated Gas:  Yes

     Vehicle Type:     LDGV    LDGT12   LDGT34    LDGT     HDGV     LDDV     LDDT     HDDV       MC   All Veh
         GVWR:                  <6000    >6000    (All)
                    ------   ------   ------   ------   ------   ------   ------   ------   ------   ------
  VMT Distribution:   0.3071   0.4054   0.1595              0.0369   0.0002   0.0015   0.0857   0.0038   1.0000
 Fuel Economy (mpg):     24.1     18.5     14.2     17.1      9.9     32.4     18.4      7.3     50.0     16.3
 -------------------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
   Composite VOC :    0.399    0.315    0.385    0.335    0.517    0.217    0.243    0.460     4.05    0.386
   Composite CO  :     4.33     4.10     4.53     4.22     7.89    1.637    0.563    1.672    20.08    4.226
   Composite NOX :    0.334    0.321    0.479    0.365    0.993    0.388    0.255    4.573     1.06    0.742
   Composite CO2 :    368.0    478.9    623.9    519.9    895.3    314.0    553.9   1400.7    177.4   561.30
 -------------------------------------------------------------------------------------------------------------------
       Veh. Type:   GasBUS    URBAN   SCHOOL
                    ------   ------   ------
         VMT Mix:   0.0003   0.0009   0.0015
 Fuel Economy (mpg):      6.4      4.3      6.2
-------------------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
   Composite VOC :    0.534    0.393    0.542
   Composite CO  :    13.49    2.376    1.506
```

```
    Composite NOX :     1.471     7.563     4.962
    Composite CO2 :  1375.1    2340.7    1646.7
-----------------------------------------------------------------------------------------------------------

* # # # # # # # # # # # # # # # # # # # # # # # # #
* 2012 25 mph - Summer
* File 1, Run 1, Scenario 6.
* # # # # # # # # # # # # # # # # # # # # # # # # #

* Reading PM Gas Carbon ZML Levels
* from the external data file PMGZML.CSV

* Reading PM Gas Carbon DR1 Levels
* from the external data file PMGDR1.CSV

* Reading PM Gas Carbon DR2 Levels
* from the external data file PMGDR2.CSV

* Reading PM Diesel Zero Mile Levels
* from the external data file PMDZML.CSV

* Reading the First PM Deterioration Rates
* from the external data file PMDDR1.CSV

* Reading the Second PM Deterioration Rates
* from the external data file PMDDR2.CSV
 M583 Warning:
         The user supplied arterial average speed of 25.0
         will be used for all hours of the day.  100% of VMT
         has been assigned to the arterial/collector roadway
         type for all hours of the day and all vehicle types.
 M 48 Warning:
          there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
               Calendar Year:  2012
                      Month:  July
                   Altitude:  Low
          Minimum Temperature:  70.4 (F)
          Maximum Temperature:  93.7 (F)
            Absolute Humidity:   75. grains/lb
          Fuel Sulfur Content:   30. ppm

          Exhaust I/M Program:  Yes
             Evap I/M Program:  Yes
                  ATP Program:  No
             Reformulated Gas:  Yes

     Vehicle Type:     LDGV    LDGT12    LDGT34     LDGT     HDGV     LDDV     LDDT     HDDV      MC   All Veh
            GVWR:               <6000     >6000     (All)
                   ------   ------   ------   ------   ------   ------   ------   ------   ------   ------
  VMT Distribution:   0.3071    0.4054    0.1595              0.0369    0.0002    0.0015    0.0857    0.0038    1.0000
```

```
Fuel Economy (mpg):    24.1    18.5    14.2    17.1     9.9    32.4    18.4     7.3    50.0    16.3
 ---------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
   Composite VOC :   0.369   0.291   0.355   0.309   0.441   0.191   0.214   0.386    3.77   0.352
   Composite CO  :    4.14    3.95    4.37    4.07    6.19   1.414   0.480   1.322   16.91   3.975
   Composite NOX :   0.308   0.302   0.453   0.344   1.036   0.359   0.237   4.242    1.12   0.696
   Composite CO2 :   368.0   478.9   623.9   519.9   895.3   314.0   553.9  1400.7   177.4  561.30
 ---------------------------------------------------------------------------------------------------------
       Veh. Type:   GasBUS   URBAN  SCHOOL
                    ------  ------  ------
         VMT Mix:   0.0003  0.0009  0.0015
 Fuel Economy (mpg):   6.4     4.3     6.2
---------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
   Composite VOC :   0.455   0.329   0.454
   Composite CO  :   10.59   1.878   1.191
   Composite NOX :   1.535   6.965   4.566
   Composite CO2 :  1375.1  2340.7  1646.7
---------------------------------------------------------------------------------------------------------

* # # # # # # # # # # # # # # # # # # # # # # # # #
* 2012 30 mph - Summer
* File 1, Run 1, Scenario 7.
* # # # # # # # # # # # # # # # # # # # # # # # # #

* Reading PM Gas Carbon ZML Levels
* from the external data file PMGZML.CSV

* Reading PM Gas Carbon DR1 Levels
* from the external data file PMGDR1.CSV

* Reading PM Gas Carbon DR2 Levels
* from the external data file PMGDR2.CSV

* Reading PM Diesel Zero Mile Levels
* from the external data file PMDZML.CSV

* Reading the First PM Deterioration Rates
* from the external data file PMDDR1.CSV

* Reading the Second PM Deterioration Rates
* from the external data file PMDDR2.CSV
  M583 Warning:
        The user supplied arterial average speed of 30.0
        will be used for all hours of the day.  100% of VMT
        has been assigned to the arterial/collector roadway
        type for all hours of the day and all vehicle types.
  M 48 Warning:
         there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
               Calendar Year:  2012
```

```
                 Month:  July
               Altitude:  Low
    Minimum Temperature:  70.4 (F)
    Maximum Temperature:  93.7 (F)
      Absolute Humidity:   75. grains/lb
    Fuel Sulfur Content:   30. ppm

     Exhaust I/M Program:  Yes
        Evap I/M Program:  Yes
             ATP Program:  No
        Reformulated Gas:  Yes

   Vehicle Type:    LDGV   LDGT12   LDGT34    LDGT    HDGV    LDDV    LDDT    HDDV     MC   All Veh
          GVWR:             <6000    >6000    (All)
                   ------  ------  ------  ------  ------  ------  ------  ------  ------  ------
 VMT Distribution:  0.3071  0.4054  0.1595           0.0369  0.0002  0.0015  0.0857  0.0038  1.0000
Fuel Economy (mpg):   24.1    18.5    14.2    17.1     9.9    32.4    18.4     7.3    50.0    16.3
-------------------------------------------------------------------------------------------------
Composite Emission Factors (g/mi):
   Composite VOC :   0.350   0.276   0.337   0.293   0.390   0.173   0.192   0.331    3.57   0.329
   Composite CO  :    4.10    3.92    4.32    4.03    5.13   1.268   0.426   1.093   14.61   3.875
   Composite NOX :   0.290   0.289   0.434   0.330   1.080   0.344   0.227   4.069    1.17   0.669
   Composite CO2 :   368.0   478.9   623.9   519.9   895.3   314.0   553.9  1400.7   177.4  561.30
-------------------------------------------------------------------------------------------------
      Veh. Type:   GasBUS   URBAN   SCHOOL
                   ------  ------  ------
        VMT Mix:   0.0003  0.0009  0.0015
Fuel Economy (mpg):    6.4     4.3     6.2
-------------------------------------------------------------------------------------------------
Composite Emission Factors (g/mi):
   Composite VOC :   0.402   0.282   0.389
   Composite CO  :    8.78   1.553   0.985
   Composite NOX :   1.600   6.652   4.359
   Composite CO2 :  1375.1  2340.7  1646.7
-------------------------------------------------------------------------------------------------

* # # # # # # # # # # # # # # # # # # # # # # # # #
* 2012 35 mph - Summer
* File 1, Run 1, Scenario 8.
* # # # # # # # # # # # # # # # # # # # # # # # # #

* Reading PM Gas Carbon ZML Levels
* from the external data file PMGZML.CSV

* Reading PM Gas Carbon DR1 Levels
* from the external data file PMGDR1.CSV

* Reading PM Gas Carbon DR2 Levels
* from the external data file PMGDR2.CSV

* Reading PM Diesel Zero Mile Levels
* from the external data file PMDZML.CSV
```

```
* Reading the First PM Deterioration Rates
* from the external data file PMDDR1.CSV

* Reading the Second PM Deterioration Rates
* from the external data file PMDDR2.CSV
 M583 Warning:
        The user supplied arterial average speed of 35.0
        will be used for all hours of the day.  100% of VMT
        has been assigned to the arterial/collector roadway
        type for all hours of the day and all vehicle types.
 M 48 Warning:
         there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
              Calendar Year:  2012
                    Month:  July
                  Altitude:  Low
         Minimum Temperature:  70.4 (F)
         Maximum Temperature:  93.7 (F)
          Absolute Humidity:   75. grains/lb
         Fuel Sulfur Content:   30. ppm

         Exhaust I/M Program:  Yes
           Evap I/M Program:  Yes
              ATP Program:  No
           Reformulated Gas:  Yes

     Vehicle Type:     LDGV   LDGT12   LDGT34     LDGT     HDGV     LDDV     LDDT     HDDV      MC   All Veh
          GVWR:            <6000    >6000    (All)
                  ------   ------   ------   ------   ------   ------   ------   ------   ------   ------
  VMT Distribution:   0.3071   0.4054   0.1595            0.0369   0.0002   0.0015   0.0857   0.0038   1.0000
 Fuel Economy (mpg):     24.1     18.5     14.2     17.1      9.9     32.4     18.4      7.3     50.0     16.3
 ---------------------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
    Composite VOC :    0.335    0.265    0.323    0.281    0.355    0.159    0.176    0.290     3.41    0.313
    Composite CO  :     4.16     3.97     4.39     4.09     4.50    1.174    0.391    0.946    12.91    3.884
    Composite NOX :    0.279    0.283    0.426    0.323    1.124    0.341    0.225    4.034     1.22    0.661
    Composite CO2 :    368.0    478.9    623.9    519.9    895.3    314.0    553.9   1400.7    177.4   561.30
 ---------------------------------------------------------------------------------------------------------------------
       Veh. Type:   GasBUS    URBAN   SCHOOL
                  ------   ------   ------
        VMT Mix:   0.0003   0.0009   0.0015
 Fuel Economy (mpg):      6.4      4.3      6.2
---------------------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
    Composite VOC :    0.365    0.247    0.341
    Composite CO  :     7.69    1.345    0.852
    Composite NOX :    1.665    6.589    4.317
    Composite CO2 :   1375.1   2340.7   1646.7
---------------------------------------------------------------------------------------------------------------------
```

```
* #########################
* 2012 50 mph - Summer
* File 1, Run 1, Scenario 9.
* #########################

* Reading PM Gas Carbon ZML Levels
* from the external data file PMGZML.CSV

* Reading PM Gas Carbon DR1 Levels
* from the external data file PMGDR1.CSV

* Reading PM Gas Carbon DR2 Levels
* from the external data file PMGDR2.CSV

* Reading PM Diesel Zero Mile Levels
* from the external data file PMDZML.CSV

* Reading the First PM Deterioration Rates
* from the external data file PMDDR1.CSV

* Reading the Second PM Deterioration Rates
* from the external data file PMDDR2.CSV
 M583 Warning:
      The user supplied arterial average speed of 50.0
      will be used for all hours of the day.  100% of VMT
      has been assigned to the arterial/collector roadway
      type for all hours of the day and all vehicle types.
 M 48 Warning:
       there are no sales for vehicle class HDGV8b

 LEV phase-in data read from file MA_LEV2.D
            Calendar Year:  2012
                 Month:  July
               Altitude:  Low
       Minimum Temperature:  70.4 (F)
       Maximum Temperature:  93.7 (F)
        Absolute Humidity:   75. grains/lb
       Fuel Sulfur Content:   30. ppm

       Exhaust I/M Program:  Yes
         Evap I/M Program:  Yes
            ATP Program:  No
         Reformulated Gas:  Yes

    Vehicle Type:     LDGV   LDGT12   LDGT34    LDGT    HDGV    LDDV    LDDT    HDDV      MC   All Veh
         GVWR:                <6000    >6000    (All)
                      ------  ------  ------  ------  ------  ------  ------  ------  ------  ------
  VMT Distribution:   0.3071   0.4054   0.1595            0.0369   0.0002   0.0015   0.0857   0.0038   1.0000
 Fuel Economy (mpg):     24.1     18.5     14.2     17.1      9.9     32.4     18.4      7.3     50.0     16.3
 ------------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
   Composite VOC :    0.312    0.252    0.305    0.267    0.297    0.136    0.150    0.223     3.21    0.289
```

```
    Composite CO  :     4.93     4.68     5.12     4.80     4.20    1.085    0.358    0.807    10.68    4.493
    Composite NOX :    0.294    0.300    0.446    0.341    1.255    0.407    0.268    4.797     1.34    0.746
    Composite CO2 :    368.0    478.9    623.9    519.9    895.3    314.0    553.9   1400.7    177.4   561.30
 -----------------------------------------------------------------------------------------------------------
         Veh. Type:   GasBUS    URBAN   SCHOOL
                      ------   ------   ------
           VMT Mix:   0.0003   0.0009   0.0015
 Fuel Economy (mpg):     6.4      4.3      6.2
 -----------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
    Composite VOC :    0.309    0.190    0.262
    Composite CO  :     7.19    1.146    0.727
    Composite NOX :    1.859    7.969    5.230
    Composite CO2 :   1375.1   2340.7   1646.7
-----------------------------------------------------------------------------------------------------------
```

```
*****************************************************************************
* MOBILE6.2.03 (24-Sep-2003)                                                *
* Input file: MA12_ALL.INP (file 1, run 1).                                 *
*****************************************************************************


* # # # # # # # # # # # # # # # # # # # # # # # # #
* 2012 Idle Scenario - Summer (multiply g/mi by 2.5 mph to get g/hr)
* File 1, Run 1, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # #


                    Calendar Year:  2012
                            Month:  July
       Gasoline Fuel Sulfur Content:   30. ppm
         Diesel Fuel Sulfur Content:   15. ppm
             Particle Size Cutoff: 10.00 Microns
                 Reformulated Gas:  Yes

     Vehicle Type:     LDGV   LDGT12   LDGT34     LDGT     HDGV     LDDV     LDDT     HDDV       MC   All Veh
             GVWR:             <6000    >6000    (All)
                     ------   ------   ------   ------   ------   ------   ------   ------   ------   ------
 VMT Distribution:   0.3071   0.4054   0.1595            0.0369   0.0002   0.0015   0.0857   0.0038   1.0000
 -----------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
             Lead:   0.0000   0.0000   0.0000   0.0000   0.0000   ------   ------   ------   0.0000   0.0000
            GASPM:   0.0038   0.0037   0.0037   0.0037   0.0220   ------   ------   ------   0.0205   0.0042
          ECARBON:   ------   ------   ------   ------   ------   0.0747   0.0111   0.0645   ------   0.0056
          OCARBON:   ------   ------   ------   ------   ------   0.0211   0.0160   0.0322   ------   0.0028
              SO4:   0.0005   0.0006   0.0006   0.0006   0.0013   0.0002   0.0003   0.0009   0.0002   0.0006
 Total Exhaust PM:   0.0043   0.0043   0.0043   0.0043   0.0233   0.0960   0.0275   0.0976   0.0207   0.0131
            Brake:   0.0125   0.0125   0.0125   0.0125   0.0125   0.0125   0.0125   0.0125   0.0125   0.0125
             Tire:   0.0080   0.0080   0.0080   0.0080   0.0085   0.0080   0.0080   0.0248   0.0040   0.0094
         Total PM:   0.0249   0.0249   0.0248   0.0249   0.0443   0.1165   0.0480   0.1350   0.0372   0.0351
              SO2:   0.0067   0.0087   0.0115   0.0095   0.0164   0.0029   0.0052   0.0131   0.0033   0.0092
              NH3:   0.1011   0.1015   0.1017   0.1016   0.0451   0.0068   0.0068   0.0270   0.0113   0.0925
 -----------------------------------------------------------------------------------------------------------
         Veh. Type:   GasBUS    URBAN   SCHOOL
                      ------   ------   ------
           VMT Mix:   0.0003   0.0009   0.0015
```

```
---------------------------------------------------------------------------------------------------------------------
Composite Emission Factors (g/mi):
         Lead:   0.0000   ------   ------
        GASPM:   0.0299   ------   ------
      ECARBON:   ------   0.0823   0.0489
      OCARBON:   ------   0.0646   0.0384
          SO4:   0.0013   0.0015   0.0011
 Total Exhaust PM:   0.0312   0.1484   0.0884
        Brake:   0.0125   0.0125   0.0125
         Tire:   0.0120   0.0120   0.0120
     Total PM:   0.0557   0.1729   0.1129
          SO2:   0.0253   0.0218   0.0153
          NH3:   0.0451   0.0270   0.0270
---------------------------------------------------------------------------------------------------------------------

* # # # # # # # # # # # # # # # # # # # # # # # # #
* 2012 5 mph - Summer
* File 1, Run 1, Scenario 2.
* # # # # # # # # # # # # # # # # # # # # # # # # #

                    Calendar Year:  2012
                            Month:  July
       Gasoline Fuel Sulfur Content:   30. ppm
         Diesel Fuel Sulfur Content:   15. ppm
             Particle Size Cutoff: 10.00 Microns
                 Reformulated Gas:  Yes

   Vehicle Type:    LDGV   LDGT12   LDGT34    LDGT    HDGV    LDDV    LDDT    HDDV     MC   All Veh
        GVWR:              <6000    >6000    (All)
                ------   ------   ------   ------   ------   ------   ------   ------   ------   ------
 VMT Distribution:   0.3071   0.4054   0.1595            0.0369   0.0002   0.0015   0.0857   0.0038   1.0000
---------------------------------------------------------------------------------------------------------------------
Composite Emission Factors (g/mi):
         Lead:   0.0000   0.0000   0.0000   0.0000   0.0000   ------   ------   ------   0.0000   0.0000
        GASPM:   0.0038   0.0037   0.0037   0.0037   0.0220   ------   ------   ------   0.0205   0.0042
      ECARBON:   ------   ------   ------   ------   ------   0.0747   0.0111   0.0645   ------   0.0056
      OCARBON:   ------   ------   ------   ------   ------   0.0211   0.0160   0.0322   ------   0.0028
          SO4:   0.0005   0.0006   0.0006   0.0006   0.0013   0.0002   0.0003   0.0009   0.0002   0.0006
 Total Exhaust PM:   0.0043   0.0043   0.0043   0.0043   0.0233   0.0960   0.0275   0.0976   0.0207   0.0131
        Brake:   0.0125   0.0125   0.0125   0.0125   0.0125   0.0125   0.0125   0.0125   0.0125   0.0125
         Tire:   0.0080   0.0080   0.0080   0.0080   0.0085   0.0080   0.0080   0.0248   0.0040   0.0094
     Total PM:   0.0249   0.0249   0.0248   0.0249   0.0443   0.1165   0.0480   0.1350   0.0372   0.0351
          SO2:   0.0067   0.0087   0.0115   0.0095   0.0164   0.0029   0.0052   0.0131   0.0033   0.0092
          NH3:   0.1011   0.1015   0.1017   0.1016   0.0451   0.0068   0.0068   0.0270   0.0113   0.0925
---------------------------------------------------------------------------------------------------------------------
    Veh. Type:   GasBUS    URBAN   SCHOOL
                 ------   ------   ------
      VMT Mix:   0.0003   0.0009   0.0015
---------------------------------------------------------------------------------------------------------------------
Composite Emission Factors (g/mi):
         Lead:   0.0000   ------   ------
        GASPM:   0.0299   ------   ------
```

ECARBON:	------	0.0823	0.0489
OCARBON:	------	0.0646	0.0384
SO4:	0.0013	0.0015	0.0011
Total Exhaust PM:	0.0312	0.1484	0.0884
Brake:	0.0125	0.0125	0.0125
Tire:	0.0120	0.0120	0.0120
Total PM:	0.0557	0.1729	0.1129
SO2:	0.0253	0.0218	0.0153
NH3:	0.0451	0.0270	0.0270

----

* #
* 2012 10 mph - Summer
* File 1, Run 1, Scenario 3.
* #

Calendar Year: 2012
Month: July
Gasoline Fuel Sulfur Content: 30. ppm
Diesel Fuel Sulfur Content: 15. ppm
Particle Size Cutoff: 10.00 Microns
Reformulated Gas: Yes

Vehicle Type:	LDGV	LDGT12	LDGT34	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
GVWR:		<6000	>6000	(All)						
VMT Distribution:	0.3071	0.4054	0.1595		0.0369	0.0002	0.0015	0.0857	0.0038	1.0000

Composite Emission Factors (g/mi):

	LDGV	LDGT12	LDGT34	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
Lead:	0.0000	0.0000	0.0000	0.0000	0.0000	------	------	------	0.0000	0.0000
GASPM:	0.0038	0.0037	0.0037	0.0037	0.0220	------	------	------	0.0205	0.0042
ECARBON:	------	------	------	------	------	0.0747	0.0111	0.0645	------	0.0056
OCARBON:	------	------	------	------	------	0.0211	0.0160	0.0322	------	0.0028
SO4:	0.0005	0.0006	0.0006	0.0006	0.0013	0.0002	0.0003	0.0009	0.0002	0.0006
Total Exhaust PM:	0.0043	0.0043	0.0043	0.0043	0.0233	0.0960	0.0275	0.0976	0.0207	0.0131
Brake:	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125
Tire:	0.0080	0.0080	0.0080	0.0080	0.0085	0.0080	0.0080	0.0248	0.0040	0.0094
Total PM:	0.0249	0.0249	0.0248	0.0249	0.0443	0.1165	0.0480	0.1350	0.0372	0.0351
SO2:	0.0067	0.0087	0.0115	0.0095	0.0164	0.0029	0.0052	0.0131	0.0033	0.0092
NH3:	0.1011	0.1015	0.1017	0.1016	0.0451	0.0068	0.0068	0.0270	0.0113	0.0925

Veh. Type:	GasBUS	URBAN	SCHOOL
VMT Mix:	0.0003	0.0009	0.0015

Composite Emission Factors (g/mi):

Lead:	0.0000	------	------
GASPM:	0.0299	------	------
ECARBON:	------	0.0823	0.0489
OCARBON:	------	0.0646	0.0384
SO4:	0.0013	0.0015	0.0011
Total Exhaust PM:	0.0312	0.1484	0.0884

```
          Brake:   0.0125   0.0125   0.0125
           Tire:   0.0120   0.0120   0.0120
       Total PM:   0.0557   0.1729   0.1129
            SO2:   0.0253   0.0218   0.0153
            NH3:   0.0451   0.0270   0.0270
------------------------------------------------------------------------------------------

* # # # # # # # # # # # # # # # # # # # # # # # # #
* 2012 15 mph - Summer
* File 1, Run 1, Scenario 4.
* # # # # # # # # # # # # # # # # # # # # # # # # #

                 Calendar Year:  2012
                         Month:  July
      Gasoline Fuel Sulfur Content:   30. ppm
        Diesel Fuel Sulfur Content:   15. ppm
             Particle Size Cutoff: 10.00 Microns
                Reformulated Gas:  Yes

  Vehicle Type:   LDGV   LDGT12   LDGT34    LDGT    HDGV    LDDV    LDDT    HDDV     MC   All Veh
         GVWR:            <6000    >6000    (All)
                 ------   ------   ------   ------  ------  ------  ------  ------  ------  ------
 VMT Distribution:  0.3071   0.4054   0.1595           0.0369   0.0002   0.0015   0.0857   0.0038   1.0000
------------------------------------------------------------------------------------------
Composite Emission Factors (g/mi):
           Lead:   0.0000   0.0000   0.0000   0.0000   0.0000   ------   ------   ------   0.0000   0.0000
          GASPM:   0.0038   0.0037   0.0037   0.0037   0.0220   ------   ------   ------   0.0205   0.0042
        ECARBON:   ------   ------   ------   ------   ------   0.0747   0.0111   0.0645   ------   0.0056
        OCARBON:   ------   ------   ------   ------   ------   0.0211   0.0160   0.0322   ------   0.0028
            SO4:   0.0005   0.0006   0.0006   0.0006   0.0013   0.0002   0.0003   0.0009   0.0002   0.0006
 Total Exhaust PM:   0.0043   0.0043   0.0043   0.0043   0.0233   0.0960   0.0275   0.0976   0.0207   0.0131
          Brake:   0.0125   0.0125   0.0125   0.0125   0.0125   0.0125   0.0125   0.0125   0.0125   0.0125
           Tire:   0.0080   0.0080   0.0080   0.0080   0.0085   0.0080   0.0080   0.0248   0.0040   0.0094
       Total PM:   0.0249   0.0249   0.0248   0.0249   0.0443   0.1165   0.0480   0.1350   0.0372   0.0351
            SO2:   0.0067   0.0087   0.0115   0.0095   0.0164   0.0029   0.0052   0.0131   0.0033   0.0092
            NH3:   0.1011   0.1015   0.1017   0.1016   0.0451   0.0068   0.0068   0.0270   0.0113   0.0925
------------------------------------------------------------------------------------------
      Veh. Type:   GasBUS    URBAN    SCHOOL
                   ------   ------   ------
        VMT Mix:   0.0003   0.0009   0.0015
------------------------------------------------------------------------------------------
Composite Emission Factors (g/mi):
           Lead:   0.0000   ------   ------
          GASPM:   0.0299   ------   ------
        ECARBON:   ------   0.0823   0.0489
        OCARBON:   ------   0.0646   0.0384
            SO4:   0.0013   0.0015   0.0011
 Total Exhaust PM:   0.0312   0.1484   0.0884
          Brake:   0.0125   0.0125   0.0125
           Tire:   0.0120   0.0120   0.0120
       Total PM:   0.0557   0.1729   0.1129
            SO2:   0.0253   0.0218   0.0153
```

```
            NH3:   0.0451   0.0270   0.0270
-------------------------------------------------------------------------------

* #########################
* 2012 20 mph - Summer
* File 1, Run 1, Scenario 5.
* #########################

                   Calendar Year:  2012
                           Month:  July
        Gasoline Fuel Sulfur Content:   30. ppm
          Diesel Fuel Sulfur Content:   15. ppm
             Particle Size Cutoff: 10.00 Microns
                Reformulated Gas:  Yes

      Vehicle Type:   LDGV   LDGT12   LDGT34    LDGT    HDGV    LDDV    LDDT    HDDV      MC   All Veh
          GVWR:                <6000    >6000    (All)
                     ------  ------  ------  ------  ------  ------  ------  ------  ------  ------
  VMT Distribution:   0.3071   0.4054   0.1595            0.0369   0.0002   0.0015   0.0857   0.0038   1.0000
-------------------------------------------------------------------------------
Composite Emission Factors (g/mi):
            Lead:   0.0000   0.0000   0.0000   0.0000   0.0000   ------   ------   ------   0.0000   0.0000
           GASPM:   0.0038   0.0037   0.0037   0.0037   0.0220   ------   ------   ------   0.0205   0.0042
         ECARBON:   ------   ------   ------   ------   ------   0.0747   0.0111   0.0645   ------   0.0056
         OCARBON:   ------   ------   ------   ------   ------   0.0211   0.0160   0.0322   ------   0.0028
             SO4:   0.0005   0.0006   0.0006   0.0006   0.0013   0.0002   0.0003   0.0009   0.0002   0.0006
  Total Exhaust PM:   0.0043   0.0043   0.0043   0.0043   0.0233   0.0960   0.0275   0.0976   0.0207   0.0131
           Brake:   0.0125   0.0125   0.0125   0.0125   0.0125   0.0125   0.0125   0.0125   0.0125   0.0125
            Tire:   0.0080   0.0080   0.0080   0.0080   0.0085   0.0080   0.0080   0.0248   0.0040   0.0094
        Total PM:   0.0249   0.0249   0.0248   0.0248   0.0443   0.1165   0.0480   0.1350   0.0372   0.0351
             SO2:   0.0067   0.0088   0.0115   0.0095   0.0164   0.0029   0.0052   0.0131   0.0033   0.0092
             NH3:   0.1011   0.1015   0.1017   0.1016   0.0451   0.0068   0.0068   0.0270   0.0113   0.0925
-------------------------------------------------------------------------------
        Veh. Type:   GasBUS    URBAN   SCHOOL
                     ------   ------   ------
         VMT Mix:   0.0003   0.0009   0.0015
-------------------------------------------------------------------------------
Composite Emission Factors (g/mi):
            Lead:   0.0000   ------   ------
           GASPM:   0.0299   ------   ------
         ECARBON:   ------   0.0823   0.0489
         OCARBON:   ------   0.0646   0.0384
             SO4:   0.0013   0.0015   0.0011
  Total Exhaust PM:   0.0312   0.1484   0.0884
           Brake:   0.0125   0.0125   0.0125
            Tire:   0.0120   0.0120   0.0120
        Total PM:   0.0557   0.1729   0.1129
             SO2:   0.0253   0.0218   0.0153
             NH3:   0.0451   0.0270   0.0270
-------------------------------------------------------------------------------

* #########################
```

```
* 2012 25 mph - Summer
* File 1, Run 1, Scenario 6.
* # # # # # # # # # # # # # # # # # # # # # # # # #

                    Calendar Year:  2012
                            Month:  July
       Gasoline Fuel Sulfur Content:   30. ppm
         Diesel Fuel Sulfur Content:   15. ppm
             Particle Size Cutoff: 10.00 Microns
               Reformulated Gas:  Yes

    Vehicle Type:     LDGV   LDGT12   LDGT34     LDGT     HDGV     LDDV     LDDT     HDDV       MC   All Veh
            GVWR:             <6000    >6000    (All)
                    ------   ------   ------   ------   ------   ------   ------   ------   ------   ------
VMT Distribution:   0.3071   0.4054   0.1595            0.0369   0.0002   0.0015   0.0857   0.0038   1.0000
---------------------------------------------------------------------------------------------------------
Composite Emission Factors (g/mi):
           Lead:    0.0000   0.0000   0.0000   0.0000   0.0000   ------   ------   ------   0.0000   0.0000
          GASPM:    0.0039   0.0038   0.0037   0.0038   0.0218   ------   ------   ------   0.0205   0.0042
        ECARBON:    ------   ------   ------   ------   ------   0.0747   0.0111   0.0645   ------   0.0056
        OCARBON:    ------   ------   ------   ------   ------   0.0211   0.0160   0.0322   ------   0.0028
            SO4:    0.0004   0.0005   0.0005   0.0005   0.0015   0.0002   0.0003   0.0009   0.0001   0.0006
Total Exhaust PM:   0.0043   0.0043   0.0043   0.0043   0.0233   0.0960   0.0275   0.0976   0.0206   0.0131
          Brake:    0.0125   0.0125   0.0125   0.0125   0.0125   0.0125   0.0125   0.0125   0.0125   0.0125
           Tire:    0.0080   0.0080   0.0080   0.0080   0.0085   0.0080   0.0080   0.0248   0.0040   0.0094
       Total PM:    0.0248   0.0248   0.0248   0.0248   0.0444   0.1165   0.0480   0.1350   0.0372   0.0351
            SO2:    0.0067   0.0088   0.0115   0.0095   0.0163   0.0029   0.0052   0.0131   0.0033   0.0092
            NH3:    0.1011   0.1015   0.1017   0.1016   0.0451   0.0068   0.0068   0.0270   0.0113   0.0925
---------------------------------------------------------------------------------------------------------
       Veh. Type:   GasBUS    URBAN   SCHOOL
                    ------   ------   ------
         VMT Mix:   0.0003   0.0009   0.0015
---------------------------------------------------------------------------------------------------------
Composite Emission Factors (g/mi):
           Lead:    0.0000   ------   ------
          GASPM:    0.0297   ------   ------
        ECARBON:    ------   0.0823   0.0489
        OCARBON:    ------   0.0646   0.0384
            SO4:    0.0015   0.0015   0.0011
Total Exhaust PM:   0.0313   0.1484   0.0884
          Brake:    0.0125   0.0125   0.0125
           Tire:    0.0120   0.0120   0.0120
       Total PM:    0.0558   0.1729   0.1129
            SO2:    0.0253   0.0218   0.0153
            NH3:    0.0451   0.0270   0.0270
---------------------------------------------------------------------------------------------------------

* # # # # # # # # # # # # # # # # # # # # # # # # #
* 2012 30 mph - Summer
* File 1, Run 1, Scenario 7.
* # # # # # # # # # # # # # # # # # # # # # # # # #
```

```
                    Calendar Year:  2012
                          Month:  July
         Gasoline Fuel Sulfur Content:   30. ppm
           Diesel Fuel Sulfur Content:   15. ppm
              Particle Size Cutoff: 10.00 Microns
                Reformulated Gas:  Yes

   Vehicle Type:     LDGV   LDGT12   LDGT34     LDGT     HDGV     LDDV     LDDT     HDDV      MC   All Veh
          GVWR:               <6000     >6000     (All)
                     ------   ------   ------   ------   ------   ------   ------   ------   ------   ------
 VMT Distribution:   0.3071    0.4054    0.1595             0.0369   0.0002    0.0015    0.0857    0.0038    1.0000
--------------------------------------------------------------------------------------------------------------------
Composite Emission Factors (g/mi):
          Lead:   0.0000    0.0000    0.0000    0.0000    0.0000    ------    ------    ------    0.0000    0.0000
         GASPM:   0.0040    0.0038    0.0038    0.0038    0.0216    ------    ------    ------    0.0205    0.0042
      ECARBON:    ------    ------    ------    ------    ------    0.0747    0.0111    0.0645    ------    0.0056
      OCARBON:    ------    ------    ------    ------    ------    0.0211    0.0160    0.0322    ------    0.0028
           SO4:   0.0003    0.0005    0.0005    0.0005    0.0017    0.0002    0.0003    0.0009    0.0001    0.0005
 Total Exhaust PM:   0.0043    0.0043    0.0043    0.0043    0.0234    0.0960    0.0275    0.0976    0.0206    0.0131
         Brake:   0.0125    0.0125    0.0125    0.0125    0.0125    0.0125    0.0125    0.0125    0.0125    0.0125
          Tire:   0.0080    0.0080    0.0080    0.0080    0.0085    0.0080    0.0080    0.0248    0.0040    0.0094
      Total PM:   0.0248    0.0248    0.0248    0.0248    0.0444    0.1165    0.0480    0.1350    0.0371    0.0351
           SO2:   0.0067    0.0088    0.0115    0.0096    0.0162    0.0029    0.0052    0.0131    0.0033    0.0092
           NH3:   0.1011    0.1015    0.1017    0.1016    0.0451    0.0068    0.0068    0.0270    0.0113    0.0925
--------------------------------------------------------------------------------------------------------------------
      Veh. Type:    GasBUS     URBAN    SCHOOL
                    ------    ------    ------
       VMT Mix:    0.0003    0.0009    0.0015
--------------------------------------------------------------------------------------------------------------------
Composite Emission Factors (g/mi):
          Lead:   0.0000    ------    ------
         GASPM:   0.0296    ------    ------
      ECARBON:    ------    0.0823    0.0489
      OCARBON:    ------    0.0646    0.0384
           SO4:   0.0018    0.0015    0.0011
 Total Exhaust PM:   0.0313    0.1484    0.0884
         Brake:   0.0125    0.0125    0.0125
          Tire:   0.0120    0.0120    0.0120
      Total PM:   0.0559    0.1729    0.1129
           SO2:   0.0252    0.0218    0.0153
           NH3:   0.0451    0.0270    0.0270
--------------------------------------------------------------------------------------------------------------------

* # # # # # # # # # # # # # # # # # # # # # # # # #
* 2012 35 mph - Summer
* File 1, Run 1, Scenario 8.
* # # # # # # # # # # # # # # # # # # # # # # # # #

                    Calendar Year:  2012
                          Month:  July
         Gasoline Fuel Sulfur Content:   30. ppm
           Diesel Fuel Sulfur Content:   15. ppm
```

```
                Particle Size Cutoff: 10.00 Microns
                  Reformulated Gas:  Yes

       Vehicle Type:    LDGV   LDGT12   LDGT34    LDGT    HDGV    LDDV    LDDT    HDDV      MC   All Veh
            GVWR:              <6000    >6000     (All)
                        ------  ------  ------  ------  ------  ------  ------  ------  ------  ------
   VMT Distribution:  0.3071  0.4054  0.1595           0.0369  0.0002  0.0015  0.0857  0.0038  1.0000
 ------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
            Lead:   0.0000  0.0000  0.0000  0.0000  0.0000  ------  ------  ------  0.0000  0.0000
           GASPM:   0.0040  0.0038  0.0038  0.0038  0.0215  ------  ------  ------  0.0205  0.0043
         ECARBON:   ------  ------  ------  ------  ------  0.0747  0.0111  0.0645  ------  0.0056
         OCARBON:   ------  ------  ------  ------  ------  0.0211  0.0160  0.0322  ------  0.0028
             SO4:   0.0002  0.0004  0.0004  0.0004  0.0019  0.0002  0.0003  0.0009  0.0001  0.0005
  Total Exhaust PM:   0.0042  0.0043  0.0043  0.0043  0.0234  0.0960  0.0275  0.0976  0.0206  0.0131
           Brake:   0.0125  0.0125  0.0125  0.0125  0.0125  0.0125  0.0125  0.0125  0.0125  0.0125
            Tire:   0.0080  0.0080  0.0080  0.0080  0.0085  0.0080  0.0080  0.0248  0.0040  0.0094
        Total PM:   0.0248  0.0248  0.0248  0.0248  0.0445  0.1165  0.0480  0.1350  0.0371  0.0351
             SO2:   0.0067  0.0088  0.0115  0.0096  0.0162  0.0029  0.0052  0.0131  0.0033  0.0092
             NH3:   0.1011  0.1015  0.1017  0.1016  0.0451  0.0068  0.0068  0.0270  0.0113  0.0925
 ------------------------------------------------------------------------------------------------------

        Veh. Type:   GasBUS   URBAN   SCHOOL
                     ------  ------  ------
          VMT Mix:   0.0003  0.0009  0.0015
 ------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
            Lead:   0.0000  ------  ------
           GASPM:   0.0294  ------  ------
         ECARBON:   ------  0.0823  0.0489
         OCARBON:   ------  0.0646  0.0384
             SO4:   0.0020  0.0015  0.0011
  Total Exhaust PM:   0.0314  0.1484  0.0884
           Brake:   0.0125  0.0125  0.0125
            Tire:   0.0120  0.0120  0.0120
        Total PM:   0.0560  0.1729  0.1129
             SO2:   0.0251  0.0218  0.0153
             NH3:   0.0451  0.0270  0.0270
 ------------------------------------------------------------------------------------------------------


* # # # # # # # # # # # # # # # # # # # # # # # # #
* 2012 50 mph - Summer
* File 1, Run 1, Scenario 9.
* # # # # # # # # # # # # # # # # # # # # # # # # #

                     Calendar Year:  2012
                             Month:  July
          Gasoline Fuel Sulfur Content:   30. ppm
            Diesel Fuel Sulfur Content:   15. ppm
                Particle Size Cutoff: 10.00 Microns
                  Reformulated Gas:  Yes

       Vehicle Type:    LDGV   LDGT12   LDGT34    LDGT    HDGV    LDDV    LDDT    HDDV      MC   All Veh
```

```
        GVWR:        <6000   >6000   (All)
                  ------  ------  ------  ------  ------  ------  ------  ------  ------  ------
  VMT Distribution:  0.3071  0.4054  0.1595          0.0369  0.0002  0.0015  0.0857  0.0038  1.0000
--------------------------------------------------------------------------------------------------
Composite Emission Factors (g/mi):
        Lead:  0.0000  0.0000  0.0000  0.0000  0.0000  ------  ------  ------  0.0000  0.0000
       GASPM:  0.0040  0.0038  0.0038  0.0038  0.0215  ------  ------  ------  0.0205  0.0043
     ECARBON:  ------  ------  ------  ------  ------  0.0747  0.0111  0.0645  ------  0.0056
     OCARBON:  ------  ------  ------  ------  ------  0.0211  0.0160  0.0322  ------  0.0028
         SO4:  0.0002  0.0004  0.0004  0.0004  0.0019  0.0002  0.0003  0.0009  0.0001  0.0005
 Total Exhaust PM:  0.0042  0.0043  0.0043  0.0043  0.0234  0.0960  0.0275  0.0976  0.0206  0.0131
       Brake:  0.0125  0.0125  0.0125  0.0125  0.0125  0.0125  0.0125  0.0125  0.0125  0.0125
        Tire:  0.0080  0.0080  0.0080  0.0080  0.0085  0.0080  0.0080  0.0248  0.0040  0.0094
     Total PM:  0.0248  0.0248  0.0248  0.0248  0.0445  0.1165  0.0480  0.1350  0.0371  0.0351
         SO2:  0.0067  0.0088  0.0115  0.0096  0.0162  0.0029  0.0052  0.0131  0.0033  0.0092
         NH3:  0.1011  0.1015  0.1017  0.1016  0.0451  0.0068  0.0068  0.0270  0.0113  0.0925
--------------------------------------------------------------------------------------------------
    Veh. Type:  GasBUS   URBAN   SCHOOL
                ------  ------  ------
      VMT Mix:  0.0003  0.0009  0.0015
--------------------------------------------------------------------------------------------------
Composite Emission Factors (g/mi):
        Lead:  0.0000  ------  ------
       GASPM:  0.0294  ------  ------
     ECARBON:  ------  0.0823  0.0489
     OCARBON:  ------  0.0646  0.0384
         SO4:  0.0020  0.0015  0.0011
 Total Exhaust PM:  0.0314  0.1484  0.0884
       Brake:  0.0125  0.0125  0.0125
        Tire:  0.0120  0.0120  0.0120
     Total PM:  0.0560  0.1729  0.1129
         SO2:  0.0251  0.0218  0.0153
         NH3:  0.0451  0.0270  0.0270
--------------------------------------------------------------------------------------------------
```

Source: KBE and Massport.

Table I-9 MOVES2010b Sample Input File for 2013


```
<runspec>
	<description><![CDATA[2013 BOS EDR - Suffolk County 07/72/14 - Summer]]></description>
	<modelscale value="Inv"/>
	<modeldomain value="PROJECT"/>
	<geographicselections>
		<geographicselection type="COUNTY" key="25025" description="MASSACHUSETTS - Suffolk County"/>
	</geographicselections>
	<timespan>
		<year key="2013"/>
		<month id="7"/>
		<day id="5"/>
		<beginhour id="16"/>
		<endhour id="16"/>
		<aggregateBy key="Hour"/>
	</timespan>
	<onroadvehicleselections>
		<onroadvehicleselection fueltypeid="3" fueltypedesc="Compressed Natural Gas (CNG)" sourcetypeid="21" sourcetypename="Passenger Car"/>
		<onroadvehicleselection fueltypeid="3" fueltypedesc="Compressed Natural Gas (CNG)" sourcetypeid="31" sourcetypename="Passenger Truck"/>
		<onroadvehicleselection fueltypeid="2" fueltypedesc="Diesel Fuel" sourcetypeid="21" sourcetypename="Passenger Car"/>
		<onroadvehicleselection fueltypeid="2" fueltypedesc="Diesel Fuel" sourcetypeid="31" sourcetypename="Passenger Truck"/>
		<onroadvehicleselection fueltypeid="1" fueltypedesc="Gasoline" sourcetypeid="21" sourcetypename="Passenger Car"/>
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		<onroadvehicleselection fueltypeid="4" fueltypedesc="Liquefied Petroleum Gas (LPG)" sourcetypeid="21" sourcetypename="Passenger Car"/>
		<onroadvehicleselection fueltypeid="4" fueltypedesc="Liquefied Petroleum Gas (LPG)" sourcetypeid="31" sourcetypename="Passenger Truck"/>
	</onroadvehicleselections>
	<offroadvehicleselections>
	</offroadvehicleselections>
	<offroadvehiclesccs>
	</offroadvehiclesccs>
	<roadtypes>
		<roadtype roadtypeid="1" roadtypename="Off-Network"/>
		<roadtype roadtypeid="2" roadtypename="Rural Restricted Access"/>
		<roadtype roadtypeid="3" roadtypename="Rural Unrestricted Access"/>
		<roadtype roadtypeid="4" roadtypename="Urban Restricted Access"/>
		<roadtype roadtypeid="5" roadtypename="Urban Unrestricted Access"/>
	</roadtypes>
	<pollutantprocessassociations>
		<pollutantprocessassociation pollutantkey="90" pollutantname="Atmospheric CO2" processkey="1" processname="Running Exhaust"/>
		<pollutantprocessassociation pollutantkey="90" pollutantname="Atmospheric CO2" processkey="2" processname="Start Exhaust"/>
		<pollutantprocessassociation pollutantkey="90" pollutantname="Atmospheric CO2" processkey="90" processname="Extended Idle Exhaust"/>
		<pollutantprocessassociation pollutantkey="2" pollutantname="Carbon Monoxide (CO)" processkey="1" processname="Running Exhaust"/>
		<pollutantprocessassociation pollutantkey="2" pollutantname="Carbon Monoxide (CO)" processkey="2" processname="Start Exhaust"/>
		<pollutantprocessassociation pollutantkey="2" pollutantname="Carbon Monoxide (CO)" processkey="15" processname="Crankcase Running Exhaust"/>
		<pollutantprocessassociation pollutantkey="2" pollutantname="Carbon Monoxide (CO)" processkey="16" processname="Crankcase Start Exhaust"/>
```

<pollutantprocessassociation pollutantkey="2" pollutantname="Carbon Monoxide (CO)" processkey="17" processname="Crankcase Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="2" pollutantname="Carbon Monoxide (CO)" processkey="90" processname="Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="5" pollutantname="Methane (CH4)" processkey="1" processname="Running Exhaust"/>
<pollutantprocessassociation pollutantkey="5" pollutantname="Methane (CH4)" processkey="2" processname="Start Exhaust"/>
<pollutantprocessassociation pollutantkey="5" pollutantname="Methane (CH4)" processkey="15" processname="Crankcase Running Exhaust"/>
<pollutantprocessassociation pollutantkey="5" pollutantname="Methane (CH4)" processkey="16" processname="Crankcase Start Exhaust"/>
<pollutantprocessassociation pollutantkey="5" pollutantname="Methane (CH4)" processkey="17" processname="Crankcase Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="5" pollutantname="Methane (CH4)" processkey="18" processname="Refueling Displacement Vapor Loss"/>
<pollutantprocessassociation pollutantkey="5" pollutantname="Methane (CH4)" processkey="19" processname="Refueling Spillage Loss"/>
<pollutantprocessassociation pollutantkey="5" pollutantname="Methane (CH4)" processkey="90" processname="Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="33" pollutantname="Nitrogen Dioxide (NO2)" processkey="1" processname="Running Exhaust"/>
<pollutantprocessassociation pollutantkey="33" pollutantname="Nitrogen Dioxide (NO2)" processkey="2" processname="Start Exhaust"/>
<pollutantprocessassociation pollutantkey="33" pollutantname="Nitrogen Dioxide (NO2)" processkey="15" processname="Crankcase Running Exhaust"/>
<pollutantprocessassociation pollutantkey="33" pollutantname="Nitrogen Dioxide (NO2)" processkey="16" processname="Crankcase Start Exhaust"/>
<pollutantprocessassociation pollutantkey="33" pollutantname="Nitrogen Dioxide (NO2)" processkey="17" processname="Crankcase Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="33" pollutantname="Nitrogen Dioxide (NO2)" processkey="90" processname="Extended Idle Exhaust"/>
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<pollutantprocessassociation pollutantkey="6" pollutantname="Nitrous Oxide (N2O)" processkey="2" processname="Start Exhaust"/>
<pollutantprocessassociation pollutantkey="6" pollutantname="Nitrous Oxide (N2O)" processkey="15" processname="Crankcase Running Exhaust"/>
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<pollutantprocessassociation pollutantkey="79" pollutantname="Non-Methane Hydrocarbons" processkey="2" processname="Start Exhaust"/>
<pollutantprocessassociation pollutantkey="79" pollutantname="Non-Methane Hydrocarbons" processkey="15" processname="Crankcase Running Exhaust"/>
<pollutantprocessassociation pollutantkey="79" pollutantname="Non-Methane Hydrocarbons" processkey="16" processname="Crankcase Start Exhaust"/>
<pollutantprocessassociation pollutantkey="79" pollutantname="Non-Methane Hydrocarbons" processkey="17" processname="Crankcase Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="79" pollutantname="Non-Methane Hydrocarbons" processkey="18" processname="Refueling Displacement Vapor Loss"/>
<pollutantprocessassociation pollutantkey="79" pollutantname="Non-Methane Hydrocarbons" processkey="19" processname="Refueling Spillage Loss"/>
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<pollutantprocessassociation pollutantkey="3" pollutantname="Oxides of Nitrogen (NOx)" processkey="1" processname="Running Exhaust"/>
<pollutantprocessassociation pollutantkey="3" pollutantname="Oxides of Nitrogen (NOx)" processkey="2" processname="Start Exhaust"/>

<pollutantprocessassociation pollutantkey="3" pollutantname="Oxides of Nitrogen (NOx)" processkey="15" processname="Crankcase Running Exhaust"/>
<pollutantprocessassociation pollutantkey="3" pollutantname="Oxides of Nitrogen (NOx)" processkey="16" processname="Crankcase Start Exhaust"/>
<pollutantprocessassociation pollutantkey="3" pollutantname="Oxides of Nitrogen (NOx)" processkey="17" processname="Crankcase Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="3" pollutantname="Oxides of Nitrogen (NOx)" processkey="90" processname="Extended Idle Exhaust"/>
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<pollutantprocessassociation pollutantkey="100" pollutantname="Primary Exhaust PM10 - Total" processkey="2" processname="Start Exhaust"/>
<pollutantprocessassociation pollutantkey="100" pollutantname="Primary Exhaust PM10 - Total" processkey="15" processname="Crankcase Running Exhaust"/>
<pollutantprocessassociation pollutantkey="100" pollutantname="Primary Exhaust PM10 - Total" processkey="16" processname="Crankcase Start Exhaust"/>
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<pollutantprocessassociation pollutantkey="110" pollutantname="Primary Exhaust PM2.5 - Total" processkey="1" processname="Running Exhaust"/>
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<pollutantprocessassociation pollutantkey="106" pollutantname="Primary PM10 - Brakewear Particulate" processkey="9" processname="Brakewear"/>
<pollutantprocessassociation pollutantkey="102" pollutantname="Primary PM10 - Elemental Carbon" processkey="1" processname="Running Exhaust"/>
<pollutantprocessassociation pollutantkey="102" pollutantname="Primary PM10 - Elemental Carbon" processkey="2" processname="Start Exhaust"/>
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<pollutantprocessassociation pollutantkey="102" pollutantname="Primary PM10 - Elemental Carbon" processkey="16" processname="Crankcase Start Exhaust"/>
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<pollutantprocessassociation pollutantkey="101" pollutantname="Primary PM10 - Organic Carbon" processkey="1" processname="Running Exhaust"/>
<pollutantprocessassociation pollutantkey="101" pollutantname="Primary PM10 - Organic Carbon" processkey="2" processname="Start Exhaust"/>
<pollutantprocessassociation pollutantkey="101" pollutantname="Primary PM10 - Organic Carbon" processkey="15" processname="Crankcase Running Exhaust"/>

<pollutantprocessassociation pollutantkey="101" pollutantname="Primary PM10 - Organic Carbon" processkey="16" processname="Crankcase Start Exhaust"/>
<pollutantprocessassociation pollutantkey="101" pollutantname="Primary PM10 - Organic Carbon" processkey="17" processname="Crankcase Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="101" pollutantname="Primary PM10 - Organic Carbon" processkey="90" processname="Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="105" pollutantname="Primary PM10 - Sulfate Particulate" processkey="1" processname="Running Exhaust"/>
<pollutantprocessassociation pollutantkey="105" pollutantname="Primary PM10 - Sulfate Particulate" processkey="2" processname="Start Exhaust"/>
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<pollutantprocessassociation pollutantkey="116" pollutantname="Primary PM2.5 - Brakewear Particulate" processkey="9" processname="Brakewear"/>
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<pollutantprocessassociation pollutantkey="112" pollutantname="Primary PM2.5 - Elemental Carbon" processkey="2" processname="Start Exhaust"/>
<pollutantprocessassociation pollutantkey="112" pollutantname="Primary PM2.5 - Elemental Carbon" processkey="15" processname="Crankcase Running Exhaust"/>
<pollutantprocessassociation pollutantkey="112" pollutantname="Primary PM2.5 - Elemental Carbon" processkey="16" processname="Crankcase Start Exhaust"/>
<pollutantprocessassociation pollutantkey="112" pollutantname="Primary PM2.5 - Elemental Carbon" processkey="17" processname="Crankcase Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="112" pollutantname="Primary PM2.5 - Elemental Carbon" processkey="90" processname="Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="111" pollutantname="Primary PM2.5 - Organic Carbon" processkey="1" processname="Running Exhaust"/>
<pollutantprocessassociation pollutantkey="111" pollutantname="Primary PM2.5 - Organic Carbon" processkey="2" processname="Start Exhaust"/>
<pollutantprocessassociation pollutantkey="111" pollutantname="Primary PM2.5 - Organic Carbon" processkey="15" processname="Crankcase Running Exhaust"/>
<pollutantprocessassociation pollutantkey="111" pollutantname="Primary PM2.5 - Organic Carbon" processkey="16" processname="Crankcase Start Exhaust"/>
<pollutantprocessassociation pollutantkey="111" pollutantname="Primary PM2.5 - Organic Carbon" processkey="17" processname="Crankcase Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="111" pollutantname="Primary PM2.5 - Organic Carbon" processkey="90" processname="Extended Idle Exhaust"/>
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<pollutantprocessassociation pollutantkey="115" pollutantname="Primary PM2.5 - Sulfate Particulate" processkey="15" processname="Crankcase Running Exhaust"/>

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<pollutantprocessassociation pollutantkey="117" pollutantname="Primary PM2.5 - Tirewear Particulate" processkey="10" processname="Tirewear"/>
<pollutantprocessassociation pollutantkey="31" pollutantname="Sulfur Dioxide (SO2)" processkey="1" processname="Running Exhaust"/>
<pollutantprocessassociation pollutantkey="31" pollutantname="Sulfur Dioxide (SO2)" processkey="2" processname="Start Exhaust"/>
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<pollutantprocessassociation pollutantkey="1" pollutantname="Total Gaseous Hydrocarbons" processkey="15" processname="Crankcase Running Exhaust"/>
<pollutantprocessassociation pollutantkey="1" pollutantname="Total Gaseous Hydrocarbons" processkey="16" processname="Crankcase Start Exhaust"/>
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<pollutantprocessassociation pollutantkey="87" pollutantname="Volatile Organic Compounds" processkey="1" processname="Running Exhaust"/>
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<pollutantprocessassociation pollutantkey="87" pollutantname="Volatile Organic Compounds" processkey="19" processname="Refueling Spillage Loss"/>
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<savedata>

</savedata>

<donotexecute>

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		</donotexecute>

		<generatordatabase shouldsave="false" servername="" databasename="" description=""/>
				<donotperformfinalaggregation selected="false"/>
		<lookuptableflags scenarioid="" truncateoutput="true" truncateactivity="true"/>
	</runspec>
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Source: KBE and Massport.

Table I-10 MOVES2010b Sample Output Files for 2013

MasterKey	MOVESRunID	iterationID	yearID	monthID	dayID	hourID	stateID	countyID	zoneID	linkID	pollutantID	
	processID	sourceTypeID	fuelTypeID	modelYearID	roadTypeID	SCC	emissionQuant		activityTypeID		activity	
	emissionRate	massUnits	distanceUnits	MPH								
"2,1,2013,7,5,16,25,25025,250250,2,31,0,0,5,00"			2	1	2013	7	5	16	25	25025	250250	2
	1	31	0	0	5	0	0.541467488	1	1	0.541467488	g	mi
	5											
"2,1,2013,7,5,16,25,25025,250250,1,21,0,0,5,00"			2	1	2013	7	5	16	25	25025	250250	1
	1	21	0	0	5	0	0.326723099	1	1	0.326723099	g	mi
	5											
"2,1,2013,7,5,16,25,25025,250250,2,31,0,0,5,00"			2	1	2013	7	5	16	25	25025	250250	2
	2	31	0	0	5	0	11.17020035	1	1	11.17020035	g	mi
	5 9.54											
"2,1,2013,7,5,16,25,25025,250250,1,21,0,0,5,00"			2	1	2013	7	5	16	25	25025	250250	1
	2	21	0	0	5	0	7.90542984	1	1	7.90542984	g	mi
	5											
"2,1,2013,7,5,16,25,25025,250250,2,31,0,0,5,00"			2	1	2013	7	5	16	25	25025	250250	2
	3	31	0	0	5	0	2.195039988	1	1	2.195039988	g	mi
	5											
"2,1,2013,7,5,16,25,25025,250250,1,21,0,0,5,00"			2	1	2013	7	5	16	25	25025	250250	1
	3	21	0	0	5	0	1.142830014	1	1	1.142830014	g	mi
	5											
"2,1,2013,7,5,16,25,25025,250250,2,31,0,0,5,00"			2	1	2013	7	5	16	25	25025	250250	2
	5	31	0	0	5	0	0.021090999	1	1	0.021090999	g	mi
	5											
"2,1,2013,7,5,16,25,25025,250250,1,21,0,0,5,00"			2	1	2013	7	5	16	25	25025	250250	1
	5	21	0	0	5	0	0.0173645	1	1	0.0173645	g	mi
	5											
"2,1,2013,7,5,16,25,25025,250250,2,31,0,0,5,00"			2	1	2013	7	5	16	25	25025	250250	2
	6	31	0	0	5	0	0.0344657	1	1	0.0344657	g	mi
	5											
"2,1,2013,7,5,16,25,25025,250250,1,21,0,0,5,00"			2	1	2013	7	5	16	25	25025	250250	1
	6	21	0	0	5	0	0.016850799	1	1	0.016850799	g	mi
	5											
"2,1,2013,7,5,16,25,25025,250250,2,31,0,0,5,00"			2	1	2013	7	5	16	25	25025	250250	2
	31	31	0	0	5	0	0.0420729	1	1	0.0420729	g	mi
	5											
"2,1,2013,7,5,16,25,25025,250250,1,21,0,0,5,00"			2	1	2013	7	5	16	25	25025	250250	1
	31	21	0	0	5	0	0.031576999	1	1	0.031576999	g	mi
	5											
"2,1,2013,7,5,16,25,25025,250250,2,31,0,0,5,00"			2	1	2013	7	5	16	25	25025	250250	2
	33	31	0	0	5	0	0.290695995	1	1	0.290695995	g	mi
	5											
"2,1,2013,7,5,16,25,25025,250250,1,21,0,0,5,00"			2	1	2013	7	5	16	25	25025	250250	1
	33	21	0	0	5	0	0.138448	1	1	0.138448	g	mi
	5											
"2,1,2013,7,5,16,25,25025,250250,2,31,0,0,5,00"			2	1	2013	7	5	16	25	25025	250250	2
	79	31	0	0	5	0	0.520376503	1	1	0.520376503	g	mi
	5											
"2,1,2013,7,5,16,25,25025,250250,1,21,0,0,5,00"			2	1	2013	7	5	16	25	25025	250250	1
	79	21	0	0	5	0	0.30935812	1	1	0.30935812	g	mi
	5											
"2,1,2013,7,5,16,25,25025,250250,2,31,0,0,5,00"			2	1	2013	7	5	16	25	25025	250250	2
	87	31	0	0	5	0	0.536831021	1	1	0.536831021	g	mi
	5											
"2,1,2013,7,5,16,25,25025,250250,1,21,0,0,5,00"			2	1	2013	7	5	16	25	25025	250250	1
	87	21	0	0	5	0	0.318788111	1	1	0.318788111	g	mi
	5											
"2,1,2013,7,5,16,25,25025,250250,2,31,0,0,5,00"			2	1	2013	7	5	16	25	25025	250250	2
	90	31	0	0	5	0	1616.969971	1	1	1616.969971	g	mi
	5											
"2,1,2013,7,5,16,25,25025,250250,1,21,0,0,5,00"			2	1	2013	7	5	16	25	25025	250250	1
	90	21	0	0	5	0	1217.579956	1	1	1217.579956	g	mi
	5											
"2,1,2013,7,5,16,25,25025,250250,2,31,0,0,5,00"			2	1	2013	7	5	16	25	25025	250250	2
	91	31	0	0	5	0	0.021315079	1	1	0.021315079	g	mi
	5											
"2,1,2013,7,5,16,25,25025,250250,1,21,0,0,5,00"			2	1	2013	7	5	16	25	25025	250250	1
	91	21	0	0	5	0	0.016057063	1	1	0.016057063	g	mi
	5											
"2,1,2013,7,5,16,25,25025,250250,2,31,0,0,5,00"			2	1	2013	7	5	16	25	25025	250250	2
	100		31	0	0	5	0	0.025370281	1	1	0.025370281	g
	mi 5											
"2,1,2013,7,5,16,25,25025,250250,1,21,0,0,5,00"			2	1	2013	7	5	16	25	25025	250250	1
	100		21	0	0	5	0	0.013770857	1	1	0.013770857	g
	mi 5											

"2,1,2013,7,5,16,25,25025,250250,2,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	2
101	31	0	0	5	0	0.0188297	1	1	0.0188297	g
mi 5										
"2,1,2013,7,5,16,25,25025,250250,1,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	1
101	21	0	0	5	0	0.0110328	1	1	0.0110328	g
mi 5										
"2,1,2013,7,5,16,25,25025,250250,2,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	2
102	31	0	0	5	0	0.00621243	1	1	0.00621243	g
mi 5										
"2,1,2013,7,5,16,25,25025,250250,1,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	1
102	21	0	0	5	0	0.00254243	1	1	0.00254243	g
mi 5										
"2,1,2013,7,5,16,25,25025,250250,2,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	2
105	31	0	0	5	0	0.000328182	1	1	0.000328182	g
mi 5										
"2,1,2013,7,5,16,25,25025,250250,1,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	1
105	21	0	0	5	0	0.000195657	1	1	0.000195657	g
mi 5										
"2,1,2013,7,5,16,25,25025,250250,2,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	2
106	31	0	0	5	0	0.128012002	1	1	0.128012002	g
mi 5										
"2,1,2013,7,5,16,25,25025,250250,1,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	1
106	21	0	0	5	0	0.077043504	1	1	0.077043504	g
mi 5										
"2,1,2013,7,5,16,25,25025,250250,2,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	2
107	31	0	0	5	0	0.0102863	1	1	0.0102863	g
mi 5										
"2,1,2013,7,5,16,25,25025,250250,1,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	1
107	21	0	0	5	0	0.0100247	1	1	0.0100247	g
mi 5										
"2,1,2013,7,5,16,25,25025,250250,2,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	2
110	31	0	0	5	0	0.024015995	1	1	0.024015995	g
mi 5										
"2,1,2013,7,5,16,25,25025,250250,1,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	1
110	21	0	0	5	0	0.012702617	1	1	0.012702617	g
mi 5										
"2,1,2013,7,5,16,25,25025,250250,2,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	2
111	31	0	0	5	0	0.017722599	1	1	0.017722599	g
mi 5										
"2,1,2013,7,5,16,25,25025,250250,1,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	1
111	21	0	0	5	0	0.0101714	1	1	0.0101714	g
mi 5										
"2,1,2013,7,5,16,25,25025,250250,2,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	2
112	31	0	0	5	0	0.00598663	1	1	0.00598663	g
mi 5										
"2,1,2013,7,5,16,25,25025,250250,1,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	1
112	21	0	0	5	0	0.00235052	1	1	0.00235052	g
mi 5										
"2,1,2013,7,5,16,25,25025,250250,2,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	2
115	31	0	0	5	0	0.000306794	1	1	0.000306794	g
mi 5										
"2,1,2013,7,5,16,25,25025,250250,1,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	1
115	21	0	0	5	0	0.000180717	1	1	0.000180717	g
mi 5										
"2,1,2013,7,5,16,25,25025,250250,2,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	2
116	31	0	0	5	0	0.033511098	1	1	0.033511098	g
mi 5										
"2,1,2013,7,5,16,25,25025,250250,1,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	1
116	21	0	0	5	0	0.0201685	1	1	0.0201685	g
mi 5										
"2,1,2013,7,5,16,25,25025,250250,2,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	2
117	31	0	0	5	0	0.00246674	1	1	0.00246674	g
mi 5										
"2,1,2013,7,5,16,25,25025,250250,1,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	1
117	21	0	0	5	0	0.002404	1	1	0.002404	g
mi 5										
"2,1,2013,7,5,16,25,25025,250250,5,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	5
1 31	0	0	5	0	0.339683294	1	1	0.339683294	g	mi
10										
"2,1,2013,7,5,16,25,25025,250250,4,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	4
1 21	0	0	5	0	0.196033701	1	1	0.196033701	g	mi
10										
"2,1,2013,7,5,16,25,25025,250250,5,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	5
2 31	0	0	5	0	8.026370049	1	1	8.026370049	g	mi
10										
"2,1,2013,7,5,16,25,25025,250250,4,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	4
2 21	0	0	5	0	5.577809811	1	1	5.577809811	g	mi
10										

"2,1,2013,7,5,16,25,25025,250250,5,31,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	5
3	31	0	0	5	0	1.550410032	1	1	1.550410032	g	mi
10											
"2,1,2013,7,5,16,25,25025,250250,4,21,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	4
3	21	0	0	5	0	0.857756019	1	1	0.857756019	g	mi
10											
"2,1,2013,7,5,16,25,25025,250250,5,31,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	5
5	31	0	0	5	0	0.0133945	1	1	0.0133945	g	mi
10											
"2,1,2013,7,5,16,25,25025,250250,4,21,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	4
5	21	0	0	5	0	0.0111399	1	1	0.0111399	g	mi
10											
"2,1,2013,7,5,16,25,25025,250250,5,31,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	5
6	31	0	0	5	0	0.0172328	1	1	0.0172328	g	mi
10											
"2,1,2013,7,5,16,25,25025,250250,4,21,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	4
6	21	0	0	5	0	0.00842538	1	1	0.00842538	g	mi
10											
"2,1,2013,7,5,16,25,25025,250250,5,31,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	5
31	31	0	0	5	0	0.0256122	1	1	0.0256122	g	mi
10											
"2,1,2013,7,5,16,25,25025,250250,4,21,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	4
31	21	0	0	5	0	0.0190448	1	1	0.0190448	g	mi
10											
"2,1,2013,7,5,16,25,25025,250250,5,31,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	5
33	31	0	0	5	0	0.208293006	1	1	0.208293006	g	mi
10											
"2,1,2013,7,5,16,25,25025,250250,4,21,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	4
33	21	0	0	5	0	0.105052002	1	1	0.105052002	g	mi
10											
"2,1,2013,7,5,16,25,25025,250250,5,31,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	5
79	31	0	0	5	0	0.326289296	1	1	0.326289296	g	mi
10											
"2,1,2013,7,5,16,25,25025,250250,4,21,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	4
79	21	0	0	5	0	0.184893698	1	1	0.184893698	g	mi
10											
"2,1,2013,7,5,16,25,25025,250250,5,31,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	5
87	31	0	0	5	0	0.336544394	1	1	0.336544394	g	mi
10											
"2,1,2013,7,5,16,25,25025,250250,4,21,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	4
87	21	0	0	5	0	0.190544009	1	1	0.190544009	g	mi
10											
"2,1,2013,7,5,16,25,25025,250250,5,31,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	5
90	31	0	0	5	0	984.1790161	1	1	984.1790161	g	mi
10											
"2,1,2013,7,5,16,25,25025,250250,4,21,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	4
90	21	0	0	5	0	734.3469849	1	1	734.3469849	g	mi
10											
"2,1,2013,7,5,16,25,25025,250250,5,31,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	5
91	31	0	0	5	0	0.012973246	1	1	0.012973246	g	mi
10											
"2,1,2013,7,5,16,25,25025,250250,4,21,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	4
91	21	0	0	5	0	0.009684321	1	1	0.009684321	g	mi
10											
"2,1,2013,7,5,16,25,25025,250250,5,31,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	5
100		31	0	0	5	0	0.018086907	1	1	0.018086907	g
mi 10											
"2,1,2013,7,5,16,25,25025,250250,4,21,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	4
100		21	0	0	5	0	0.009970945	1	1	0.009970945	g
mi 10											
"2,1,2013,7,5,16,25,25025,250250,5,31,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	5
101		31	0	0	5	0	0.0136242	1	1	0.0136242	g
mi 10											
"2,1,2013,7,5,16,25,25025,250250,4,21,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	4
101		21	0	0	5	0	0.00800066	1	1	0.00800066	g
mi 10											
"2,1,2013,7,5,16,25,25025,250250,5,31,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	5
102		31	0	0	5	0	0.00426086	1	1	0.00426086	g
mi 10											
"2,1,2013,7,5,16,25,25025,250250,4,21,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	4
102		21	0	0	5	0	0.00185221	1	1	0.00185221	g
mi 10											
"2,1,2013,7,5,16,25,25025,250250,5,31,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	5
105		31	0	0	5	0	0.000201806	1	1	0.000201806	g
mi 10											
"2,1,2013,7,5,16,25,25025,250250,4,21,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	4
105		21	0	0	5	0	0.000118075	1	1	0.000118075	g
mi 10											

"2,1,2013,7,5,16,25,25025,250250,5,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	5
106	31	0	0	5	0	0.073845498	1	1	0.073845498	g
mi 10										
"2,1,2013,7,5,16,25,25025,250250,4,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	4
106	21	0	0	5	0	0.044722699	1	1	0.044722699	g
mi 10										
"2,1,2013,7,5,16,25,25025,250250,5,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	5
107	31	0	0	5	0	0.00954603	1	1	0.00954603	g
mi 10										
"2,1,2013,7,5,16,25,25025,250250,4,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	4
107	21	0	0	5	0	0.00930327	1	1	0.00930327	g
mi 10										
"2,1,2013,7,5,16,25,25025,250250,5,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	5
110	31	0	0	5	0	0.017015142	1	1	0.017015142	g
mi 10										
"2,1,2013,7,5,16,25,25025,250250,4,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	4
110	21	0	0	5	0	0.009193944	1	1	0.009193944	g
mi 10										
"2,1,2013,7,5,16,25,25025,250250,5,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	5
111	31	0	0	5	0	0.0127288	1	1	0.0127288	g
mi 10										
"2,1,2013,7,5,16,25,25025,250250,4,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	4
111	21	0	0	5	0	0.00737279	1	1	0.00737279	g
mi 10										
"2,1,2013,7,5,16,25,25025,250250,5,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	5
112	31	0	0	5	0	0.00409761	1	1	0.00409761	g
mi 10										
"2,1,2013,7,5,16,25,25025,250250,4,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	4
112	21	0	0	5	0	0.00171208	1	1	0.00171208	g
mi 10										
"2,1,2013,7,5,16,25,25025,250250,5,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	5
115	31	0	0	5	0	0.000188741	1	1	0.000188741	g
mi 10										
"2,1,2013,7,5,16,25,25025,250250,4,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	4
115	21	0	0	5	0	0.000109063	1	1	0.000109063	g
mi 10										
"2,1,2013,7,5,16,25,25025,250250,5,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	5
116	31	0	0	5	0	0.019331301	1	1	0.019331301	g
mi 10										
"2,1,2013,7,5,16,25,25025,250250,4,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	4
116	21	0	0	5	0	0.0117075	1	1	0.0117075	g
mi 10										
"2,1,2013,7,5,16,25,25025,250250,5,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	5
117	31	0	0	5	0	0.00228922	1	1	0.00228922	g
mi 10										
"2,1,2013,7,5,16,25,25025,250250,4,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	4
117	21	0	0	5	0	0.002231	1	1	0.002231	g
mi 10										
"2,1,2013,7,5,16,25,25025,250250,8,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	8
1 31	0	0	5	0	0.27259931	1	1	0.27259931	g	mi
15										
"2,1,2013,7,5,16,25,25025,250250,7,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	7
1 21	0	0	5	0	0.152553529	1	1	0.152553529	g	mi
15										
"2,1,2013,7,5,16,25,25025,250250,8,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	8
2 31	0	0	5	0	7.032839775	1	1	7.032839775	g	mi
15										
"2,1,2013,7,5,16,25,25025,250250,7,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	7
2 21	0	0	5	0	4.838580132	1	1	4.838580132	g	mi
15										
"2,1,2013,7,5,16,25,25025,250250,8,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	8
3 31	0	0	5	0	1.241090059	1	1	1.241090059	g	mi
15										
"2,1,2013,7,5,16,25,25025,250250,7,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	7
3 21	0	0	5	0	0.704855025	1	1	0.704855025	g	mi
15										
"2,1,2013,7,5,16,25,25025,250250,8,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	8
5 31	0	0	5	0	0.0108368	1	1	0.0108368	g	mi
15										
"2,1,2013,7,5,16,25,25025,250250,7,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	7
5 21	0	0	5	0	0.00907194	1	1	0.00907194	g	mi
15										
"2,1,2013,7,5,16,25,25025,250250,8,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	8
6 31	0	0	5	0	0.0114886	1	1	0.0114886	g	mi
15										
"2,1,2013,7,5,16,25,25025,250250,7,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	7
6 21	0	0	5	0	0.00561692	1	1	0.00561692	g	mi
15										

"2,1,2013,7,5,16,25,25025,250250,8,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	8
31 31	0	0	5	0	0.0201253	1	1	0.0201253	g	mi
15										
"2,1,2013,7,5,16,25,25025,250250,7,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	7
31 21	0	0	5	0	0.0148673	1	1	0.0148673	g	mi
15										
"2,1,2013,7,5,16,25,25025,250250,8,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	8
33 31	0	0	5	0	0.167715997	1	1	0.167715997	g	mi
15										
"2,1,2013,7,5,16,25,25025,250250,7,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	7
33 21	0	0	5	0	0.0866317	1	1	0.0866317	g	mi
15										
"2,1,2013,7,5,16,25,25025,250250,8,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	8
79 31	0	0	5	0	0.261762291	1	1	0.261762291	g	mi
15										
"2,1,2013,7,5,16,25,25025,250250,7,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	7
79 21	0	0	5	0	0.143481523	1	1	0.143481523	g	mi
15										
"2,1,2013,7,5,16,25,25025,250250,8,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	8
87 31	0	0	5	0	0.269955814	1	1	0.269955814	g	mi
15										
"2,1,2013,7,5,16,25,25025,250250,7,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	7
87 21	0	0	5	0	0.147874892	1	1	0.147874892	g	mi
15										
"2,1,2013,7,5,16,25,25025,250250,8,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	8
90 31	0	0	5	0	773.2470093	1	1	773.2470093	g	mi
15										
"2,1,2013,7,5,16,25,25025,250250,7,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	7
90 21	0	0	5	0	573.2659912	1	1	573.2659912	g	mi
15										
"2,1,2013,7,5,16,25,25025,250250,8,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	8
91 31	0	0	5	0	0.010192635	1	1	0.010192635	g	mi
15										
"2,1,2013,7,5,16,25,25025,250250,7,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	7
91 21	0	0	5	0	0.007560035	1	1	0.007560035	g	mi
15										
"2,1,2013,7,5,16,25,25025,250250,8,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	8
100	31	0	0	5	0	0.015659081	1	1	0.015659081	g
mi 15										
"2,1,2013,7,5,16,25,25025,250250,7,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	7
100	21	0	0	5	0	0.008704285	1	1	0.008704285	g
mi 15										
"2,1,2013,7,5,16,25,25025,250250,8,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	8
101	31	0	0	5	0	0.0118891	1	1	0.0118891	g
mi 15										
"2,1,2013,7,5,16,25,25025,250250,7,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	7
101	21	0	0	5	0	0.00698994	1	1	0.00698994	g
mi 15										
"2,1,2013,7,5,16,25,25025,250250,8,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	8
102	31	0	0	5	0	0.00361034	1	1	0.00361034	g
mi 15										
"2,1,2013,7,5,16,25,25025,250250,7,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	7
102	21	0	0	5	0	0.00162213	1	1	0.00162213	g
mi 15										
"2,1,2013,7,5,16,25,25025,250250,8,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	8
105	31	0	0	5	0	0.00015968	1	1	0.00015968	g
mi 15										
"2,1,2013,7,5,16,25,25025,250250,7,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	7
105	21	0	0	5	0	9.22E-05	1	1	9.22E-05	g
mi 15										
"2,1,2013,7,5,16,25,25025,250250,8,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	8
106	31	0	0	5	0	0.055789798	1	1	0.055789798	g
mi 15										
"2,1,2013,7,5,16,25,25025,250250,7,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	7
106	21	0	0	5	0	0.033949099	1	1	0.033949099	g
mi 15										
"2,1,2013,7,5,16,25,25025,250250,8,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	8
107	31	0	0	5	0	0.00886139	1	1	0.00886139	g
mi 15										
"2,1,2013,7,5,16,25,25025,250250,7,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	7
107	21	0	0	5	0	0.00863606	1	1	0.00863606	g
mi 15										
"2,1,2013,7,5,16,25,25025,250250,8,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	8
110	31	0	0	5	0	0.014681491	1	1	0.014681491	g
mi 15										
"2,1,2013,7,5,16,25,25025,250250,7,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	7
110	21	0	0	5	0	0.008024358	1	1	0.008024358	g
mi 15										

"2,1,2013,7,5,16,25,25025,250250,8,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	8
111	31	0	0	5	0	0.0110641	1	1	0.0110641	g
mi 15										
"2,1,2013,7,5,16,25,25025,250250,7,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	7
111	21	0	0	5	0	0.00643991	1	1	0.00643991	g
mi 15										
"2,1,2013,7,5,16,25,25025,250250,8,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	8
112	31	0	0	5	0	0.00346793	1	1	0.00346793	g
mi 15										
"2,1,2013,7,5,16,25,25025,250250,7,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	7
112	21	0	0	5	0	0.00149927	1	1	0.00149927	g
mi 15										
"2,1,2013,7,5,16,25,25025,250250,8,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	8
115	31	0	0	5	0	0.000149391	1	1	0.000149391	g
mi 15										
"2,1,2013,7,5,16,25,25025,250250,7,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	7
115	21	0	0	5	0	8.52E-05	1	1	8.52E-05	g
mi 15										
"2,1,2013,7,5,16,25,25025,250250,8,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	8
116	31	0	0	5	0	0.0146047	1	1	0.0146047	g
mi 15										
"2,1,2013,7,5,16,25,25025,250250,7,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	7
116	21	0	0	5	0	0.00888719	1	1	0.00888719	g
mi 15										
"2,1,2013,7,5,16,25,25025,250250,8,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	8
117	31	0	0	5	0	0.00212503	1	1	0.00212503	g
mi 15										
"2,1,2013,7,5,16,25,25025,250250,7,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	7
117	21	0	0	5	0	0.002071	1	1	0.002071	g
mi 15										
"2,1,2013,7,5,16,25,25025,250250,11,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	11
1 31	0	0	5	0	0.235486299	1	1	0.235486299	g	mi
20										
"2,1,2013,7,5,16,25,25025,250250,10,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	10
1 21	0	0	5	0	0.129031345	1	1	0.129031345	g	mi
20										
"2,1,2013,7,5,16,25,25025,250250,11,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	11
2 31	0	0	5	0	6.342860222	1	1	6.342860222	g	mi
20										
"2,1,2013,7,5,16,25,25025,250250,10,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	10
2 21	0	0	5	0	4.314929962	1	1	4.314929962	g	mi
20										
"2,1,2013,7,5,16,25,25025,250250,11,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	11
3 31	0	0	5	0	1.029240012	1	1	1.029240012	g	mi
20										
"2,1,2013,7,5,16,25,25025,250250,10,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	10
3 21	0	0	5	0	0.590570986	1	1	0.590570986	g	mi
20										
"2,1,2013,7,5,16,25,25025,250250,11,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	11
5 31	0	0	5	0	0.00938203	1	1	0.00938203	g	mi
20										
"2,1,2013,7,5,16,25,25025,250250,10,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	10
5 21	0	0	5	0	0.00787267	1	1	0.00787267	g	mi
20										
"2,1,2013,7,5,16,25,25025,250250,11,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	11
6 31	0	0	5	0	0.00861641	1	1	0.00861641	g	mi
20										
"2,1,2013,7,5,16,25,25025,250250,10,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	10
6 21	0	0	5	0	0.00421269	1	1	0.00421269	g	mi
20										
"2,1,2013,7,5,16,25,25025,250250,11,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	11
31 31	0	0	5	0	0.0173086	1	1	0.0173086	g	mi
20										
"2,1,2013,7,5,16,25,25025,250250,10,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	10
31 21	0	0	5	0	0.0127003	1	1	0.0127003	g	mi
20										
"2,1,2013,7,5,16,25,25025,250250,11,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	11
33 31	0	0	5	0	0.139559999	1	1	0.139559999	g	mi
20										
"2,1,2013,7,5,16,25,25025,250250,10,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	10
33 21	0	0	5	0	0.072641797	1	1	0.072641797	g	mi
20										
"2,1,2013,7,5,16,25,25025,250250,11,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	11
79 31	0	0	5	0	0.226104304	1	1	0.226104304	g	mi
20										
"2,1,2013,7,5,16,25,25025,250250,10,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	10
79 21	0	0	5	0	0.121158339	1	1	0.121158339	g	mi
20										

"2,1,2013,7,5,16,25,25025,250250,11,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	11
87 31	0	0	5	0	0.233172804	1	1	0.233172804	g	mi
20										
"2,1,2013,7,5,16,25,25025,250250,10,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	10
87 21	0	0	5	0	0.124876671	1	1	0.124876671	g	mi
20										
"2,1,2013,7,5,16,25,25025,250250,11,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	11
90 31	0	0	5	0	664.9710083	1	1	664.9710083	g	mi
20										
"2,1,2013,7,5,16,25,25025,250250,10,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	10
90 21	0	0	5	0	489.7049866	1	1	489.7049866	g	mi
20										
"2,1,2013,7,5,16,25,25025,250250,11,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	11
91 31	0	0	5	0	0.008765317	1	1	0.008765317	g	mi
20										
"2,1,2013,7,5,16,25,25025,250250,10,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	10
91 21	0	0	5	0	0.006458046	1	1	0.006458046	g	mi
20										
"2,1,2013,7,5,16,25,25025,250250,11,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	11
100	31	0	0	5	0	0.013662091	1	1	0.013662091	g
mi 20										
"2,1,2013,7,5,16,25,25025,250250,10,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	10
100	21	0	0	5	0	0.007569498	1	1	0.007569498	g
mi 20										
"2,1,2013,7,5,16,25,25025,250250,11,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	11
101	31	0	0	5	0	0.0103558	1	1	0.0103558	g
mi 20										
"2,1,2013,7,5,16,25,25025,250250,10,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	10
101	21	0	0	5	0	0.00608004	1	1	0.00608004	g
mi 20										
"2,1,2013,7,5,16,25,25025,250250,11,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	11
102	31	0	0	5	0	0.00316834	1	1	0.00316834	g
mi 20										
"2,1,2013,7,5,16,25,25025,250250,10,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	10
102	21	0	0	5	0	0.00141065	1	1	0.00141065	g
mi 20										
"2,1,2013,7,5,16,25,25025,250250,11,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	11
105	31	0	0	5	0	0.000137991	1	1	0.000137991	g
mi 20										
"2,1,2013,7,5,16,25,25025,250250,10,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	10
105	21	0	0	5	0	7.88E-05	1	1	7.88E-05	g
mi 20										
"2,1,2013,7,5,16,25,25025,250250,11,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	11
106	31	0	0	5	0	0.046803702	1	1	0.046803702	g
mi 20										
"2,1,2013,7,5,16,25,25025,250250,10,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	10
106	21	0	0	5	0	0.028479399	1	1	0.028479399	g
mi 20										
"2,1,2013,7,5,16,25,25025,250250,11,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	11
107	31	0	0	5	0	0.00822404	1	1	0.00822404	g
mi 20										
"2,1,2013,7,5,16,25,25025,250250,10,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	10
107	21	0	0	5	0	0.00801475	1	1	0.00801475	g
mi 20										
"2,1,2013,7,5,16,25,25025,250250,11,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	11
110	31	0	0	5	0	0.012789628	1	1	0.012789628	g
mi 20										
"2,1,2013,7,5,16,25,25025,250250,10,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	10
110	21	0	0	5	0	0.006977417	1	1	0.006977417	g
mi 20										
"2,1,2013,7,5,16,25,25025,250250,11,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	11
111	31	0	0	5	0	0.00961831	1	1	0.00961831	g
mi 20										
"2,1,2013,7,5,16,25,25025,250250,10,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	10
111	21	0	0	5	0	0.00560098	1	1	0.00560098	g
mi 20										
"2,1,2013,7,5,16,25,25025,250250,11,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	11
112	31	0	0	5	0	0.00304221	1	1	0.00304221	g
mi 20										
"2,1,2013,7,5,16,25,25025,250250,10,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	10
112	21	0	0	5	0	0.00130366	1	1	0.00130366	g
mi 20										
"2,1,2013,7,5,16,25,25025,250250,11,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	11
115	31	0	0	5	0	0.000129128	1	1	0.000129128	g
mi 20										
"2,1,2013,7,5,16,25,25025,250250,10,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	10
115	21	0	0	5	0	7.28E-05	1	1	7.28E-05	g
mi 20										

"2,1,2013,7,5,16,25,25025,250250,11,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	11
116	31	0	0	5	0	0.0122523	1	1	0.0122523	g
mi 20										
"2,1,2013,7,5,16,25,25025,250250,10,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	10
116	21	0	0	5	0	0.00745534	1	1	0.00745534	g
mi 20										
"2,1,2013,7,5,16,25,25025,250250,11,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	11
117	31	0	0	5	0	0.00197219	1	1	0.00197219	g
mi 20										
"2,1,2013,7,5,16,25,25025,250250,10,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	10
117	21	0	0	5	0	0.001922	1	1	0.001922	g
mi 20										
"2,1,2013,7,5,16,25,25025,250250,14,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	14
1 31	0	0	5	0	0.205836996	1	1	0.205836996	g	mi
25										
"2,1,2013,7,5,16,25,25025,250250,13,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	13
1 21	0	0	5	0	0.111237466	1	1	0.111237466	g	mi
25										
"2,1,2013,7,5,16,25,25025,250250,14,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	14
2 31	0	0	5	0	5.474760056	1	1	5.474760056	g	mi
25										
"2,1,2013,7,5,16,25,25025,250250,13,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	13
2 21	0	0	5	0	3.645420074	1	1	3.645420074	g	mi
25										
"2,1,2013,7,5,16,25,25025,250250,14,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	14
3 31	0	0	5	0	0.889353991	1	1	0.889353991	g	mi
25										
"2,1,2013,7,5,16,25,25025,250250,13,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	13
3 21	0	0	5	0	0.509352028	1	1	0.509352028	g	mi
25										
"2,1,2013,7,5,16,25,25025,250250,14,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	14
5 31	0	0	5	0	0.00814638	1	1	0.00814638	g	mi
25										
"2,1,2013,7,5,16,25,25025,250250,13,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	13
5 21	0	0	5	0	0.00681255	1	1	0.00681255	g	mi
25										
"2,1,2013,7,5,16,25,25025,250250,14,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	14
6 31	0	0	5	0	0.00689313	1	1	0.00689313	g	mi
25										
"2,1,2013,7,5,16,25,25025,250250,13,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	13
6 21	0	0	5	0	0.00337015	1	1	0.00337015	g	mi
25										
"2,1,2013,7,5,16,25,25025,250250,14,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	14
31 31	0	0	5	0	0.0154712	1	1	0.0154712	g	mi
25										
"2,1,2013,7,5,16,25,25025,250250,13,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	13
31 21	0	0	5	0	0.0112422	1	1	0.0112422	g	mi
25										
"2,1,2013,7,5,16,25,25025,250250,14,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	14
33 31	0	0	5	0	0.121002004	1	1	0.121002004	g	mi
25										
"2,1,2013,7,5,16,25,25025,250250,13,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	13
33 21	0	0	5	0	0.062628202	1	1	0.062628202	g	mi
25										
"2,1,2013,7,5,16,25,25025,250250,14,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	14
79 31	0	0	5	0	0.197690994	1	1	0.197690994	g	mi
25										
"2,1,2013,7,5,16,25,25025,250250,13,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	13
79 21	0	0	5	0	0.104424968	1	1	0.104424968	g	mi
25										
"2,1,2013,7,5,16,25,25025,250250,14,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	14
87 31	0	0	5	0	0.203890204	1	1	0.203890204	g	mi
25										
"2,1,2013,7,5,16,25,25025,250250,13,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	13
87 21	0	0	5	0	0.107642993	1	1	0.107642993	g	mi
25										
"2,1,2013,7,5,16,25,25025,250250,14,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	14
90 31	0	0	5	0	594.3540039	1	1	594.3540039	g	mi
25										
"2,1,2013,7,5,16,25,25025,250250,13,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	13
90 21	0	0	5	0	433.4830017	1	1	433.4830017	g	mi
25										
"2,1,2013,7,5,16,25,25025,250250,14,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	14
91 31	0	0	5	0	0.007834428	1	1	0.007834428	g	mi
25										
"2,1,2013,7,5,16,25,25025,250250,13,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	13
91 21	0	0	5	0	0.005716617	1	1	0.005716617	g	mi
25										

"2,1,2013,7,5,16,25,25025,250250,14,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	14
100	31	0	0	5	0	0.010887519	1	1	0.010887519	g
mi 25										
"2,1,2013,7,5,16,25,25025,250250,13,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	13
100	21	0	0	5	0	0.005879078	1	1	0.005879078	g
mi 25										
"2,1,2013,7,5,16,25,25025,250250,14,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	14
101	31	0	0	5	0	0.00809568	1	1	0.00809568	g
mi 25										
"2,1,2013,7,5,16,25,25025,250250,13,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	13
101	21	0	0	5	0	0.0047197	1	1	0.0047197	g
mi 25										
"2,1,2013,7,5,16,25,25025,250250,14,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	14
102	31	0	0	5	0	0.00266815	1	1	0.00266815	g
mi 25										
"2,1,2013,7,5,16,25,25025,250250,13,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	13
102	21	0	0	5	0	0.00108962	1	1	0.00108962	g
mi 25										
"2,1,2013,7,5,16,25,25025,250250,14,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	14
105	31	0	0	5	0	0.000123719	1	1	0.000123719	g
mi 25										
"2,1,2013,7,5,16,25,25025,250250,13,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	13
105	21	0	0	5	0	6.98E-05	1	1	6.98E-05	g
mi 25										
"2,1,2013,7,5,16,25,25025,250250,14,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	14
106	31	0	0	5	0	0.0414965	1	1	0.0414965	g
mi 25										
"2,1,2013,7,5,16,25,25025,250250,13,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	13
106	21	0	0	5	0	0.025030799	1	1	0.025030799	g
mi 25										
"2,1,2013,7,5,16,25,25025,250250,14,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	14
107	31	0	0	5	0	0.00763343	1	1	0.00763343	g
mi 25										
"2,1,2013,7,5,16,25,25025,250250,13,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	13
107	21	0	0	5	0	0.00743928	1	1	0.00743928	g
mi 25										
"2,1,2013,7,5,16,25,25025,250250,14,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	14
110	31	0	0	5	0	0.010195088	1	1	0.010195088	g
mi 25										
"2,1,2013,7,5,16,25,25025,250250,13,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	13
110	21	0	0	5	0	0.005418856	1	1	0.005418856	g
mi 25										
"2,1,2013,7,5,16,25,25025,250250,14,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	14
111	31	0	0	5	0	0.00751578	1	1	0.00751578	g
mi 25										
"2,1,2013,7,5,16,25,25025,250250,13,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	13
111	21	0	0	5	0	0.00434771	1	1	0.00434771	g
mi 25										
"2,1,2013,7,5,16,25,25025,250250,14,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	14
112	31	0	0	5	0	0.00256357	1	1	0.00256357	g
mi 25										
"2,1,2013,7,5,16,25,25025,250250,13,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	13
112	21	0	0	5	0	0.0010067	1	1	0.0010067	g
mi 25										
"2,1,2013,7,5,16,25,25025,250250,14,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	14
115	31	0	0	5	0	0.000115788	1	1	0.000115788	g
mi 25										
"2,1,2013,7,5,16,25,25025,250250,13,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	13
115	21	0	0	5	0	6.44E-05	1	1	6.44E-05	g
mi 25										
"2,1,2013,7,5,16,25,25025,250250,14,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	14
116	31	0	0	5	0	0.010863	1	1	0.010863	g
mi 25										
"2,1,2013,7,5,16,25,25025,250250,13,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	13
116	21	0	0	5	0	0.00655257	1	1	0.00655257	g
mi 25										
"2,1,2013,7,5,16,25,25025,250250,14,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	14
117	31	0	0	5	0	0.00183056	1	1	0.00183056	g
mi 25										
"2,1,2013,7,5,16,25,25025,250250,13,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	13
117	21	0	0	5	0	0.001784	1	1	0.001784	g
mi 25										
"2,1,2013,7,5,16,25,25025,250250,17,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	17
1 31	0	0	5	0	0.182246894	1	1	0.182246894	g	mi
30										
"2,1,2013,7,5,16,25,25025,250250,16,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	16
1 21	0	0	5	0	0.098243289	1	1	0.098243289	g	mi
30										

"2,1,2013,7,5,16,25,25025,250250,17,31,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	17
2	31	0	0	5	0	5.202020168	1	1	5.202020168	g	mi
30											
"2,1,2013,7,5,16,25,25025,250250,16,21,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	16
2	21	0	0	5	0	3.497260094	1	1	3.497260094	g	mi
30											
"2,1,2013,7,5,16,25,25025,250250,17,31,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	17
3	31	0	0	5	0	0.750014007	1	1	0.750014007	g	mi
30											
"2,1,2013,7,5,16,25,25025,250250,16,21,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	16
3	21	0	0	5	0	0.419853985	1	1	0.419853985	g	mi
30											
"2,1,2013,7,5,16,25,25025,250250,17,31,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	17
5	31	0	0	5	0	0.00722917	1	1	0.00722917	g	mi
30											
"2,1,2013,7,5,16,25,25025,250250,16,21,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	16
5	21	0	0	5	0	0.00621248	1	1	0.00621248	g	mi
30											
"2,1,2013,7,5,16,25,25025,250250,17,31,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	17
6	31	0	0	5	0	0.00574428	1	1	0.00574428	g	mi
30											
"2,1,2013,7,5,16,25,25025,250250,16,21,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	16
6	21	0	0	5	0	0.00280846	1	1	0.00280846	g	mi
30											
"2,1,2013,7,5,16,25,25025,250250,17,31,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	17
31	31	0	0	5	0	0.0137833	1	1	0.0137833	g	mi
30											
"2,1,2013,7,5,16,25,25025,250250,16,21,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	16
31	21	0	0	5	0	0.0100314	1	1	0.0100314	g	mi
30											
"2,1,2013,7,5,16,25,25025,250250,17,31,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	17
33	31	0	0	5	0	0.102242	1	1	0.102242	g	mi
30											
"2,1,2013,7,5,16,25,25025,250250,16,21,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	16
33	21	0	0	5	0	0.0516163	1	1	0.0516163	g	mi
30											
"2,1,2013,7,5,16,25,25025,250250,17,31,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	17
79	31	0	0	5	0	0.175017893	1	1	0.175017893	g	mi
30											
"2,1,2013,7,5,16,25,25025,250250,16,21,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	16
79	21	0	0	5	0	0.092030786	1	1	0.092030786	g	mi
30											
"2,1,2013,7,5,16,25,25025,250250,17,31,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	17
87	31	0	0	5	0	0.180512398	1	1	0.180512398	g	mi
30											
"2,1,2013,7,5,16,25,25025,250250,16,21,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	16
87	21	0	0	5	0	0.094872281	1	1	0.094872281	g	mi
30											
"2,1,2013,7,5,16,25,25025,250250,17,31,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	17
90	31	0	0	5	0	529.5089722	1	1	529.5089722	g	mi
30											
"2,1,2013,7,5,16,25,25025,250250,16,21,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	16
90	21	0	0	5	0	386.79599	1	1	386.79599	g	mi
30											
"2,1,2013,7,5,16,25,25025,250250,17,31,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	17
91	31	0	0	5	0	0.006979678	1	1	0.006979678	g	mi
30											
"2,1,2013,7,5,16,25,25025,250250,16,21,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	16
91	21	0	0	5	0	0.005100915	1	1	0.005100915	g	mi
30											
"2,1,2013,7,5,16,25,25025,250250,17,31,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	17
100		31	0	0	5	0	0.009549048	1	1	0.009549048	g
mi 30											
"2,1,2013,7,5,16,25,25025,250250,16,21,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	16
100		21	0	0	5	0	0.005431345	1	1	0.005431345	g
mi 30											
"2,1,2013,7,5,16,25,25025,250250,17,31,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	17
101		31	0	0	5	0	0.00715694	1	1	0.00715694	g
mi 30											
"2,1,2013,7,5,16,25,25025,250250,16,21,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	16
101		21	0	0	5	0	0.0043624	1	1	0.0043624	g
mi 30											
"2,1,2013,7,5,16,25,25025,250250,17,31,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	17
102		31	0	0	5	0	0.00228191	1	1	0.00228191	g
mi 30											
"2,1,2013,7,5,16,25,25025,250250,16,21,0,0,5,00"		2	1	2013	7	5	16	25	25025	250250	16
102		21	0	0	5	0	0.00100667	1	1	0.00100667	g
mi 30											

"2,1,2013,7,5,16,25,25025,250250,17,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	17
105	31	0	0	5	0	0.000110198	1	1	0.000110198	g
mi 30										
"2,1,2013,7,5,16,25,25025,250250,16,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	16
105	21	0	0	5	0	6.23E-05	1	1	6.23E-05	g
mi 30										
"2,1,2013,7,5,16,25,25025,250250,17,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	17
106	31	0	0	5	0	0.0313452	1	1	0.0313452	g
mi 30										
"2,1,2013,7,5,16,25,25025,250250,16,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	16
106	21	0	0	5	0	0.0188538	1	1	0.0188538	g
mi 30										
"2,1,2013,7,5,16,25,25025,250250,17,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	17
107	31	0	0	5	0	0.00708594	1	1	0.00708594	g
mi 30										
"2,1,2013,7,5,16,25,25025,250250,16,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	16
107	21	0	0	5	0	0.00690552	1	1	0.00690552	g
mi 30										
"2,1,2013,7,5,16,25,25025,250250,17,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	17
110	31	0	0	5	0	0.008934652	1	1	0.008934652	g
mi 30										
"2,1,2013,7,5,16,25,25025,250250,16,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	16
110	21	0	0	5	0	0.005005916	1	1	0.005005916	g
mi 30										
"2,1,2013,7,5,16,25,25025,250250,17,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	17
111	31	0	0	5	0	0.00664007	1	1	0.00664007	g
mi 30										
"2,1,2013,7,5,16,25,25025,250250,16,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	16
111	21	0	0	5	0	0.0040184	1	1	0.0040184	g
mi 30										
"2,1,2013,7,5,16,25,25025,250250,17,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	17
112	31	0	0	5	0	0.00219145	1	1	0.00219145	g
mi 30										
"2,1,2013,7,5,16,25,25025,250250,16,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	16
112	21	0	0	5	0	0.000930006	1	1	0.000930006	g
mi 30										
"2,1,2013,7,5,16,25,25025,250250,17,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	17
115	31	0	0	5	0	0.000103133	1	1	0.000103133	g
mi 30										
"2,1,2013,7,5,16,25,25025,250250,16,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	16
115	21	0	0	5	0	5.75E-05	1	1	5.75E-05	g
mi 30										
"2,1,2013,7,5,16,25,25025,250250,17,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	17
116	31	0	0	5	0	0.00820554	1	1	0.00820554	g
mi 30										
"2,1,2013,7,5,16,25,25025,250250,16,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	16
116	21	0	0	5	0	0.00493554	1	1	0.00493554	g
mi 30										
"2,1,2013,7,5,16,25,25025,250250,17,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	17
117	31	0	0	5	0	0.00169927	1	1	0.00169927	g
mi 30										
"2,1,2013,7,5,16,25,25025,250250,16,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	16
117	21	0	0	5	0	0.001656	1	1	0.001656	g
mi 30										
"2,1,2013,7,5,16,25,25025,250250,20,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	20
1 31	0	0	5	0	0.162003309	1	1	0.162003309	g	mi
35										
"2,1,2013,7,5,16,25,25025,250250,19,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	19
1 21	0	0	5	0	0.088214017	1	1	0.088214017	g	mi
35										
"2,1,2013,7,5,16,25,25025,250250,20,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	20
2 31	0	0	5	0	4.952119827	1	1	4.952119827	g	mi
35										
"2,1,2013,7,5,16,25,25025,250250,19,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	19
2 21	0	0	5	0	3.230390072	1	1	3.230390072	g	mi
35										
"2,1,2013,7,5,16,25,25025,250250,20,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	20
3 31	0	0	5	0	0.71015799	1	1	0.71015799	g	mi
35										
"2,1,2013,7,5,16,25,25025,250250,19,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	19
3 21	0	0	5	0	0.384189993	1	1	0.384189993	g	mi
35										
"2,1,2013,7,5,16,25,25025,250250,20,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	20
5 31	0	0	5	0	0.00632234	1	1	0.00632234	g	mi
35										
"2,1,2013,7,5,16,25,25025,250250,19,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	19
5 21	0	0	5	0	0.00563793	1	1	0.00563793	g	mi
35										

"2,1,2013,7,5,16,25,25025,250250,20,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	20
6 31	0	0	5	0	0.00492367	1	1	0.00492367	g	mi
35										
"2,1,2013,7,5,16,25,25025,250250,19,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	19
6 21	0	0	5	0	0.00240725	1	1	0.00240725	g	mi
35										
"2,1,2013,7,5,16,25,25025,250250,20,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	20
31 31	0	0	5	0	0.0130462	1	1	0.0130462	g	mi
35										
"2,1,2013,7,5,16,25,25025,250250,19,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	19
31 21	0	0	5	0	0.00941961	1	1	0.00941961	g	mi
35										
"2,1,2013,7,5,16,25,25025,250250,20,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	20
33 31	0	0	5	0	0.097178601	1	1	0.097178601	g	mi
35										
"2,1,2013,7,5,16,25,25025,250250,19,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	19
33 21	0	0	5	0	0.047284301	1	1	0.047284301	g	mi
35										
"2,1,2013,7,5,16,25,25025,250250,20,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	20
79 31	0	0	5	0	0.155681297	1	1	0.155681297	g	mi
35										
"2,1,2013,7,5,16,25,25025,250250,19,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	19
79 21	0	0	5	0	0.082576014	1	1	0.082576014	g	mi
35										
"2,1,2013,7,5,16,25,25025,250250,20,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	20
87 31	0	0	5	0	0.160621196	1	1	0.160621196	g	mi
35										
"2,1,2013,7,5,16,25,25025,250250,19,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	19
87 21	0	0	5	0	0.08514408	1	1	0.08514408	g	mi
35										
"2,1,2013,7,5,16,25,25025,250250,20,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	20
90 31	0	0	5	0	501.2059937	1	1	501.2059937	g	mi
35										
"2,1,2013,7,5,16,25,25025,250250,19,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	19
90 21	0	0	5	0	363.2049866	1	1	363.2049866	g	mi
35										
"2,1,2013,7,5,16,25,25025,250250,20,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	20
91 31	0	0	5	0	0.006606636	1	1	0.006606636	g	mi
35										
"2,1,2013,7,5,16,25,25025,250250,19,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	19
91 21	0	0	5	0	0.004789812	1	1	0.004789812	g	mi
35										
"2,1,2013,7,5,16,25,25025,250250,20,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	20
100	31	0	0	5	0	0.008854099	1	1	0.008854099	g
mi 35										
"2,1,2013,7,5,16,25,25025,250250,19,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	19
100	21	0	0	5	0	0.005070779	1	1	0.005070779	g
mi 35										
"2,1,2013,7,5,16,25,25025,250250,20,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	20
101	31	0	0	5	0	0.00655026	1	1	0.00655026	g
mi 35										
"2,1,2013,7,5,16,25,25025,250250,19,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	19
101	21	0	0	5	0	0.00407143	1	1	0.00407143	g
mi 35										
"2,1,2013,7,5,16,25,25025,250250,20,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	20
102	31	0	0	5	0	0.00219974	1	1	0.00219974	g
mi 35										
"2,1,2013,7,5,16,25,25025,250250,19,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	19
102	21	0	0	5	0	0.000940871	1	1	0.000940871	g
mi 35										
"2,1,2013,7,5,16,25,25025,250250,20,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	20
105	31	0	0	5	0	0.000104109	1	1	0.000104109	g
mi 35										
"2,1,2013,7,5,16,25,25025,250250,19,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	19
105	21	0	0	5	0	5.85E-05	1	1	5.85E-05	g
mi 35										
"2,1,2013,7,5,16,25,25025,250250,20,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	20
106	31	0	0	5	0	0.0234113	1	1	0.0234113	g
mi 35										
"2,1,2013,7,5,16,25,25025,250250,19,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	19
106	21	0	0	5	0	0.0141033	1	1	0.0141033	g
mi 35										
"2,1,2013,7,5,16,25,25025,250250,20,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	20
107	31	0	0	5	0	0.00657656	1	1	0.00657656	g
mi 35										
"2,1,2013,7,5,16,25,25025,250250,19,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	19
107	21	0	0	5	0	0.00640929	1	1	0.00640929	g
mi 35										

"2,1,2013,7,5,16,25,25025,250250,20,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	20
110	31	0	0	5	0	0.008283545	1	1	0.008283545	g
mi 35										
"2,1,2013,7,5,16,25,25025,250250,19,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	19
110	21	0	0	5	0	0.00467355	1	1	0.00467355	g
mi 35										
"2,1,2013,7,5,16,25,25025,250250,20,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	20
111	31	0	0	5	0	0.00607283	1	1	0.00607283	g
mi 35										
"2,1,2013,7,5,16,25,25025,250250,19,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	19
111	21	0	0	5	0	0.00375027	1	1	0.00375027	g
mi 35										
"2,1,2013,7,5,16,25,25025,250250,20,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	20
112	31	0	0	5	0	0.00211329	1	1	0.00211329	g
mi 35										
"2,1,2013,7,5,16,25,25025,250250,19,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	19
112	21	0	0	5	0	0.000869256	1	1	0.000869256	g
mi 35										
"2,1,2013,7,5,16,25,25025,250250,20,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	20
115	31	0	0	5	0	9.74E-05	1	1	9.74E-05	g
mi 35										
"2,1,2013,7,5,16,25,25025,250250,19,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	19
115	21	0	0	5	0	5.40E-05	1	1	5.40E-05	g
mi 35										
"2,1,2013,7,5,16,25,25025,250250,20,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	20
116	31	0	0	5	0	0.00612861	1	1	0.00612861	g
mi 35										
"2,1,2013,7,5,16,25,25025,250250,19,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	19
116	21	0	0	5	0	0.00369197	1	1	0.00369197	g
mi 35										
"2,1,2013,7,5,16,25,25025,250250,20,31,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	20
117	31	0	0	5	0	0.00157711	1	1	0.00157711	g
mi 35										
"2,1,2013,7,5,16,25,25025,250250,19,21,0,0,5,00"	2	1	2013	7	5	16	25	25025	250250	19
117	21	0	0	5	0	0.001537	1	1	0.001537	g
mi 35										

Source: KBE and Massport.

Fuel Storage and Handling

As in previous years, VOC emissions from fuel storage and handling were calculated using methods based on EPA's AP-42[3] document. Calculations account for evaporative emissions from breathing losses, working losses, and spillage from aboveground storage tanks, underground storage tanks, and aircraft refueling. In 2003, additional information became available on the fire training fuel, Tek-Flame®. Emissions of VOCs from this fuel were estimated by EDMS. Table I-11 presents Logan Airport's fuel throughput by category.

Stationary Sources

Stationary sources include the Central Heating and Cooling Plant, emergency generators, snow melters, space heaters, and boilers. Emission factors from EPA's AP-42 or NO_x Reasonably Available Control Technology (RACT) compliance testing were combined with the actual 2012/2013 fuel throughput of the stationary sources to obtain emissions of VOCs, NO_X, CO, and PM with a diameter of less than or equal to 10 micrograms or 2.5 micrograms (PM_{10}/$PM_{2.5}$).

Title V of the 1990 Clean Air Act (CAA) Amendments requires facilities with air emissions to document their emissions and obtain a single permit combining all sources. The permitting program ensures that all emission sources are accounted for, the proper permits have been received, and permit conditions are being followed. A Title V Air Operating Permit covers all of the stationary sources at Logan Airport including boilers, emergency generators, snow melters, fire training, cooling towers, paint booths, deicing facilities, and storage tanks. Table I-12 presents Logan Airport's stationary source fuel throughput by fuel category.

3 Compilation of Air Pollutant Emission Factors, AP-42, Office of Air Quality Planning and Standards, EPA, Fifth Edition, 1995.

Table I-11 Fuel Throughput by Fuel Category (gallons)

Fuel Category	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Jet Fuel	354,095,516	441,901,932	416,748,819	358,190,362	319,439,910	373,996,141	368,645,392	364,450,864	367,585,187	345,631,788	327,358,619	335,693,997	340,421,373	343,731,127	349,397,940
Fire Training Fuel[1]	NA	NA	NA	NA	13,719	12,227	8,105	5,000	8,631	5,971	3,510	800	3,810	2,587	5,400
Aviation Gas	99,726	90,922	60,691	35,111	32,515	34,717	52,487	35,098	29,067	25,037	18,238	15,268	14,064	12,306	14,422
Auto Gas	7,200,000	7,569,206	6,181,472	5,754,740	5,436,322	5,803,442	5,903,424	6,028,931	6,022,237	5,693,178	5,736,724	5,696,505	5,487,952	6,694,626	6,800,936
Diesel	768,106	839,751	1,239,904	1,067,847	1,030,185	1,078,665	1,567,688	1,164,493	1,141,335	1,071,707	1,121,241	1,168,761	1,099,720	878,499	1,094,714
Heating Oil No.2	480,733	494,500	582,283	340,492	370,903	381,852	367,899	259,768	423,181	303,143	409,049	319,727	384,906	210,794	289,665
Heating Oil No.6	1,600,893	1,555,527	1,641,693	1,079,283	1,122,975	2,940,752	3,098,126	1,396,529	1,073,260	16,385	368,690	9,010	11,285	6,786	17,721

Source: Massport, 2012 and 2013.
1 Fire Training Fuel used in 1999-2002 was Jet A Fuel while in 2003 through 2013 it was Tek-Flame®. 2012 includes 100 gallons of avgas and 2013 includes 400 gallons of avgas.
NA Not available.

Table I-12 Stationary Source Fuel Throughput by Fuel Category (gallons)

Fuel Category	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Natural Gas (ft^3)	183,943,000	283,720,049	199,500,000	268,359,282	201,714,114	62,610,000	92,460,000	112,390,000	338,430,000	458,680,000	430,810,000	449,640,000	479,830,000	360,523,000	402,496,000
Heating Oil No. 2	480,733	494,500	582,283	340,492	370,903	381,852	367,899	259,768	423,181	303,143	409,050	319,727	384,906	210,794	289,665
Heating Oil No. 6	1,600,893	1,555,527	1,641,693	1,079,283	1,122,975	2,940,752	3,098,126	1,396,529	1,073,260	16,385	368,690	9,010	11,285	6,786	17,721
Diesel Fuel[1]	57,441	NA	NA	NA	NA	67,198	77,848	77,848	258,606	146,718	145,778	116,511	218,081	42,109	231,130
Fire Training Fuel[2]	23,000	NA	NA	NA	13,719	12,227	8,105	5,000	8,631	5,971	3,510	800	3,810	2,587	5,400

Source: Massport, 2012 and 2013.
NA Not available.
1 Diesel fuel was from the stationary snow melter usage. Starting in 2007, portable snow melter usage was also included.
2 Fire Training Fuel used in 1999-2002 was Jet A Fuel while in 2003 through 2013 it was Tek-Flame®. 2012 includes 100 gallons of avgas and 2013 includes 400 gallons of avgas.

1993 Through 2008 Emissions Inventories

Tables I-13 through I-19 contain the 1993 through 2008 Emissions Inventory summary tables for Logan Airport.

Table I-13 Estimated VOC Emissions (in kg/day) at Logan Airport 1993-1999[1]

	1993	1994	1995	1996	1997	1998	1999[2]
Aircraft/GSE Model	**Logan Dispersion Modeling System (LDMS)**					**EDMS v3.22**	**EDMS v4.21**
Motor Vehicle Model	**MOBILE5a**					**MOB5a_h**	**MOB6.2.03**
Aircraft Sources							
Air carriers	1,958	1,554	1,407	1,390	1,227	736	653
Commuter aircraft	943	543	531	622	498	154	196
Cargo aircraft	89	244	236	214	207	43	318
General aviation	51	48	36	24	27	13	141
Total aircraft sources	3,041	2,389	2,210	2,250	1,959	946	1,308
Ground Service Equipment[3]	636	533	521	497	530	145	243
Motor Vehicles							
Ted Williams Tunnel through-traffic	NA	NA	NA	NA	NA	NA	15
Parking/curbside	173	148	127	102	102	118	101
On-airport vehicles[4]	238	215	179	223	205	258	256
Total motor vehicle sources	411	363	306	325	307	376	372
Other Sources							
Fuel storage/handling	408	434	318	356	381	372	352
Miscellaneous sources[5]	5	5	5	6	6	2	16
Total other sources	413	439	323	362	387	374	368
Total Airport Sources	4,501	3,724	3,360	3,434	3,183	1,841	2,291

Source: KBE and Massport.
Notes:
kg/day kilograms per day. 1 kg/day is approximately equivalent to 0.40234 tons per year (tpy).
NA Not available.
MOB MOBILE model for motor vehicle emissions (MOB5a_h=MOBILE5a_h, MOB6.2.03=MOBILE6.2 version .03)
1 The emissions inventory for 1990 is shown in Chapter 7. Emission inventories for 1991 and 1992 were not prepared.
2 Year 1999 emissions were last re-calculated using EDMS v4.21 in the 2004 ESPR Air Quality Analysis.
3 Beginning in 1996 and later, emissions include vehicles and equipment converted to alternative fuels. APU emissions are also included.
4 1999 emissions inventory include reductions attributable to CNG shuttle buses.
5 Includes the Central Heating and Cooling Plant, emergency electricity generation, and other stationary sources. Fire Training emissions were included in 1999. Diesel snow melter usage was added in 1999.

Table I-14 Estimated VOC Emissions (in kg/day) at Logan Airport 2000-2008

Aircraft/GSE Model:	EDMS v4.03		EDMS v4.11		EDMS v4.21	EDMS v4.5		EDMS v5.0.1		EDMS v5.0.2		EDMS v5.1
Motor Vehicle Model:	**MOBILE 6.0**			**MOB 6.2.01**	**MOBILE 6.2.03**							
Year:	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**		**2007**		**2008**	
Aircraft Sources												
Air carriers	514	374	248	208	292	271	227	511	435	381	324	286
Commuter aircraft	140	113	75	95	127	140	125	371	479	409	253	176
Cargo aircraft	207	149	127	94	110	41	19	46	129	112	107	70
General aviation	42	43	52	61	127	147	147	236	226	206	201	171
Total aircraft sources	903	679	502	458	656	599	518	1,164[1]	1,269	1,108	885	703
Ground Service Equipment[2]	153	143	247	227	187	178	167	77	78	78	66	66
Motor Vehicles												
Ted Williams Tunnel through-traffic	12	10	9	0[3]	0[3]	0[3]	0[3]	0[3]	0[3]	0[3]	0[3]	0[3]
Parking/curbside[4]	89	77	51	45	38	37	33	33	31	31	25	25
On-airport vehicles	206	170	152	135	129	118	106	106	104	104	82	82
Total motor vehicle sources	307	257	212	180	167	155	139	139	135	135	107	107
Other Sources												
Fuel storage/handling	412	372	329	297	341	340	336	336	338	338	320	320
Miscellaneous sources[5]	2	2	2	3	9	13	8	8	14	14	13	12
Total other sources	414	374	331	300	350	353	344	344	352	352	333	332
Total Airport Sources	1,777	1,453	1,292	1,165	1,360	1,285	1,168	1,724	1,834	1,673	1,391	1,208

Source: KBE and Massport
Notes: Years 2006 to 2008 were computed with previous years EDMS version to provide for a common basis of comparison.
kg/day = kilograms per day. 1 kg/day is equivalent to approximately 0.40234 tons per year (tpy).
1 The 2006 increase in aircraft VOC emissions is largely attributable to the addition of aircraft main engine startup emissions.
2 GSE emissions include aircraft APUs as well as vehicles and equipment converted to alternative fuels.
3 Due to the new roadway configuration and opening of the Ted Williams Tunnel there was no Ted Williams Tunnel through-traffic at Logan Airport beginning in 2003.
4 Parking/curbside is based on VMT analysis.
5 Includes the Central Heating and Cooling Plant, emergency electricity generation, snow melter usage, and other stationary sources.

Table I-15 Estimated NO_X Emissions (in kg/day) at Logan Airport 1993-1999[1]

	1993	1994	1995	1996	1997	1998	1999[2]
Aircraft/GSE Model	**Logan Dispersion Modeling System (LDMS)**					**EDMS v3.22**	**EDMS v4.21**
Motor Vehicle Model	**MOBILE5a**					**MOB5a_h**	**MOB6.2.03**
Aircraft Sources							
Air carriers	4,271	4,317	3,861	3,781	4,150	4,471	4,183
Commuter aircraft	202	158	192	137	159	203	166
Cargo aircraft	213	257	332	363	262	254	286
General aviation	13	13	17	18	21	5	12
Total aircraft sources	4,699	4,745	4,402	4,299	4,592	4,933	4,647
Ground Service Equipment[3]	722	617	607	588	622	317	444
Motor Vehicles							
Ted Williams Tunnel through-traffic	NA	NA	NA	NA	NA	NA	28
Parking/curbside	25	24	24	24	24	37	39
On-airport vehicles[4]	240	239	229	257	244	372	449
Total motor vehicle sources	265	263	253	281	268	409	516
Other Sources							
Fuel storage/handling[5]	0	0	0	0	0	0	0
Miscellaneous sources[6]	278	330	320	275	244	284	165
Total other sources	278	330	320	275	244	284	165
Total Airport Sources	5,964	5,955	5,582	5,443	5,726	5,943	5,772

Source: KBE and Massport.
Notes:
kg/day kilograms per day. 1 kg/day is approximately equivalent to 0.40234 tons per year (tpy).
NA Not available.
MOB MOBILE model for motor vehicle emissions (MOB5a_h=MOBILE5a_h, MOB6.2.03=MOBILE6.2 version .03)
1 The emissions inventory for 1990 is shown in Chapter 7. Emission inventories for 1991 and 1992 were not prepared.
2 Year 1999 emissions were last re-calculated using EDMS v4.21 in the 2004 ESPR Air Quality Analysis.
3 Beginning in 1996 and later, emissions include vehicles and equipment converted to alternative fuels. APU emissions are also included.
4 1999 emissions inventory include reductions attributable to CNG shuttle buses.
5 Fuel storage and handling facilities are not sources of NOx emissions.
6 Includes the Central Heating and Cooling Plant, emergency electricity generation, and other stationary sources. Fire Training emissions were included in 1999. Diesel snow melter usage was added in 1999.

Table I-16 Estimated NO_X Emissions (in kg/day) at Logan Airport, 2000-2008

Aircraft/GSE Model:	EDMS v4.03		EDMS v4.11		EDMS v4.21	EDMS v4.5		EDMS v5.0.1		EDMS v5.0.2		EDMS v5.1
Motor Vehicle Model:	**MOBILE 6.0**			**MOB 6.2.01**	**MOBILE 6.2.03**							
Year:	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**		**2007**		**2008**	
Aircraft Sources												
Air carriers	4,202	3,707	2,721	2,479	2,949	2,880	2,849	3,044	3,120	3,121	3,031	3,031
Commuter aircraft	125	233	208	185	245	225	195	256	353	354	319	319
Cargo aircraft	284	267	246	213	215	211	192	125	248	248	233	233
General aviation	49	34	38	45	49	50	49	60	56	56	43	43
Total aircraft sources	4,660	4,241	3,213	2,922	3,458	3,366	3,285	3,485	3,777	3,779	3,626	3,626
Ground Service	333	305	322	291	333	312	280	300	299	299	257	257
Motor Vehicles												
Ted Williams Tunnel through-traffic	26	22	20	0[2]	0[2]	0[2]	0[2]	0[2]	0[2]	0[2]	0[2]	0[2]
Parking/curbside[3]	52	46	32	28	21	22	19	19	18	18	15	15
On-airport vehicles	425	369	341	302	267	269	238	238	233	233	182	182
Total motor vehicle sources	503	437	393	330	288	291	257	257	251	251	197	197
Other Sources												
Fuel storage/handling[4]	0	0	0	0	0	0	0	0	0	0	0	0
Miscellaneous sources[5]	211	185	175	151	211	218	109	109	128	128	124	124
Total other sources	211	185	175	151	211	218	109	109	128	128	124	124
Total Airport Sources	5,707	5,168	4,103	3,694	4,290	4,187	3,931	4,151	4,455	4,457	4,204	4,204

Source: KBE and Massport

Notes: Years 2006 to 2008 were computed with previous years EDMS version to provide for a common basis of comparison.
kg/day - kilograms per day. 1 kg/day is approximately equivalent to 0.40234 tons per year (tpy).

1 GSE emissions include APUs as well as vehicles and equipment converted to alternative fuels.

2 Due to the new roadway configuration and opening of the Ted Williams Tunnel there was no Ted Williams Tunnel through-traffic at Logan Airport beginning in 2003.

3 Parking/curbside data is based on VMT analysis.

4 Fuel storage/handling facilities are not a source of NO_x emissions.

5 Includes the Central Heating and Cooling Plant, emergency electricity generation, snow melter usage, and other stationary sources.

Table I-17 Estimated CO Emissions (in kg/day) at Logan Airport 1993-1999[1]							
	1993	1994	1995	1996	1997	1998	1999[2]
Aircraft/GSE Model	**Logan Dispersion Modeling System (LDMS)**					**EDMS v3.22**	**EDMS v4.21**
Motor Vehicle Model	**MOBILE5a**					**MOB5a_h**	**MOB6.2.03**
Aircraft Sources							
Air carriers	5,663	4,660	4,691	4,812	4,698	3,079	3,754
Commuter aircraft	1,309	927	934	859	770	482	1,404
Cargo aircraft	344	572	598	580	514	218	503
General aviation	353	356	339	549	654	269	940
Total aircraft sources	7,669	6,515	6,562	6,800	6,636	4,048	6,601
Ground Service Equipment[3]	7,482	6,187	6,029	5,740	6,098	5,113	4,532
Motor Vehicles							
Ted Williams Tunnel through-traffic	NA	NA	NA	NA	NA	NA	151
Parking/curbside	952	820	650	644	586	772	437
On-airport vehicles[4]	1,575	1,451	1,087	1,514	1,283	1,883	2,547
Total motor vehicle sources	2,527	2,271	1,737	2,158	1,869	2,655	3,135
Other Sources							
Fuel storage/handling[5]	0	0	0	0	0	0	0
Miscellaneous sources[6]	26	30	29	39	37	37	168
Total other sources	26	30	29	39	37	37	168
Total Airport Sources	17,704	15,003	14,357	14,737	14,640	11,853	14,436

Source: KBE and Massport.
Notes:
kg/day kilograms per day. 1 kg/day is approximately equivalent to 0.40234 tons per year (tpy).
NA Not available.
MOB MOBILE model for motor vehicle emissions (MOB5a_h=MOBILE5a_h, MOB6.2.03=MOBILE6.2 version .03)
1 The emissions inventory for 1990 is shown in Chapter 7. Emission inventories for 1991 and 1992 were not prepared.
2 Year 1999 emissions were last re-calculated using EDMS v4.21 in the 2004 ESPR Air Quality Analysis.
3 Beginning in 1996 and later, emissions include vehicles and equipment converted to alternative fuels. APU emissions are also included.
4 1999 emission inventory include reductions attributable to CNG shuttle buses.
5 Fuel storage and handling facilities are not sources of CO emissions.
6 Includes the Central Heating and Cooling Plant, emergency electricity generation, and other stationary sources. Fire Training emissions were included in 1999. Diesel snow melter usage was added in 1999.

Table I-18 Estimated CO Emissions (in kg/day) at Logan Airport, 2000-2008

Aircraft/GSE Model:	EDMS v4.03		EDMS v4.11		EDMS v4.21	EDMS v4.5		EDMS v5.0.1		EDMS v5.0.2		EDMS v5.1
Motor Vehicle Model:	**MOBILE 6.0**			**MOB 6.2.01**	**MOBILE 6.2.03**							
Year:	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**		**2007**		**2008**	
Aircraft Sources												
Air carriers	2,994	2,475	2,156	2,128	2,985	2,895	2,828	3,167	2,973	2,973	2,710	2,710
Commuter aircraft	1,188	1,072	783	846	1,010	1,010	950	1,587	2,484	2,484	2,436	2,436
Cargo aircraft	400	323	285	209	229	174	138	158	241	241	255	255
General aviation	295	407	256	276	416	437	398	442	401	403	345	345
Total aircraft sources	4,877	4,277	3,480	3,459	4,640	4,516	4,314	5,354	6,099	6,101	5,746	5,746
Ground Service Equipment[1]	5,335	5,193	5,170	4,758	3,586	3,531	3,409	1,586	1,904	1,904	1,609	1,609
Motor Vehicles												
Ted Williams Tunnel through-traffic	133	121	112	0[2]	0[2]	0[2]	0[2]	0[2]	0[2]	0[2]	0[2]	0[2]
Parking/curbside[3]	495	440	295	253	180	179	144	144	139	139	117	117
On-airport vehicles	2,245	2,001	1,872	1,685	1,412	1,290	1,036	1,036	1,038	1,038	834	834
Total motor vehicle sources	2,873	2,562	2,279	1,938	1,592	1,469	1,180	1,180	1,177	1,177	951	951
Other Sources												
Fuel storage/handling[4]	0	0	0	0	0	0	0	0	0	0	0	0
Miscellaneous sources[5]	27	24	23	22	33	40	24	24	51	51	55	55
Total other sources	27	24	23	22	33	40	24	24	51	51	55	55
Total Airport Sources	13,112	12,056	10,952	10,177	9,851	9,556	8,927	8,144	9,231	9,233	8,361	8,361

Source: KBE and Massport

Notes: Years 2006 to 2008 were computed with previous years EDMS version to provide for a common basis of comparison.
kg/day = kilograms per day. 1 kg/day is approximately equivalent to 0.40234 tons per year (tpy).

1 GSE emissions include APUs as well as vehicles and equipment converted to alternative fuels.
2 Due to the new roadway configuration and opening of the Ted Williams Tunnel there was no Ted Williams Tunnel through-traffic at Logan Airport beginning in 2003.
3 Parking/curbside information is based on VMT analysis.
4 Fuel storage/handling facilities are not a source of CO emissions.
5 Includes the Central Heating and Cooling Plant, emergency electricity generation, snow melter usage, and other stationary sources.

Table I-19 Estimated $PM_{10}/PM_{2.5}$ Emissions (in kg/day) at Logan Airport, 2005-2008[1]

Aircraft/GSE Model:	EDMS v4.5		EDMS v5.0.1		EDMS v5.0.2		EDMS v5.1
Motor Vehicle Model:	MOBILE 6.2.03						
Year:	2005[2]	2006		2007		2008	
Aircraft Sources							
Air carriers	25	25	38	35	67	63	42
Commuter aircraft	1	1	2	6	14	11	6
Cargo aircraft	2	3	2	3	6	5	4
General aviation	2	2	2	2	5	5	4
Total aircraft sources	30	31	44	46	92	84	56
Ground Service Equipment[3]	11	9	9	10	10	8	15
Motor Vehicles							
Ted Williams Tunnel through-traffic	0[4]	0[4]	0[4]	0[4]	0[4]	0[4]	0[4]
Parking/curbside[5]	1	1	1	<1	<1	<1	<1
On-airport vehicles	8	8	8	9	9	7	7
Total motor vehicle sources	9	9	9	9	9	7	7
Other Sources							
Fuel storage/handling[6]	0	0	0	0	0	0	0
Miscellaneous sources[7]	34	16	16	17	17	3	3
Total other sources	34	16	16	17	17	3	3
Total Airport Sources	84	65	78	82	128	102	81

Source: KBE and Massport

Notes: Years 2006 to 2008 were computed with previous years EDMS version to provide for a common basis of comparison.
kg/day = kilograms per day. 1 kg/day is approximately equivalent to 0.40234 tons per year (tpy); PM - particulate matter

1 It is assumed that all PM are less than 2.5 microns in diameter ($PM_{2.5}$).

2 2005 is the first year that $PM_{10}/PM_{2.5}$ emissions were included in the Logan Airport ESPR/EDR emission inventories.

3 GSE emissions include APUs as well as vehicles and equipment converted to alternative fuels.

4 Due to the new roadway configuration and opening of the Ted Williams Tunnel there was no Ted Williams Tunnel through-traffic at Logan Airport beginning in 2003.

5 Parking/curbside is based on VTM analysis.

6 Fuel storage and handling facilities are not sources of PM emissions.

7 Includes the Central Heating and Cooling Plant, emergency electricity generation, fire training, snow melters, and other stationary sources.

Greenhouse Gas Emissions Inventory for 2012/2013

The Massachusetts Executive Office of Energy and Environmental Affairs (EEA) has published the *MEPA Greenhouse Gas Emissions Policy and Protocol*.[4] These guidelines require that certain projects undergoing review under the Massachusetts Environmental Policy Act (MEPA) quantify the greenhouse gas (GHG) emissions generated by proposed projects, and identify measures to avoid, minimize, or mitigate such emissions.[5] Even though the *2012/2013 EDR* does not assess any proposed projects and is therefore not subject to the GHG policy, Massport has voluntarily prepared an emission inventory of GHG emissions directly and indirectly associated with Logan Airport.

In April 2009, the Transportation Research Board Airport Cooperative Research Program (ACRP); published the *Guidebook on Preparing Airport Greenhouse Gas Emission Inventories (ACRP Report 11)*, which provides recommended instructions to airport operators on how to prepare an airport-specific GHG emissions inventory.[6] The 2012/2013 GHG emissions estimates include aircraft (within the ground taxi/delay and up to 3,000 feet), GSE, APU, motor vehicles, a variety of stationary sources, and electricity usage. Aircraft cruise emissions over the 3,000-foot level were not included. This work was accomplished following the EEA guidelines and uses widely-accepted emission factors that are considered appropriate for this application, including International Organization for Standardization New England electricity-based values.

Methodology

Airport GHG emissions are calculated in much the same way as criteria pollutants,[7] through the use of input data such as activity levels or material throughput rates (i.e., fuel usage, VMT, electrical consumption) that are applied to appropriate emission factors (i.e., in units of GHG emissions per gallon of fuel).

In this case, the input data were either based on Massport records, or data and information derived from the latest version of the FAA EDMS (EDMS v5.1.3 was used for the 2012 analysis and EDMS v5.1.4.1 for the 2013 analysis). Table I-20 summarizes the data and information used in the 2012/2013 GHG inventory.

Massport will update the GHG Emissions Inventory for Logan Airport annually.

4 Revised *MEPA Greenhouse Gas Emissions Policy and Protocol*, Massachusetts Executive Office of Energy and Environmental Affairs, effective May 10, 2010.
5 These GHGs are comprised primarily of carbon dioxide (CO_2), methane (CH_4), nitrous oxides (N_2O), and three groups of fluorinated gases (i.e., sulfur hexafluoride [SF_6], hydrofluorocarbons [HFCs], and perfluorocarbons [PFCs]). GHG emission sources associated with airports are generally limited to CO_2, CH_4, and N_2O.
6 Transportation Research Board, Airport Cooperative Research Panel, ACRP Report 11, Project 02-06, *Guidebook on Preparing Airport Greenhouse Gas Emissions Inventories* (in production). See http://onlinepubs.trb.org/onlinepubs/acrp/acrp_rpt_011.pdf for the full report.
7 Criteria pollutants are pollutants for which there are National Ambient Air Quality Standards (i.e., carbon monoxide, sulfur dioxide, nitrogen dioxide, etc.).

Table I-20 Logan Airport Greenhouse Gas (GHG) Inventory Input Data and Information[1] for 2012/2013					
Activity	**Fuel Type**	**2012 Usage**	**2013 Usage**	**Units**	**Source**
Aircraft					
Aircraft Taxi	Jet A[2]	19,194,409	19,530,264	gallons	EDMS[6]
	AvGas[3]	687	806	gallons	EDMS[6]
Engine Startup	Jet A	208,109	212,551	gallons	EDMS[6]
Aircraft Ground up to 3,000 feet	Jet A[2]	17,467,104	16,862,831	gallons	EDMS[6]
	AvGas[3]	625	696	gallons	EDMS[6]
Aircraft Support Equipment					
GSE	Diesel	582,042	663,539	gallons	Massport
	Gasoline	508,813	568,670	gallons	Massport
	Propane	1,739	1,680	gallons	EDMS[6]
	CNG	410,149	408,373	ft^3	EDMS[6]
APU	Jet A	796,203	788,927	gallons	EDMS[6]
Motor Vehicles					
On-airport Vehicles	Composite[5]	61,160,893	64,639,190	VMT	Massport
On-airport Parking/Curbsides	Composite[5]	1,219,658	1,281,365	Idle hours	Massport
Massport Shuttle Bus	CNG	418,882	229,665	GEG	Massport
	Diesel	24	0	gallons	Massport
Massport Express Bus	Diesel	195,489	376,142	gallons	Massport
Masspoort Fire Rescue	Diesel	12,000	21,000	gallons	Massport
Aquircultural Equipment	Diesel	75,038	104,943	gallons	Massport
Massport Fleet Vehicles (Honda Civic)	CNG	78,579	4,800	GEG	Massport
Massport Fleet Vehicles (Fueled Onsite)	Gasoline	152,486	236,022	gallons	Massport
Massport Fleet Vehicles (Fueled Offsite)	Gasoline	79,227	79,730	gallons	Massport
Massport Fleet Vehicles (Fueled Onsite)	Diesel	198,156	175,970	gallons	Massport
Off-airport Vehicles (Public)	Composite[5]	147,871,129	156,460,130	VMT	Massport
Off-airport Vehicles (Airport Employees)	Composite[5]	3,581,673	2,632,372	VMT	Massport
Off-airport Vehicles (Tenant Employees)	Composite[5]	48,376,557	35,554,640	VMT	Massport

Table I-20 (Continued) Logan Airport Greenhouse Gas (GHG) Inventory Input Data and Information[1] for 2012/2013

Activity	Fuel Type	2012 Usage	2013 Usage	Units	Source
Stationary and Portable Sources					
Boilers and Space Heaters	No 2 Oil	210,794	289,665	gallons	Massport
	No 6 Oil	6,786	17,721	gallons	Massport
	Natural Gas	360	399	million ft^3	Massport
Generators	Diesel	44,633	57,847	gallons	Massport
Snow melters	ULSD	42,109	231,130	gallons	Massport
	CNG	0.75	3	million ft^3	Massport
Fire Training Facility	Tekflame	2,487	5,000	gallons	Massport
	AvGas	100	400	gallons	Massport
Electrical Consumption – Massport	-	18,904,904	15,148,132	kWh	Massport
Electrical Consumption – Tenant and Common Area	-	161,883,769	167,883,496	kWh	Massport

Sources: Massport and KBE.
Notes: APU – Auxiliary power units; CNG – compressed natural gas; GEG – gasoline equivalent gallons; GSE – ground support equipment; kWh – kilowatt hours; VMT – vehicle miles traveled; ULSD – ultra low sulfur diesel.
1 Based on 2012 and 2013 activity levels and conditions.
2 Jet A density of 6.84 pounds per gallon.
3 AvGas density of 6.0 pounds per gallon.
4 The LTO (landing and take-off operation) includes landing, taxi-in, taxi-out, take-off, and up to an altitude of 3,000 feet.
5 Composite means gasoline and diesel-fueled motor vehicle fleet mix based on MOBILE6.2 (2012 analysis). For the 2013 analysis composite also included CNG and liquefied petroleum gas (LPG) fueled motor vehicles.
6 EDMS v5.1.3 was used for the 2012 analysis and EDMS v5.1.4.1 for the 2013 analysis.

Emission factors were obtained from the U.S. Energy Information Administration, the International Panel on Climate Change (IPCC), and the EPA.[8,9,10] Table I-21 presents these emission factors for CO_2, nitrous oxide (N_2O), and methane (CH_4) for 2012. Emission factors for 2013 are presented in Table I-22 and were updated to reflect the most recent version of EPA's GHG Emission Factors Hub (April 2014).[11]

8 U.S. Energy Information Administration, *Voluntary Reporting of Greenhouse Gases Program. Fuel and Energy Source Codes and Emission Coefficients,* www.eia.doe.gov/oiaf/1605/coefficients.html.
9 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, 2006, www.ipcc-nggip.iges.or.jp/public/2006gl/index.html.
10 U.S. Environmental Protection Agency, MOBILE6.2 Emissions Model, www.epa.gov/otaq/m6.htm.
11 U.S. Environmental Protection Agency, GHG Emissions Factors Hub (April 2014), www.epa.gov/climateleadership/inventory/ghg-emissions.html. The most recent version of the Emission Factors Hub includes updates to emission factors for stationary and mobile combustion sources, new electricity emission factors from EPA's Emissions & Generation Resource Integrated Database (eGRID) and the IPCC Fourth Assessment Report (AR4).

Table I-21 Greenhouse Gas (GHG) Emission Factors for 2012

Sources	Fuel	CO_2	N_2O	CH_4	Units
Aircraft[1]	Jet A	21.1	0.00068	0.00060	lb/gallon
	AvGas	18.4	0.00024	0.01554	lb/gallon
Ground Support Equipment/ Auxiliary Power Units[1]	Diesel	22. 4	0.00019	0.00053	lb/gallon
	Gasoline	19.6	0.00020	0.00055	lb/gallon
	CNG	120.6	0.00020	0.00020	lb/1000 ft^3
	Propane	12.7	2.3E-07	3.0E-06	lb/gallon
	Jet A	21.1	0.00068	0.00060	lb/gallon
Motor Vehicles[2]	Composite	368	0.0050	0.0140	g/mile
	Composite	921	0.0125	0.1900	g/hour
	CNG	120.6	0.00020	0.00020	lb/1000 ft^3
	Diesel	22. 4	0.00019	0.00053	lb/gallon
	Gasoline	19.6	0.00020	0.00055	lb/gallon
Stationary and Portable[1]	No. 2 Oil	22.4	0.00019	0.00053	lb/gallon
	No. 6 Oil	26.0	0.00021	0.00022	lb/gallon
	Natural Gas	120.6	0.00020	0.00020	lb/1000 ft^3
	ULSD	22.4	0.00019	0.00053	lb/gallon
Fire Training Facility[1]	Tekflame[3]	12.7	2.3E-07	3.0E-06	lb/gallon
	AvGas	18.4	0.00019	0.00052	lb/gallon
Electrical Consumption[4]	-	0.98	0.00001	0.00002	lb/kW-hr

Sources: Massport and KBE.

Notes: CH_4 – methane; CNG – compressed natural gas; CO_2 – carbon dioxide; g- grams; kWhr – kilowatt hour; lb – pound; N_2O – nitrous oxides; ULSD – Ultra Low Sulfur Diesel.

1 Energy Information Administration, Voluntary Reporting of Greenhouse Gases Program Fuel and Energy Source Codes and Emission Coefficients, www.eia.doe.gov/oiaf/1605/coefficients.html.

2 Environmental Protection Agency, MOBILE6.2 Emissions Model, www.epa.gov/otaq/m6.htm, and Volume 2 of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, www.ipcc-nggip.iges.or.jp/public/2006gl/index.html.

3 As propane.

4 Energy Information Administration, *Updated State-and Regional-level Greenhouse Gas Emission Factors for Electricity* (March 2002), http://www.eia.gov/pub/oiaf/1605/cdrom/pdf/e-supdoc.pdf.

Table I-22 Greenhouse Gas (GHG) Emission Factors for 2013

Sources	Fuel	CO_2	N_2O	CH_4	Units
Aircraft[1]	Jet A	21.5	0.00066	-[5]	lb/gallon
	AvGas	18.3	0.00024	0.01556	lb/gallon
Ground Support Equipment/ Auxiliary Power Units[1]	Diesel	22.5	0.00057	0.00126	lb/gallon
	Gasoline	19.4	0.00049	0.00110	lb/gallon
	CNG	120.0	0.00023	0.00226	lb/1000 ft^3
	Propane	12.6	0.00011	0.00060	lb/gallon
	Jet A	21.5	0.00066	-[5]	lb/gallon
Motor Vehicles[1,2]	Composite	514	0.00513	0.00748	g/mile
	Composite	4,510	0.12829	0.06071	g/hour
	CNG	120.0	0.00023	0.00226	lb/1000 ft^3
	Diesel	22.5	0.00057	0.00126	lb/gallon
	Gasoline	19.4	0.00049	0.00110	lb/gallon
Stationary and Portable[1]	No. 2 Oil	22.5	0.00018	0.00090	lb/gallon
	No. 6 Oil	24.8	0.00020	0.00099	lb/gallon
	Natural Gas	120.0	0.00023	0.00226	lb/1000 ft^3
	ULSD	22.5	0.00018	0.00090	lb/gallon
Fire Training Facility[1]	Tekflame[3]	12.6	0.00011	0.00060	lb/gallon
	AvGas	18.3	0.00024	0.01556	lb/gallon
Electrical Consumption[4]	-	0.72	0.00001	0.00007	lb/kW-hr

Sources: Massport and KBE.

Notes: CH_4 – methane; CNG – compressed natural gas; CO_2 – carbon dioxide; g- grams; kWhr – kilowatt hour; lb – pound; N_2O – nitrous oxides; ULSD – Ultra Low Sulfur Diesel.

1 Environmental Protection Agency, GHG Emissions Factors Hub (April 2014), www.epa.gov/climateleadership/inventory/ghg-emissions.html.

2 Environmental Protection Agency, MOVES2010b, http://www.epa.gov/oms/models/moves.

3 As propane.

4 Environmental Protection Agency, Emissions & Generation Resource Integrated Database (eGRID) 9th edition Version 1.0, February 2014, http://www.epa.gov/climateleadership/documents/emission-factors.pdf.5 Contributions of CH_4 emissions from commercial aircraft are reported as zero. Years of scientific measurement campaigns conducted at the exhaust exit plane of commercial aircraft gas turbine engines have repeatedly indicated that CH_4 emissions are consumed over the full emission flight envelope [Reference: Aircraft Emissions of Methane and Nitrous Oxide during the Alternative Aviation Fuel Experiment, Santoni et al., Environ. Sci. Technol., July 2011, Volume 45, pp. 7075-7082]. As a result, the EPA published that: "…methane is no longer considered to be an emission from aircraft gas turbine engines burning Jet A at higher power settings and is, in fact, consumed in net at these higher powers." [Reference: EPA, Recommended Best Practice for Quantifying Speciated Organic Gas Emissions from Aircraft Equipped with Turbofan, Turbojet, and Turboprop Engines, May 27, 2009 [EPA-420-R-09-901], http://www.epa.gov/otaq/aviation.htm]. In accordance with the following statements in the 2006 IPCC Guidelines (IPCC 2006), the FAA does not calculate CH_4 emissions for either the domestic or international bunker commercial aircraft jet fuel emissions inventories. "Methane (CH_4) may be emitted by gas turbines during idle and by older technology engines, but recent data suggest that little or no CH_4 is emitted by modern engines." "Current scientific understanding does not allow other gases (e.g., N_2O and CH_4) to be included in calculation of cruise emissions." (IPCC 1999).

Results

Tables I-23 and I-24 present the results of the 2012 and 2013 GHG emissions inventory for Logan Airport by emission source (i.e., aircraft, GSE, motor vehicles, and stationary sources) and compound (i.e., CO_2, N_2O, and CH_4), respectively.

Table I-23 Greenhouse Gas (GHG) Emissions (MMT CO_2 Eq)[1] for 2012

Activity	CO_2	N_2O	CH_4	Total
Aircraft Sources				
Aircraft Taxi	0.18	<0.01	<0.01	0.19
Engine Startup	<0.01	<0.01	<0.01	<0.01
Aircraft AGL to 3,000 feet	0.17	<0.01	<0.01	0.17
Aircraft Support Equipment				
GSE	0.01	<0.01	<0.01	0.01
APU	0.01	<0.01	<0.01	0.01
Motor Vehicles				
On-airport Vehicles	0.02	<0.01	<0.01	0.02
On-airport Parking/Curbsides	<0.01	<0.01	<0.01	<0.01
Massport Shuttle Buses	<0.01	<0.01	<0.01	<0.01
Massport Fleet Vehicles	<0.01	<0.01	<0.01	0.01
Off-airport Vehicles (Public)	0.04	<0.01	<0.01	0.04
Off-airport Vehicles (Airport Employees)	<0.01	<0.01	<0.01	<0.01
Off-airport Vehicles (Tenant Employees)	0.02	<0.01	<0.01	0.02
Stationary Sources				
Boilers	0.02	<0.01	<0.01	0.02
Generators, Snow melters, etc.	<0.01	<0.01	<0.01	<0.01
Fire Training Facility	<0.01	<0.01	<0.01	<0.01
Electrical Consumption	0.08	<0.01	<0.01	0.08

Sources: Massport and KBE.
1 Units expressed as million metric tons of CO_2 equivalent (MMT CO_2 Eq): 1 metric ton = 1.1 short tons.

Table I-24 Greenhouse Gas (GHG) Emissions (MMT CO_2 Eq)[1] for 2013

Activity	CO_2	N_2O	CH_4	Total
Aircraft Sources				
Aircraft Taxi	0.19	<0.01	<0.01	0.19
Engine Startup	<0.01	<0.01	<0.01	<0.01
Aircraft AGL to 3,000 feet	0.16	<0.01	<0.01	0.17
Aircraft Support Equipment				
GSE	0.01	<0.01	<0.01	0.01
APU	0.01	<0.01	<0.01	0.01
Motor Vehicles				
On-airport Vehicles	0.03	<0.01	<0.01	0.03
On-airport Parking/Curbsides	0.01	<0.01	<0.01	0.01
Massport Shuttle Buses	<0.01	<0.01	<0.01	<0.01
Massport Fleet Vehicles	0.01	<0.01	<0.01	0.01
Off-airport Vehicles (Public)	0.06	<0.01	<0.01	0.06
Off-airport Vehicles (Airport Employees)	<0.01	<0.01	<0.01	<0.01
Off-airport Vehicles (Tenant Employees)	0.02	<0.01	<0.01	0.02
Stationary Sources				
Boilers	0.02	<0.01	<0.01	0.02
Generators, Snow melters, etc.	<0.01	<0.01	<0.01	<0.01
Fire Training Facility	<0.01	<0.01	<0.01	<0.01
Electrical Consumption	0.06	<0.01	<0.01	0.06

Sources: Massport and KBE.
1 Units expressed as million metric tons of CO_2 equivalent (MMT CO_2 Eq): 1 metric ton = 1.1 short tons.

Table I-25 compares the total GHG emission from Logan Airport to the total GHG emissions for Massachusetts for the years 2012 and 2013.

Table I-25 Logan Airport Greenhouse Gas (GHG) Emissions Compared to Massachusetts Totals[1]

	CO_2	N_2O	CH_4	Totals
Logan Airport Emissions (2012)[2]	0.56	<0.01	<0.01	0.57
Logan Airport Emissions (2013)[2]	0.60	<0.01	<0.01	0.60
Massachusetts[3]	82.1	1.3	1.2	84.6
Percent of Logan Airport to Massachusetts[4]	<1%	<1%	<1%	<1%

Sources: Massport and KBE.
1 Units expressed as million metric tons of CO_2 equivalents (MMT CO_2 Eq): 1 metric ton = 1.1 short tons.
2 Total from Massport, tenants, and public categories.
3 Climate Analysis Indicators Tool (CAIT US) Version 4.0. (Washington, DC: World Resources Institute, 2010)
4 Percentages represent the relative amount Logan-related emissions compared to the state totals.

Table I-26 provides a comparison between Airport-related GHG emissions from 2007 through 2013. GHG emissions in 2012/2013 were slightly higher (4.8 percent) than 2010 levels. To equally compare to previous years, the 2012 and 2013 emissions are summarized in a manner similar to previous years.

Table I-26 Comparison of Estimated Total Greenhouse Gas (GHG) Emissions (MMT of CO_2eq) at Logan Airport – 2007 through 2013

Source	2007	2008	2009	2010	2011	2012	2013
Direct Emissions[2]							
Aircraft[3]	0.22	0.21	0.19	0.18	0.19	0.19	0.19
GSE/APUs	0.08	0.08	0.02	0.02	0.02	0.02	0.02
Motor vehicles[4]	0.03	0.03	0.03	0.03	0.04	0.03	0.05
Other sources[5]	0.04	0.03	0.03	0.03	0.03	0.02	0.03
Total Direct Emissions	0.37	0.35	0.27	0.27	0.28	0.26	0.29
Indirect Emissions[6]							
Aircraft[7]	0.18	0.17	0.17	0.17	0.17	0.17	0.17
Motor vehicles[8]	0.05	0.05	0.05	0.05	0.06	0.05	0.08
Electrical consumption[9]	0.09	0.08	0.07	0.07	0.08	0.08	0.06
Total Indirect Emissions	0.32	0.30	0.29	0.29	0.30	0.30	0.31
Total Emissions[10]	0.69	0.65	0.56	0.56	0.58	0.57	0.60
Percent of State Totals[11]	<1	<1	<1	<1	<1	<1	<1

Sources: Massport and KBE.
1 MMT - million metric tons of CO_2 equivalents (1 MMT = 1.1M Short Tons). CO_2 equivalents (CO_2eq) are bases for reporting the three primary GHGs (e.g., CO_2, N_2O and CH_4) in common units. Quantities are reported as "rounded" and truncated values for ease of addition.
2 Direct emissions are those that occur in areas located within the Airport's geographic boundaries.
3 Direct aircraft emissions based engine start-up, taxi-in, taxi-out and ground-based delay emissions.
4 Direct motor vehicle emissions based on on-site vehicle miles traveled (VMT).
5 Other sources include Central Heating and Cooling Plant, emergency generators, snow melters and live fire training facility.
6 Indirect emissions are those that occur off the Airport site.
7 Indirect aircraft emissions are based on take-off, climb-out and landing emissions which occur up to an altitude of 3,000 ft., the limits of the landing/take-off (LTO) cycle
8 Indirect motor vehicle emissions based on off-site Airport-related VMT and an average round trip distance of approximately 60 miles.
9 Electrical consumption emissions occur off-airport at power generating plants.
10 Total Emissions = Direct +Indirect.
11 Percentage based on relative amount of Airport total of direct emissions to statewide total from World Resources Institute (cait.wri.org).

Measured NO_2 Concentrations

This section presents the results of Massport's long-term ambient (i.e., outdoor) air quality monitoring program for NO_2 - a pollutant associated with aircraft activity and other fuel combustion sources. Between 1982 and 2011, Massport collected NO_2 concentration data at numerous locations both on the Airport and in neighboring residential communities. The purpose of this monitoring program was to track long-term trends in NO_2 levels and to compare the results to the NAAQS for this pollutant. In 2011, Massport determined that the Logan NO_2 Monitoring Program had achieved its objectives with the significant and stable decrease in NO_2 emissions since 1999 and thus discontinued the program in 2011.

When it was operational, this monitoring program used passive diffusion tube technology for a period of one week each month for 12 months of the year at each of the monitoring stations. The samples of NO_2, along with Quality Assurance/Quality Control (QA/QC) samples, were then analyzed in a laboratory.

Table I-27 presents the final year NO_2 monitoring data (i.e., 2011). For comparative purposes, historical data from 1999 are similarly shown in Table I-27. The table also includes NO_2 data collected under a separate effort by MassDEP using continuous monitors at four Boston-area locations.

As shown on Table I-27, the 2011 NO_2 levels were somewhat higher than in 2010. However, this occurrence is consistent with the cyclical trend of the average levels over the past several years[12]. Importantly, there remains a long-term trend of decreasing NO_2 concentrations at both the Massport and MassDEP monitoring sites since 1999. Other notable observations of the 2011 data reveal the following:

- Annual NO_2 concentrations at all Massport and MassDEP monitoring locations were below the annual NO_2 NAAQS of 100 micrograms per cubic meter ($\mu g/m^3$) in 2011.
- The Massport-collected data compare relatively closely with data collected by the MassDEP. The average of all Massport monitoring sites was 29.8 $\mu g/m^3$ compared to 32.3 $\mu g/m^3$ for the four MassDEP Boston-area monitors.
- The highest NO_2 concentrations in 2011 from the Massport program occurred in areas characterized by high levels of motor vehicle traffic (i.e., Main Terminal Area [Site 8] and Maverick Square [Site 12]).

12 Spatial and temporal changes in measured NO_2 levels from year to year are typical and should not be used to define short-term results. Rather, NO_2 levels are better assessed by looking at the trends over several years.

Table I-27 Massport and MassDEP Annual NO_2 Concentration Monitoring Results (µg/m³)

Monitoring Site	Site No.	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Massport Monitoring Sites														
Runway 9	**1**	61.0	58.2	41.6	45.8	33.9	30.1	35.0	31.9	17.3	31.3	32.2	32.3	38.7
Runway 4R	**2**	55.6	44.6	41.4	36.9	32.5	30.9	30.7	29.0	17.2	20.2	19.2	21.9	25.7
Runway 33L	**3**	47.7	42.6	39.4	33.3	30.8	25.4	24.5	26.3	24.2	21.6	16.9	25.0	29.8
Runway 27	**4**	42.9	37.8	35.8	30.3	25.5	24.1	22.7	22.3	16.9	18.3	17.6	19.4	23.3
Runaway 22L	**5**	47.5	39.8	38.2	33.8	27.8	23.7	22.1	24.9	17.1	21.3	20.1	21.9	29.0
Runway 22R	**6**	60.6	59.2	51.6	45.0	32.3	29.7	32.9	25.1	24.8	29.7	27.8	33.1	30.6
Runway 15R	**7**	47.0	43.4	44.3	42.6	40.8	28.7	27.7	28.7	20.5	24.2	23.9	26.7	29.7
Main Terminal Area	**8**	70.8	87.0	80.7	69.3	44.3	44.7	46.2	43.5	29.5	41.7	37.7	43.9	49.0
Webster St., Jeffries Point	**11**	52.4	45.5	43.4	39.1	32.5	28.3	31.3	31.3	22.7	25.2	23.9	27.0	30.1
Maverick Square, E. Bos	**12**	81.2	72.2	68.5	61.3	47.9	46.5	41.4	45.6	36.0	41.3	38.2	42.5	43.5
Bremen St., E. Boston	**13**	59.1	52.6	52.0	46.2	39.1	35.7	37.6	37.1	27.8	30.1	28.6	31.9	35.3
Shore St. E. Boston	**14**	45.7	38.5	38.8	35.0	27.2	24.0	24.9	22.4	18.1	19.7	18.3	20.7	26.7
Orient Heights Yacht Club	**15**	45.1	46.9	47.7	43.1	29.4	25.2	25.5	25.1	19.6	21.1	18.3	22.5	26.7
Bayswater St. E. Boston	**16**	45.2	45.5	48.3	41.2	28.4	22.8	30.4	23.1	18.4	20.2	17.8	21.0	25.9
Annavoy St. E. Boston	**17**	40.8	39.2	44.4	33.7	24.7	21.4	23.3	21.0	18.2	19.6	17.3	20.9	25.8
Pleasant St. Winthrop	**18**	42.0	39.3	37.8	32.3	27.9	22.6	23.4	21.4	17.8	20.2	17.7	20.1	24.4
Court Road, Winthrop	**19**	40.0	36.1	33.8	27.4	24.0	19.2	22.3	21.0	16.3	17.1	16.7	18.4	22.7
Cottage Park Yacht Club	**20**	37.1	50.9	45.9	36.7	22.5	19.1	27.7	21.4	16.3	18.4	17.8	17.8	22.5
Winthrop, Point Shirley	**21**	33.1	37.7	38.6	24.4	22.7	17.4	17.2	20.2	15.7	15.6	14.9	17.5	21.6
Deer Island	**22**	36.3	31.9	33.8	33.1	21.3	17.8	16.9	17.8	13.0	17.0	14.7	16.7	20.7
Runway 4R–9	**23**	42.2	66.0	42.3	33.4	28.6	24.1	27.1	26.3	19.2	22.4	21.2	21.6	26.5
Runway 33L–4R	**24**	44.3	41.7	41.8	33.5	28.1	24.3	22.3	25.7	20.9	25.2	20.0	23.6	26.2
Runway 22R–33L	**25**	62.4	50.3	49.4	42.2	33.8	31.7	29.4	34.5	22.9	25.1	25.3	29.5	34.9
Jeffries Point Park/Marginal St.	**26**	68.6	49.8	45.0	42.0	35.2	30.5	32.5	31.7	24.4	27.0	25.6	28.6	33.1
Harborwalk	**27**	54.3	48.5	47.4	43.5	35.6	35.5	29.3	34.2	24.2	26.1	24.5	28.3	34.9
Logan Athletic Fields	**29**	NA	69.1	67.6	54.9	41.9	40.2	37.5	37.0	24.6	28.8	26.8	30.8	37.8
Brophy Park, Jeffries Point	**30**	NA	48.0	45.2	41.0	36.5	31.2	32.9	31.3	24.8	26.6	24.6	26.8	30.8
Average of all Monitoring Sites		**50.5**	**50.5**	**47.5**	**40.0**	**31.7**	**28.0**	**28.7**	**28.7**	**21.0**	**24.3**	**22.5**	**25.6**	**29.8**
MassDEP Monitoring Sites[1]														
Long Island Road	**A**	20.7	24.4	22.6	22.6	16.9	12.6	13.2	13.2	13.2	13.2	11.3	13.6	13.4
Harrison Avenue	**B**	NA	45.1	47.0	45.1	43.2	37.4	35.8	35.8	37.7	37.7	33.9	32.1	33.1
Kenmore Square	**C**	56.4	54.5	56.8	47.0	47.0	51.7	43.3	43.3	39.6	41.5	37.7	36.0	38.4
East First Street	**D**	39.5	37.6	43.2	39.5	39.5	36.8	33.9	39.6	37.7	30.2	28.3	24.0	25.4

Notes: The NAAQS is 100 µg/m³.
Massport determined that the Logan NO_2 Monitoring Program had achieved its objectives with the significant and stable decrease in NO_2 emissions since 1999 and thus discontinued the program in 2011.

µg/m³ micrograms/cubic meter.

NA Not available.

1 NO_2 monitoring sites operated by the MassDEP.

J

Water Quality/ Environmental Compliance and Management

This appendix provides detailed information in support of *Chapter 8, Water Quality/Environmental Compliance and Management:*

- Table J-1 National Pollutant Discharge Elimination System (NPDES) Permit Stormwater Outfall Monitoring Requirements (2007)
- Table J-2 Logan Airport 2012 Monthly Monitoring Results for First Quarter — North, West, and Maverick Street Stormwater Outfalls
- Table J-3 Logan Airport 2012 Monthly Monitoring Results for First Quarter — Porter Street Stormwater Outfall
- Table J-4 Logan Airport 2012 Monthly Monitoring Results for Second Quarter — North, West, and Maverick Street Stormwater Outfalls
- Table J-5 Logan Airport 2012 Monthly Monitoring Results for Second Quarter — Porter Street Stormwater Outfall
- Table J-6 Logan Airport 2012 Monthly Monitoring Results for Third Quarter — North, West, and Maverick Street Stormwater Outfalls
- Table J-7 Logan Airport 2012 Monthly Monitoring Results for Third Quarter — Porter Street Stormwater Outfall
- Table J-8 Logan Airport 2012 Monthly Monitoring Results for Fourth Quarter — North, West, and Maverick Street Stormwater Outfalls
- Table J-9 Logan Airport 2012 Monthly Monitoring Results for Fourth Quarter — Porter Street Stormwater Outfall
- Table J-10 Logan Airport 2012 Quarterly Wet Weather Monitoring Results — North, West, Maverick Street, and Porter Street Stormwater Outfalls

Table J-1 NPDES Permit Stormwater Outfall Monitoring Requirements (2007)

	North Outfall 001		West Outfall 002		Maverick Outfall 003	
Monitoring Event	Field Measurement	Laboratory Analysis	Field Measurement	Laboratory Analysis	Field Measurement	Laboratory Analysis
Monthly Dry Weather	Not Required	Oil and Grease TSS[1] Benzene Surfactant Fecal Coliform *Enterococcus*	Not Required	Oil and Grease TSS[1] Benzene Surfactant Fecal Coliform *Enterococcus*	Not Required	Oil and Grease TSS[1] Benzene Surfactant Fecal Coliform *Enterococcus*
Monthly Wet Weather	pH Flow Rate[6]	Oil and Grease TSS[1] Benzene[2] Surfactant Fecal Coliform *Enterococcus*	pH Flow Rate[6]	Oil and Grease TSS[1] Benzene[2] Surfactant Fecal Coliform *Enterococcus*	pH Flow Rate[6]	Oil and Grease TSS[1] Benzene[2] Surfactant Fecal Coliform *Enterococcus*
Quarterly Wet Weather	pH Flow Rate[6]	PAHs[3]: - Benzo(a)anthracene - Benzo(a)pyrene - Benzo(b)fluoranthene - Benzo(k)fluoranthene - Chrysene -Dibenzo(a,h)anthracene - Indeno(1,2,3-cd)pyrene - Naphthalene	pH Flow Rate[6]	PAHs[3]: - Benzo(a)anthracene - Benzo(a)pyrene - Benzo(b)fluoranthene - Benzo(k)fluoranthene - Chrysene -Dibenzo(a,h)anthracene - Indeno(1,2,3-cd)pyrene - Naphthalene	pH Flow Rate[6]	PAHs[3]: - Benzo(a)anthracene - Benzo(a)pyrene - Benzo(b)fluoranthene - Benzo(k)fluoranthene - Chrysene -Dibenzo(a,h)anthracene - Indeno(1,2,3-cd)pyrene - Naphthalene
Deicing Episode (2/Deicing Season)	Not Required	Ethylene Glycol Propylene Glycol BOD5[4] COD[5] Total Ammonia Nitrogen Nonylphenol Tolytriazole	Not Required	Ethylene Glycol Propylene Glycol BOD5[4] COD[5] Total Ammonia Nitrogen Nonylphenol Tolytriazole	Not Required	Not Required
Whole Effluent Toxicity (1st and 3rd Year Deicing Season)	Not Required	Menidia beryllina Arbacia punctulata	Not Required	Menidia beryllina Arbacia punctulata	Not Required	Not Required
Treatment System Sampling (Internal Outfalls)[7]	pH Quantity, Gallons	Oil and Grease TSS[1] Benzene[2]	Not Required	Not Required	Not Required	Not Required

Table J-1 NPDES Permit Stormwater Outfall Monitoring Requirements (2007) (Continued)

	Northwest Outfall 005		Porter Outfall 003 (3 upstream locations)		Select Runway/Perimeter Outfalls	
Monitoring Event	**Field Measurement**	**Laboratory Analysis**	**Field Measurement**	**Laboratory Analysis**	**Field Measurement**	**Laboratory Analysis**
Monthly Dry Weather	Not Required	Not Required	Not Required	Oil and Grease TSS[1] Benzene Surfactant Fecal Coliform *Enterococcus*	Not Required	Not Required
Monthly Wet Weather	Not Required	Not Required	pH Flow Rate	Oil and Grease TSS[1] Benzene[2] Surfactant Fecal Coliform *Enterococcus*	Not Required	Not Required
Quarterly Wet Weather	pH Flow Rate[6]	Oil and Grease TSS[1] Benzene[2]	pH Flow Rate[6]	PAHs[3]: - Benzo(a)anthracene - Benzo(a)pyrene - Benzo(b)fluoranthene - Benzo(k)fluoranthene - Chrysene -Dibenzo(a,h)anthracene - Indeno(1,2,3-cd)pyrene - Naphthalene	pH	Oil and Grease TSS[1] Benzene[2]
Deicing Episode (2/Deicing Season)	Not Required	Not Required	Not Required	Ethylene Glycol Propylene Glycol BOD5[4] COD[5] Total Ammonia Nitrogen Nonylphenol Tolytriazole	Not Required	Ethylene Glycol Propylene Glycol BOD5[4] COD[5] Total Ammonia Nitrogen Nonylphenol Tolytriazole
Whole Effluent Toxicity (1st and 3rd Year Deicing Season)	Not Required	Not Required	Not Required	Menidia beryllina Arbacia punctulata	Not Required	Not Required
Treatment System Sampling (Internal Outfalls)[7]	Not Required	Not Required	Not Required	Not Required	Not Required	Not Required

Source: Massport

Notes: Requirements are from NPDES Permit MA0000787, issued July 31, 2007.

1 TSS - Total Suspended Solids
2 Benzene must be collected with HDPE bailer.
3 PAH - Polycyclic Aromatic Hydrocarbons
4 BOD - Biological Oxygen Demand
5 COD - Chemical Oxygen Demand
6 Flow Rate will be estimated based on measured precipitation and the hydraulic model developed for the Logan Airport drainage system.
7 Outfalls 001D and 001E samples collected by Swissport.

Table J-2 Logan Airport 2012 Monthly Monitoring Results for First Quarter — North, West, and Maverick Street Stormwater Outfalls

	Date	Event	Maximum Daily Flow (MGD)	Average Monthly Flow (MGD)	pH (S.U.)	Oil and Grease (mg/L)	TSS (mg/L)	Benzene (µg/L)	Surfactant (mg/L)	Fecal Coliform (cfu/100mL)	*Enterococcus* (cfu/100mL)	*Klebsiella*[1] (cfu/100mL)
001A – North Outfall	1/12/2012	Wet Weather	3.52	0.43	7.64	<4.0	16	<1.0	0.21	1,900	2,200	NA
002A – West Outfall	1/12/2012	Wet Weather	13.11	1.72	7.25	<4.0	23	<1.0	0.21	1,700	410	NA
004A – Maverick Street Outfall	1/12/2012	Wet Weather	0.90	0.10	7.24	<4.0	50	<1.0	0.17	210	190	NA
001C – North Outfall	1/6/2012	Dry Weather				<4.0	25	<1.0	0.28	>80,000	61,000	<10
002C – West Outfall	1/6/2012	Dry Weather				<4.0	15	<1.0	0.08	40	80	NA
004C – Maverick Street Outfall	1/6/2012	Dry Weather				<4.0	17	<1.0	<0.05	1,000	230	NA
001A – North Outfall	2/24/2012	Wet Weather	1.17	0.26	6.84	<4.0	14	<1.0	0.31	2,300	1,100	NA
002A – West Outfall	2/24/2012	Wet Weather	7.31	1.15	6.18	9.8	31	<1.0	0.30	>80,000	>80,000	NA
004A – Maverick Street Outfall	2/24/2012	Wet Weather	0.45	0.06	6.31	<4.4	18	<1.0	0.10	30	50	NA
001C – North Outfall	2/3/2012	Dry Weather				<4.0	6.0	<1.0	0.14	<10	690	NA
002C – West Outfall	2/3/2012	Dry Weather				<4.0	25	<1.0	0.16	>80,000	23,000	NA
004C – Maverick Street Outfall	2/3/2012	Dry Weather				<4.0	20	<1.0	0.07	180	100	NA
001A – North Outfall	-	Wet Weather	2.01	0.33	NS	NS	NS	NS	NS	NS	NS	NS
002A – West Outfall	-	Wet Weather	7.19	1.45	NS	NS	NS	NS	NS	NS	NS	NS
004A – Maverick Street Outfall	-	Wet Weather	0.50	0.08	NS	NS	NS	NS	NS	NS	NS	NS
001C – North Outfall	3/8/2012	Dry Weather				<4.0	26	<1.0	0.12	2,400	2,600	NA
002C – West Outfall	3/8/2012	Dry Weather				<4.0	49	<1.0	0.10	1,500	130	NA
004C – Maverick Street Outfall	3/8/2012	Dry Weather				<4.0	15	<1.0	0.06	10	<10	NA
Requirements are from NPDES Permit MA0000787, issued July 31, 2007.												
Discharge Limitations												
Maximum Daily			Report	Report	6.0 to 8.5	15 mg/L	100 mg/L	Report	Report	Report	Report	
Average Monthly			Report	Report	6.0 to 8.5	—	Report	Report	Report	Report	Report	

Source: Massport

Notes: Flow rates were estimated for outfalls 001, 002, and 004 by using the SWMM model developed for Logan Airport.
For averaging calculations, a value of zero was employed for those results measured below the laboratory detection limit. For geometric mean calculations (fecal coliform and *Enterococcus*) a value of 1 was employed for those results measured below the laboratory detection limit.

1 *Klebsiella* is an indication of non-fecal coliform bacteria and is tested for at the North Outfall when fecal coliform concentration exceeds 5,000 cfu/100ml.

NA Not Analyzed

TSS Total Suspended Solids

NS Not Sampled. A wet weather event was not conducted in March 2012.

Table J-3 Logan Airport 2012 Monthly Monitoring Results for First Quarter — Porter Street Stormwater Outfall

	Date	Event	Maximum Daily Flow (MGD)	Average Monthly Flow (MGD)	pH (S.U.)	Oil and Grease (mg/L)	TSS (mg/L)	Benzene (µg/L)	Surfactant (mg/L)	Fecal Coliform (cfu/100mL)	*Enterococcus* (cfu/100mL)
003 - Porter Street Outfall 1	1/12/2012	Wet Weather	-	-	7.33	<4.0	40	<1.0	0.18	700	2,100
003 - Porter Street Outfall 2	1/12/2012	Wet Weather	-	-	7.51	<4.0	15	<1.0	0.11	50	120
003 - Porter Street Outfall 3	1/12/2012	Wet Weather	-	-	7.41	<4.0	9.2	<1.0	0.08	<10	100
003 - Porter Street Outfall Average		Wet Weather	2.46	0.25	7.42	0.0	21	0.0	0.12	33	293
003 - Porter Street Outfall 1	1/6/2012	Dry Weather				<4.0	<5.0	<1.0	<0.05	<10	<10
003 - Porter Street Outfall 2	1/6/2012	Dry Weather				<4.0	93	<1.0	0.14	30	130
003 - Porter Street Outfall 3	1/6/2012	Dry Weather				<4.0	33	<1.0	0.08	<10	50
003 - Porter Street Outfall Average		Dry Weather				0.0	42.0	0.0	0.07	3.1	19
003 - Porter Street Outfall 1	2/24/2012	Wet Weather	-	-	6.99	<4.0	8.7	<1.0	0.05	<10	<10
003 - Porter Street Outfall 2	2/24/2012	Wet Weather	-	-	7.26	<4.0	6.3	<1.0	0.21	20	20
003 - Porter Street Outfall 3	2/24/2012	Wet Weather	-	-	7.16	<4.0	<5.0	<1.0	0.33	10	40
003 - Porter Street Outfall Average		Wet Weather	1.75	0.12	7.14	0.0	5.0	0.0	0.20	5.8	9.3
003 - Porter Street Outfall 1	2/3/2012	Dry Weather				<4.0	<5.0	<1.0	0.07	<10	<10
003 - Porter Street Outfall 2	2/3/2012	Dry Weather				<4.0	72	<1.0	0.25	<10	10
003 - Porter Street Outfall 3	2/3/2012	Dry Weather				<4.0	77	<1.0	0.15	<10	<10
003 - Porter Street Outfall Average		Dry Weather				0.0	50	0.0	0.16	1.0	2.2
003 - Porter Street Outfall 1	-	Wet Weather	-	NS	NS	NS	NS	NS	NS	NS	-
003 - Porter Street Outfall 2	-	Wet Weather	-	NS	NS	NS	NS	NS	NS	NS	-
003 - Porter Street Outfall 3	-	Wet Weather	-	NS	NS	NS	NS	NS	NS	NS	-
003 - Porter Street Outfall Average		Wet Weather	0.96	0.19	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall 1	3/8/2012	Dry Weather				<4.4	<5.0	<1.0	0.07	20	<10
003 - Porter Street Outfall 2	3/8/2012	Dry Weather				<4.0	35	<1.0	0.07	<10	<10
003 - Porter Street Outfall 3	3/8/2012	Dry Weather				<4.0	<5.0	<1.0	0.14	<10	<10
003 - Porter Street Outfall Average		Dry Weather				0.0	12	0.0	0.09	2.7	1.0
Requirements are from NPDES Permit MA0000787, issued July 31, 2007.											
Discharge Limitations											
Maximum Daily			Report	Report	6.0 to 8.5	Report	Report	Report	Report	Report	Report
Average Monthly			Report	Report	6.0 to 8.5	—	Report	Report	Report	Report	Report

Source: Massport
Notes: For averaging calculations, a value of zero was employed for those results measured below the laboratory detection limit. For geometric mean calculations (fecal coliform and *Enterococcus*) a value of 1 was employed for those results measured below the laboratory detection limit.
TSS Total Suspended Solids
NS Not Sampled. A wet weather event was not conducted in March 2012.

Table J-4 Logan Airport 2012 Monthly Monitoring Results for Second Quarter — North, West, and Maverick Street Stormwater Outfalls

	Date	Event	Maximum Daily Flow (MGD)	Average Monthly Flow (MGD)	pH (S.U.)	Oil and Grease (mg/L)	TSS (mg/L)	Benzene (µg/L)	Surfactant (mg/L)	Fecal Coliform (cfu/100mL)	*Enterococcus* (cfu/100mL)	*Klebsiella*[1] (cfu/100mL)
001A – North Outfall	4/23/2012	Wet Weather	6.92	0.54	6.94	<4.0	<5.0	<1.0	0.08	460	2,400	NA
002A – West Outfall	4/23/2012	Wet Weather	25.80	2.16	7.93	<4.0	42	<1.0	0.09	630	11,000	NA
004A – Maverick Street Outfall	4/23/2012	Wet Weather	1.56	0.14	8.10	<4.0	20	<1.0	0.11	110	420	NA
001C – North Outfall	4/12/2012	Dry Weather				<4.4	11	<1.0	0.21	750	790	NA
002C – West Outfall	4/12/2012	Dry Weather				<4.0	27	<1.0	0.14	100	600	NA
004C – Maverick Street Outfall	4/12/2012	Dry Weather				<4.0	23	<1.0	0.09	10	<10	NA
001A – North Outfall	5/1/2012	Wet Weather	3.16	0.42	7.59	<4.0	<5.0	<1.0	0.08	270	460	NA
002A – West Outfall	5/1/2012	Wet Weather	11.99	1.68	6.49	<4.0	27	<1.0	0.19	4,200	3,800	NA
004A – Maverick Street Outfall	5/1/2012	Wet Weather	0.83	0.10	6.75	<4.0	84	<1.0	0.42	320	170	NA
001C – North Outfall	5/29/2012	Dry Weather				<4.0	5.4	<1.0	0.170	5,900	680	24,000
002C – West Outfall	5/29/2012	Dry Weather				<4.0	16	<1.0	0.130	630	260	NA
004C – Maverick Street Outfall	5/29/2012	Dry Weather				<4.0	41	<1.0	0.190	280	55	NA
001A – North Outfall	6/25/2012	Wet Weather	4.05	0.51	7.23	<4.0	8.7	<1.0	0.090	29,000	3,700	NA
002A – West Outfall	6/25/2012	Wet Weather	13.71	1.95	7.16	<4.0	**110**	<1.0	0.090	2,300	3,600	NA
004A – Maverick Street Outfall	6/25/2012	Wet Weather	1.07	0.12	6.99	4.8	**160**	<1.0	0.300	64,000	1,700	NA
001C – North Outfall	6/12/2012	Dry Weather				<4.0	20	<1.0	0.190	5,500	1,300	NA
002C – West Outfall	6/12/2012	Dry Weather				<4.0	8.0	<5.0	0.140	5,800	1,900	NA
004C – Maverick Street Outfall	6/12/2012	Dry Weather				<4.0	14	<5.0	0.080	1,600	40	NA
Requirements are from NPDES Permit MA0000787, issued July 31, 2007.												
Discharge Limitations												
Maximum Daily			Report	Report	6.0 to 8.5	15 mg/L	100 mg/L	Report	Report	Report	Report	
Average Monthly			Report	Report	6.0 to 8.5	—	Report	Report	Report	Report	Report	

Source: Massport

Notes: Flow rates were estimated for outfalls 001, 002, and 004 by using the SWMM model developed for Logan Airport.
Bold values exceed maximum daily discharge limitation.
For averaging calculations, a value of zero was employed for those results measured below the laboratory detection limit. For geometric mean calculations (fecal coliform and *Enterococcus*) a value of 1 was employed for those results measured below the laboratory detection limit.

1 *Klebsiella* is an indication of non-fecal coliform bacteria and is tested for at the North Outfall when fecal coliform concentration exceeds 5,000 cfu/100ml.

NA Not Analyzed

TSS Total Suspended Solids

Table J-5 Logan Airport 2012 Monthly Monitoring Results for Second Quarter — Porter Street Stormwater Outfall

	Date	Event	Maximum Daily Flow (MGD)	Average Monthly Flow (MGD)	pH (S.U.)	Oil and Grease (mg/L)	TSS (mg/L)	Benzene (µg/L)	Surfactant (mg/L)	Fecal Coliform (cfu/100mL)	*Enterococcus* (cfu/100mL)
003 - Porter Street Outfall 1	4/23/2012	Wet Weather	-	-	7.72	<4.0	7.9	<1.0	0.17	1,500	750
003 - Porter Street Outfall 2	4/23/2012	Wet Weather	-	-	8.26	<4.0	<5.0	<1.0	0.08	10	70
003 - Porter Street Outfall 3	4/23/2012	Wet Weather	-	-	7.44	<4.4	<5.0	<1.0	0.15	10	160
003 - Porter Street Outfall Average		Wet Weather	5.39	0.34	7.81	0.0	2.6	0.0	0.13	53.1	203.3
003 - Porter Street Outfall 1	4/12/2012	Dry Weather				NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall 2	4/12/2012	Dry Weather				<4.0	23	<1.0	0.09	<10	<10
003 - Porter Street Outfall 3	4/12/2012	Dry Weather				<4.0	250	<1.0	0.16	<10	<10
003 - Porter Street Outfall Average		Dry Weather				0.0	137	0.0	0.13	1.0	1.0
003 - Porter Street Outfall 1	5/1/2012	Wet Weather	-	-	7.29	<4.0	25	<1.0	0.13	280	570
003 - Porter Street Outfall 2	5/1/2012	Wet Weather	-	-	8.08	<4.0	<5.0	<1.0	<0.05	<10	50
003 - Porter Street Outfall 3	5/1/2012	Wet Weather	-	-	7.88	<4.0	<5.0	<1.0	0.06	10	80
003 - Porter Street Outfall Average		Wet Weather	2.12	0.26	7.75	0.0	8.3	0.0	0.06	14.1	132
003 - Porter Street Outfall 1	5/29/2012	Dry Weather				<4.0	58	<1.0	0.230	2,900	160
003 - Porter Street Outfall 2	5/29/2012	Dry Weather				<4.0	53	<1.0	0.080	30	10
003 - Porter Street Outfall 3	5/29/2012	Dry Weather				<4.0	7.7	<1.0	0.200	<10	<10
003 - Porter Street Outfall Average		Dry Weather				0.0	40	0.0	0.17	44.3	11.7
003 - Porter Street Outfall 1	6/25/2012	Wet Weather	-	-	7.86	<4.0	15	<1.0	0.080	34,000	1,400
003 - Porter Street Outfall 2	6/25/2012	Wet Weather	-	-	7.53	<4.0	<5.0	<1.0	<0.050	140	520
003 - Porter Street Outfall 3	6/25/2012	Wet Weather	-	-	7.35	<4.0	<5.0	<1.0	0.110	<10	560
003 - Porter Street Outfall Average		Wet Weather	2.53	0.34	7.58	0.0	5.0	0.0	0.06	168	741
003 - Porter Street Outfall 1	6/12/2012	Dry Weather				<4.0	23	<5.0	0.140	210	200
003 - Porter Street Outfall 2	6/12/2012	Dry Weather				<4.0	20	<1.0	0.050	20	55
003 - Porter Street Outfall 3	6/12/2012	Dry Weather				<4.0	9.3	<5.0	0.140	<10	100
003 - Porter Street Outfall Average		Dry Weather				0.0	17	0.0	0.110	16.1	103
Requirements are from NPDES Permit MA0000787, issued July 31, 2007.											
Discharge Limitations											
Maximum Daily			Report	Report	6.0 to 8.5	Report	Report	Report	Report	Report	Report
Average Monthly			Report	Report	6.0 to 8.5	—	Report	Report	Report	Report	Report

Source: Massport

Notes: Porter Street Outfall location 3 (PSO-MH75) exhibited low flow during the wet sampling event and was dry during the dry sampling event, therefore PSO-MH78 was sampled in its place for both samples. For averaging calculations, a value of zero was employed for those results measured below the laboratory detection limit. For geometric mean calculations (fecal coliform and *Enterococcus*) a value of 1 was employed for those results measured below the laboratory detection limit.

TSS Total Suspended Solids

NS Not Sampled. Porter Street Outfall 1 was not sampled due to very low flow in the catch basin.

Table J-6 Logan Airport 2012 Monthly Monitoring Results for Third Quarter — North, West, and Maverick Street Stormwater Outfalls

	Date	Event	Maximum Daily Flow (MGD)	Average Monthly Flow (MGD)	pH (S.U.)	Oil and Grease (mg/L)	TSS (mg/L)	Benzene (µg/L)	Surfactant (mg/L)	Fecal Coliform (cfu/100mL)	*Enterococcus* (cfu/100mL)	*Klebsiella*[1] (cfu/100mL)
001A – North Outfall	NS	Wet Weather	4.93	0.33	NS	NS	NS	NS	NS	NS	NS	NS
002A – West Outfall	NS	Wet Weather	14.92	1.20	NS	NS	NS	NS	NS	NS	NS	NS
004A – Maverick Street Outfall	NS	Wet Weather	1.47	0.08	NS	NS	NS	NS	NS	NS	NS	NS
001C – North Outfall	7/13/2012	Dry Weather				<4.0	26	<1.0	0.110	>80,000	30	31,000
002C – West Outfall	7/13/2012	Dry Weather				<4.0	14	<1.0	0.100	9,000	200	NA
004C – Maverick Street Outfall	7/13/2012	Dry Weather				<4.0	43	<1.0	0.070	110	<10	NA
001A – North Outfall	8/15/2012	Wet Weather	3.68	0.30	7.48	<4.0	<5.0	<1.0	0.080	34,000	>80,000	14,000
002A – West Outfall	8/15/2012	Wet Weather	12.99	1.15	7.63	<4.0	16	<1.0	0.090	25,000	51,000	NA
004A – Maverick Street Outfall	8/15/2012	Wet Weather	1.01	0.06	6.94	<4.0	19	<1.0	0.100	37,000	430	NA
001C – North Outfall	8/24/2012	Dry Weather				<4.0	23	<1.0	0.140	>80,000	620	43,000
002C – West Outfall	8/24/2012	Dry Weather				<4.0	6.7	<1.0	0.120	5,900	2,000	NA
004C – Maverick Street Outfall	8/24/2012	Dry Weather				<4.0	<5.0	<1.0	0.100	1,000	160	NA
001A – North Outfall	9/19/2012	Wet Weather	2.33	0.39	7.32	<4.0	<5.0	<1.0	0.130	1,800	4,100	NA
002A – West Outfall	9/19/2012	Wet Weather	7.91	1.42	7.20	<4.0	8.1	<1.0	0.130	3,600	7,000	NA
004A – Maverick Street Outfall	9/19/2012	Wet Weather	0.65	0.08	NS	NS	NS	NS	NS	NS	NS	NS
001C – North Outfall	9/13/2012	Dry Weather				<4.0	12	<1.0	0.090	8,000	420	10,000
002C – West Outfall	9/13/2012	Dry Weather				<4.0	6.4	<1.0	0.090	2,700	3,200	NA
004C – Maverick Street Outfall	9/13/2012	Dry Weather				<4.0	34	<1.0	0.060	90	10	NA
Requirements are from NPDES Permit MA0000787, issued July 31, 2007.												
Discharge Limitations												
Maximum Daily			Report	Report	6.0 to 8.5	15 mg/L	100 mg/L	Report	Report	Report	Report	Report
Average Monthly			Report	Report	6.0 to 8.5	----	Report	Report	Report	Report	Report	Report

Source: Massport

Notes: Flow rates were estimated for outfalls 001, 002, and 004 by using the SWMM model developed for Logan Airport.
For averaging calculations, a value of zero was employed for those results measured below the laboratory detection limit. For geometric mean calculations (fecal coliform and *Enterococcus*) a value of 1 was employed for those results measured below the laboratory detection limit.

1 *Klebsiella* is an indication of non-fecal coliform bacteria and is tested for at the North Outfall when fecal coliform concentration exceeds 5,000 cfu/100ml.

TSS Total Suspended Solids

NA Not Analyzed

NS Not Sampled. Due to weather conditions, a wet weather event was not conducted in July 2012. Due to construction, the Maverick Street Outfall could not be sampled during the September 2012 wet weather event.

Table J-7 Logan Airport 2012 Monthly Monitoring Results for Third Quarter — Porter Street Stormwater Outfall

	Date	Event	Maximum Daily Flow (MGD)	Average Monthly Flow (MGD)	pH (S.U.)	Oil and Grease (mg/L)	TSS (mg/L)	Benzene (µg/L)	Surfactant (mg/L)	Fecal Coliform (cfu/100mL)	*Enterococcus* (cfu/100mL)
003 - Porter Street Outfall 1	NS	Wet Weather	-	-	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall 2	NS	Wet Weather	-	-	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall 3	NS	Wet Weather	-	-	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall Average		Wet Weather	2.49	0.23	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall 1	7/13/2012	Dry Weather				16	240	<5.0	0.370	1,000	640
003 - Porter Street Outfall 2	7/13/2012	Dry Weather				<4.0	32	<1.0	<0.050	10	30
003 - Porter Street Outfall 3	7/13/2012	Dry Weather				<4.0	<5.0	<5.0	0.170	<10	3,600
003 - Porter Street Outfall Average		Dry Weather				5.3	91	0.0	0.180	21.5	410
003 - Porter Street Outfall 1	8/15/2012	Wet Weather	-	-	7.30	<4.0	6.6	<1.0	0.100	5,200	2,600
003 - Porter Street Outfall 2	8/15/2012	Wet Weather	-	-	7.88	<4.0	<5.0	<1.0	0.060	5,400	120
003 - Porter Street Outfall 3	8/15/2012	Wet Weather	-	-	6.58	<4.0	30	<1.0	0.100	260	490
003 - Porter Street Outfall Average		Wet Weather	1.64	0.21	7.25	0.0	12.2	0.0	0.087	1940	535
003 - Porter Street Outfall 1	8/24/2012	Dry Weather				<4.0	7.7	<1.0	0.150	10	20
003 - Porter Street Outfall 2	8/24/2012	Dry Weather				<4.0	<5.0	<1.0	0.120	300	10
003 - Porter Street Outfall 3	8/24/2012	Dry Weather				<4.0	<5.0	<5.0	0.180	20	<10
003 - Porter Street Outfall Average		Dry Weather				0.0	2.6	0.0	0.150	39	6
003 - Porter Street Outfall 1	9/19/2012	Wet Weather	-	-	7.49	<4.0	<5.0	<1.0	0.190	6,100	2,200
003 - Porter Street Outfall 2	9/19/2012	Wet Weather	-	-	7.54	<4.0	<5.0	<1.0	0.060	250	300
003 - Porter Street Outfall 3	9/19/2012	Wet Weather	-	-	7.08	<4.0	<5.0	<1.0	0.150	70	230
003 - Porter Street Outfall Average		Wet Weather	1.63	0.26	7.37	0.0	0.0	0.0	0.133	474	533
003 - Porter Street Outfall 1	9/13/2012	Dry Weather				<4.0	6.3	<2.0	0.110	1,500	520
003 - Porter Street Outfall 2	9/13/2012	Dry Weather				<4.0	5.7	<1.0	0.060	120	190
003 - Porter Street Outfall 3	9/13/2012	Dry Weather				<4.0	<5.0	<1.0	0.180	60	30
003 - Porter Street Outfall Average		Dry Weather				0.0	4.0	0.0	0.117	221	144
Requirements are from NPDES Permit MA0000787, issued July 31, 2007.											
Discharge Limitations											
Maximum Daily			Report	Report	6.0 to 8.5	Report	Report	Report	Report	Report	Report
Average Monthly			Report	Report	6.0 to 8.5	—	Report	Report	Report	Report	Report

Source: Massport

Notes: For averaging calculations, a value of zero was employed for those results measured below the laboratory detection limit. For geometric mean calculations (fecal coliform and *Enterococcus*) a value of 1 was employed for those results measured below the laboratory detection limit.

TSS Total Suspended Solids

NS Not Sampled. Due to weather conditions, a wet weather event was not conducted in July 2012.

Table J-8 Logan Airport 2012 Monthly Monitoring Results for Fourth Quarter — North, West, and Maverick Street Stormwater Outfalls

	Date	Event	Maximum Daily Flow (MGD)	Average Monthly Flow (MGD)	pH (S.U.)	Oil and Grease (mg/L)	TSS (mg/L)	Benzene (µg/L)	Surfactant (mg/L)	Fecal Coliform (cfu/100mL)	*Enterococcus* (cfu/100mL)	*Klebsiella*[1] (cfu/100mL)
001A – North Outfall	NS	Wet Weather	2.51	0.26	NS	NS	NS	NS	NS	NS	NS	NS
002A – West Outfall	NS	Wet Weather	8.91	1.01	NS	NS	NS	NS	NS	NS	NS	NS
004A – Maverick Street Outfall	NS	Wet Weather	0.84	0.06	NS	NS	NS	NS	NS	NS	NS	NS
001C – North Outfall	10/18/2012	Dry Weather				<4.4	9.4	<1.0	0.110	5,000	360	NA
002C – West Outfall	10/18/2012	Dry Weather				<4.0	13	<1.0	0.100	1,800	620	NA
004C – Maverick Street Outfall	10/18/2012	Dry Weather				NS	NS	NS	NS	NS	NS	NS
001A – North Outfall	11/13/2012	Wet Weather	1.45	0.21	7.66	10	15	<1.0	0.470	>80,000	700	29,000
002A – West Outfall	11/13/2012	Wet Weather	4.90	0.84	7.48	<4.0	**160**	<1.0	0.310	1,900	2,000	NA
002A – West Outfall	11/27/2012	Wet Weather	---	---	6.40	NA	25	NA	NA	NA	NA	NA
004A – Maverick Street Outfall	11/13/2012	Wet Weather	0.23	0.04	NS	NS	NS	NS	NS	NS	NS	NS
001C – North Outfall	11/12/2012	Dry Weather				<4.0	8.1	<1.0	0.190	>80,000	720	58,000
002C – West Outfall	11/12/2012	Dry Weather				<4.0	30	<1.0	0.160	1,200	420	NA
004C – Maverick Street Outfall	11/12/2012	Dry Weather				NS	NS	NS	NS	NS	NS	NS
001A – North Outfall	12/17/2012	Wet Weather	6.92	0.79	7.49	<4.0	6.4	<1.0	0.110	540	1,100	NA
002A – West Outfall	12/17/2012	Wet Weather	24.87	2.94	7.03	<4.0	8.5	<1.0	0.100	400	350	NA
004A – Maverick Street Outfall	12/17/2012	Wet Weather	1.62	0.18	NS	NS	NS	NS	NS	NS	NS	NS
001C – North Outfall	12/7/2012	Dry Weather				<4.0	15	<1.0	0.360	4,100	70	NA
002C – West Outfall	12/7/2012	Dry Weather				<4.0	22	<1.0	0.340	400	<10	NA
004C – Maverick Street Outfall	12/7/2012	Dry Weather				NS	NS	NS	NS	NS	NS	NS
Requirements are from NPDES Permit MA0000787, issued July 31, 2007.												
Discharge Limitations												
Maximum Daily			Report	Report	6.0 to 8.5	15 mg/L	100 mg/L	Report	Report	Report	Report	Report
Average Monthly			Report	Report	6.0 to 8.5	—	Report	Report	Report	Report	Report	Report

Source: Massport

Notes: Flow rates were estimated for outfalls 001, 002, and 004 by using the SWMM model developed for Logan Airport.

Bold values exceed maximum daily discharge limitation.

For averaging calculations, a value of zero was employed for those results measured below the laboratory detection limit. For geometric mean calculations (fecal coliform and *Enterococcus*) a value of 1 was employed for those results measured below the laboratory detection limit.

1 *Klebsiella* is an indication of non-fecal coliform bacteria and is tested for at the North Outfall when fecal coliform concentration exceeds 5,000 cfu/100ml.

TSS Total Suspended Solids

NA Not Analyzed

NS Not Sampled. Due to weather conditions, a wet weather event was not conducted in October 2012. Due to construction, the Maverick Street Outfall could not be sampled during the October dry weather event and the November wet and dry weather event.

Table J-9 Logan Airport 2012 Monthly Monitoring Results for Fourth Quarter — Porter Street Stormwater Outfall

	Date	Event	Maximum Daily Flow (MGD)	Average Monthly Flow (MGD)	pH (S.U.)	Oil and Grease (mg/L)	TSS (mg/L)	Benzene (µg/L)	Surfactant (mg/L)	Fecal Coliform (cfu/100mL)	*Enterococcus* (cfu/100mL)
003 - Porter Street Outfall 1	NS	Wet Weather	-	-	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall 2	NS	Wet Weather	-	-	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall 3	NS	Wet Weather	-	-	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall Average		Wet Weather	2.40	0.14	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall 1	10/18/2012	Dry Weather				<4.0	<5.0	<1.0	0.160	100	660
003 - Porter Street Outfall 2	10/18/2012	Dry Weather				<4.0	5.9	<1.0	0.070	10	30
003 - Porter Street Outfall 3	10/18/2012	Dry Weather				<4.0	<5.0	<1.0	0.050	<10	430
003 - Porter Street Outfall Average		Dry Weather				0.0	2.0	0.0	0.093	10	204
003 - Porter Street Outfall 1	11/13/2012	Wet Weather	-	-	7.69	<4.0	15	<1.0	0.520	1,200	2,900
003 - Porter Street Outfall 2	11/13/2012	Wet Weather	-	-	8.21	<4.0	8.7	<1.0	0.080	<10	40
003 - Porter Street Outfall 3	11/13/2012	Wet Weather	-	-	**8.63**	<4.0	55	<1.0	0.090	690	490
003 - Porter Street Outfall Average		Wet Weather	0.11	0.02	8.18	0.0	26	0.0	0.230	94	384
003 - Porter Street Outfall 1	11/12/2012	Dry Weather				<4.0	10	<1.0	0.120	120	430
003 - Porter Street Outfall 2	11/12/2012	Dry Weather				<4.0	<5.0	<1.0	0.060	20	200
003 - Porter Street Outfall 3	11/12/2012	Dry Weather				<4.0	13	<1.0	0.110	<10	280
003 - Porter Street Outfall Average		Dry Weather				0.0	7.7	0.0	0.097	13	289
003 - Porter Street Outfall 1	12/17/2012	Wet Weather	-	-	7.16	<4.0	15	<1.0	0.130	320	640
003 - Porter Street Outfall 2	12/17/2012	Wet Weather	-	-	7.36	<4.0	<5.0	<1.0	0.050	2,500	460
003 - Porter Street Outfall 3	12/17/2012	Wet Weather	-	-	7.41	<4.0	<5.0	<1.0	<0.050	<10	100
003 - Porter Street Outfall Average		Wet Weather	5.27	0.54	7.31	0.0	5.0	0.0	0.060	93	309
003 - Porter Street Outfall 1	12/7/2012	Dry Weather				<4.0	8.2	<1.0	0.140	10	10
003 - Porter Street Outfall 2	12/7/2012	Dry Weather				<4.0	24	<1.0	0.810	<10	490
003 - Porter Street Outfall 3	12/7/2012	Dry Weather				<4.0	6.9	<1.0	0.270	<10	40
003 - Porter Street Outfall Average		Dry Weather				0.0	13	0.0	0.407	2.2	58
Requirements are from NPDES Permit MA0000787, issued July 31, 2007.											
Discharge Limitations											
Maximum Daily			Report	Report	6.0 to 8.5	Report	Report	Report	Report	Report	Report
Average Monthly			Report	Report	6.0 to 8.5	—	Report	Report	Report	Report	Report

Source: Massport

Notes: **Bold** values exceed maximum daily discharge limitation.
For averaging calculations, a value of zero was employed for those results measured below the laboratory detection limit. For geometric mean calculations (fecal coliform and *Enterococcus*) a value of 1 was employed for those results measured below the laboratory detection limit.

TSS Total Suspended Solids

NS Not Sampled. Due to weather conditions, a wet weather event was not conducted in October 2012.

Table J-10 Logan Airport 2012 Quarterly Wet Weather Monitoring Results – North, West, Maverick Street, and Porter Street Stormwater Outfalls

		Wet Weather									
	Date	pH (S.U.)	Benzo(a)-anthracene (µg/L)	Benzo(a)-pyrene (µg/L)	Benzo(b)-fluoranthene (µg/L)	Benzo(k)-fluoranthene (µg/L)	Chrysene (µg/L)	Dibenzo(a,h,)-anthracene (µg/L)	Indeno(1,2,3-cd)-pyrene (µg/L)	Naphthalene (µg/L)	Total PAHs (µg/L)
001 - North Outfall	4/23/2012	6.94	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<7.0	<5.0	ND
002 - West Outfall	4/23/2012	7.93	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<7.0	<5.0	ND
004 - Maverick Street Outfall	4/23/2012	8.10	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<7.0	<5.0	ND
003 - Porter Street Outfall 1	4/23/2012	7.72	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<7.0	<5.0	ND
003 - Porter Street Outfall 2	4/23/2012	8.26	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<7.0	<5.0	ND
003 - Porter Street Outfall 3	4/23/2012	7.44	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<7.0	<5.0	ND
003 - Porter Street Outfall Average		7.81	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
001 - North Outfall	6/25/2012	7.23	<10	<10	<10	<10	<10	<10	<14	<10	ND
002 - West Outfall	6/25/2012	7.16	<100	<100	<100	<100	<100	<100	<140	<100	ND
004 - Maverick Street Outfall	6/25/2012	6.99	<50	<50	<50	<50	<50	<50	<70	<50	ND
003 - Porter Street Outfall 1	6/25/2012	7.86	<25	<25	<25	<25	<25	<25	<35	<25	ND
003 - Porter Street Outfall 2	6/25/2012	7.53	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<7.0	<5.0	ND
003 - Porter Street Outfall 3	6/25/2012	7.35	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<7.0	<5.0	ND
003 - Porter Street Outfall Average		7.58	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
001 - North Outfall	9/19/2012	7.32	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<7.0	<5.0	ND
002 - West Outfall	9/19/2012	7.20	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<7.0	<5.0	ND
004 - Maverick Street Outfall	9/19/2012	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall 1	9/19/2012	7.49	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<7.0	<5.0	ND
003 - Porter Street Outfall 2	9/19/2012	7.54	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<7.0	<5.0	ND
003 - Porter Street Outfall 3	9/19/2012	7.08	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<7.0	<5.0	ND
003 - Porter Street Outfall Average		7.37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
001 - North Outfall	12/17/2012	7.49	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	ND
002 - West Outfall	12/17/2012	7.03	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	ND
004 - Maverick Street Outfall	12/17/2012	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall 1	12/17/2012	7.16	<10	<10	<10	<10	<10	<10	<10	<10	ND
003 - Porter Street Outfall 2	12/17/2012	7.36	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	ND
003 - Porter Street Outfall 3	12/17/2012	7.41	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	ND
003 - Porter Street Outfall Average		7.31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Requirements are from NPDES Permit MA0000787, issued July 31, 2007.											
Discharge Limitations											
Maximum Daily		6.0 to 8.5	Report	Report	Report	Report	Report	Report	Report	Report	Total

Source: Massport

Notes: ND Not Detected; NS Not Sampled. Due to construction, the Maverick Street Outfall could not be sampled during the 3rd and 4th Quarter wet weather event.; PAH Polynuclear Aromatic Hydrocarbons
For averaging calculations, a value of zero was employed for those results measured below the laboratory detection limit.

Table J-11 Logan Airport 2012 Quarterly Wet Weather Monitoring Results – Northwest and Runway/Perimeter Stormwater Outfalls

	Date	Maximum Daily Flow (MGD)	Average Monthly Flow (MGD)	pH (SU)	Oil and Grease (mg/L)	Total Suspended Solids (mg/L)	Benzene (µg/L)
005 - Northwest Outfall	4/23/2012	0.83	0.06	7.60	<4.0	31	<1.0
006- Runway/ Perimeter Outfall (A9)	4/23/2012	0.48	0.06	7.14	<4.4	<5.0	<1.0
006- Runway/ Perimeter Outfall (A17)	4/23/2012	0.20	0.02	6.58	<4.0	<5.0	<1.0
006- Runway/ Perimeter Outfall (A19)	4/24/2012	0.07	0.01	6.72	<4.0	<5.0	<1.0
006- Runway/ Perimeter Outfall (A21)	4/25/2012	4.40	0.42	7.11	<4.0	<5.0	<1.0
006- Runway/ Perimeter Outfall (A23)	4/26/2012	0.37	0.04	7.34	<4.0	6.3	<1.0
006- Runway/ Perimeter Outfall (A33)	4/27/2012	0.24	0.04	6.87	<4.0	<5.0	<1.0
006- Runway/ Perimeter Outfall (A38)	4/23/2012	0.60	0.03	7.26	<4.0	89	<1.0
006- Runway/Perimeter Outfall Average		0.91	0.09	7.00	0.0	14	0.0
005 - Northwest Outfall	6/25/2012	0.53	0.06	7.91	<4.0	30	<1.0
006- Runway/ Perimeter Outfall (A9)	6/25/2012	0.21	0.04	6.23	<4.4	<5.0	<1.0
006- Runway/ Perimeter Outfall (A15)	6/25/2012	0.11	0.01	6.76	<4.0	<5.0	<1.0
006- Runway/ Perimeter Outfall (A19)	6/25/2012	0.11	0.01	6.85	<4.0	<5.0	<1.0
006- Runway/ Perimeter Outfall (A21)	6/25/2012	2.03	0.29	7.04	<4.0	5.9	<1.0
006- Runway/ Perimeter Outfall (A23)	6/25/2012	0.16	0.03	7.07	<4.0	23	<1.0
006- Runway/ Perimeter Outfall (A33)	6/25/2012	0.11	0.02	7.23	<4.0	5.6	<1.0
006- Runway/ Perimeter Outfall (A38)	6/25/2012	0.28	0.03	7.22	<4.0	100	<1.0
006- Runway/Perimeter Outfall Average		0.43	0.06	6.91	0.0	19.2	0.0
005 - Northwest Outfall	9/19/2012	0.30	0.05	6.92	<4.0	12	<1.0
006- Runway/ Perimeter Outfall (A9)	9/19/2012	0.16	0.02	7.57	<4.0	<5.0	<1.0
006- Runway/ Perimeter Outfall (A15)	9/19/2012	0.02	0.00	6.54	<4.0	<5.0	<1.0
006- Runway/ Perimeter Outfall (A17)	9/19/2012	0.03	0.00	6.53	<4.0	<5.0	<1.0
006- Runway/ Perimeter Outfall (A21)	9/19/2012	1.14	0.18	6.32	<4.0	<5.0	<1.0
006- Runway/ Perimeter Outfall (A23)	9/19/2012	0.12	0.02	6.74	<4.0	<5.0	<5.0
006- Runway/ Perimeter Outfall (A33)	9/19/2012	0.08	0.01	6.49	<4.0	<5.0	<5.0
006- Runway/ Perimeter Outfall (A38)	9/19/2012	0.16	0.02	6.37	10	68	<1.0
006- Runway/Perimeter Outfall Average		0.24	0.04	6.65	1.4	9.7	0.0
005 - Northwest Outfall	12/17/2012	0.91	0.09	4.01	<4.0	11	<1.0
006- Runway/ Perimeter Outfall (A9)	12/17/2012	0.46	0.06	6.43	<4.0	<5.0	<1.0
006- Runway/ Perimeter Outfall (A18)	12/17/2012	0.21	0.02	5.68	<4.0	<5.0	<1.0
006- Runway/ Perimeter Outfall (A19)	12/17/2012	0.08	0.01	5.21	<4.0	<5.0	<1.0
006- Runway/ Perimeter Outfall (A21)	12/17/2012	4.27	0.48	6.24	<4.0	8.3	<1.0
006- Runway/ Perimeter Outfall (A23)	12/17/2012	0.37	0.04	5.14	<4.0	5.7	<1.0
006- Runway/ Perimeter Outfall (A33)	12/17/2012	0.29	0.04	5.16	<4.0	6.4	<1.0
006- Runway/ Perimeter Outfall (A38)	12/17/2012	0.58	0.04	6.86	<4.0	27	<1.0
006- Runway/Perimeter Outfall Average		0.89	0.10	5.82	0.0	6.8	0.0
Discharge Limitations		Report	Report	Report	Report	Report	Report

Source: Massport; Note: Requirements are from NPDES Permit MA 0000787, issued July 31, 2007

Table J-12 Logan Airport 2013 Monthly Monitoring Results for First Quarter — North, West, and Maverick Street Stormwater Outfalls

	Date	Event	Maximum Daily Flow (MGD)	Average Monthly Flow (MGD)	pH (S.U.)	Oil and Grease (mg/L)	TSS (mg/L)	Benzene (µg/L)	Surfactant (mg/L)	Fecal Coliform (cfu/100mL)	*Enterococcus* (cfu/100mL)	*Klebsiella*[1] (cfu/100mL)
001A – North Outfall	1/16/2013	Wet Weather	1.29	0.29	6.85	<4.0	5.7	<1.0	0.250	2,100	<10	NA
002A – West Outfall	1/16/2013	Wet Weather	5.09	1.13	7.35	<4.0	17	<1.0	0.320	240	<10	NA
004A – Maverick Street Outfall	1/16/2013	Wet Weather	0.06	0.41	NS	NS	NS	NS	NS	NS	NS	NS
001C – North Outfall	1/4/2013	Dry Weather				<4.0	10	<1.0	0.200	1,800	<10	NA
002C – West Outfall	1/4/2013	Dry Weather				<4.0	21	<1.0	0.120	1,700	330	NA
004C – Maverick Street Outfall	1/4/2013	Dry Weather				NS	NS	NS	NS	NS	NS	NS
001A – North Outfall	2/27/2013	Wet Weather	4.86	0.98	7.07	<4.0	16	<1.0	0.180	40	210	NA
002A – West Outfall	2/27/2013	Wet Weather	18.42	3.08	7.06	4.0	39	<1.0	0.190	600	2,900	NA
004A – Maverick Street Outfall	2/27/2013	Wet Weather	1.26	0.19	NS	NS	NS	NS	NS	NS	NS	NS
001C – North Outfall	2/7/2013	Dry Weather				<4.0	25	<1.0	0.590	620	<10	NA
002C – West Outfall	2/7/2013	Dry Weather				5.8	37	<1.0	0.460	780	40	NA
004C – Maverick Street Outfall	2/7/2013	Dry Weather				NS	NS	NS	NS	NS	NS	NS
001A – North Outfall	-	Wet Weather	2.58	0.74	NS	NS	NS	NS	NS	NS	NS	NS
002A – West Outfall	-	Wet Weather	15.34	2.26	NS	NS	NS	NS	NS	NS	NS	NS
004A – Maverick Street Outfall	-	Wet Weather	1.31	0.15	NS	NS	NS	NS	NS	NS	NS	NS
001C – North Outfall	3/11/2013	Dry Weather				<4.0	12	<1.0	0.120	160	40	NA
002C – West Outfall	3/11/2013	Dry Weather				<4.0	20	<1.0	0.100	130	450	NA
004C – Maverick Street Outfall	3/11/2013	Dry Weather				NS	NS	NS	NS	NS	NS	NS
Requirements are from NPDES Permit MA0000787, issued July 31, 2007.												
Discharge Limitations												
Maximum Daily			Report	Report	6.0 to 8.5	15 mg/L	100 mg/L	Report	Report	Report	Report	
Average Monthly			Report	Report	6.0 to 8.5	—	Report	Report	Report	Report	Report	

Source: Massport

Notes: Flow rates were estimated for outfalls 001, 002, and 004 by using the SWMM model developed for Logan Airport.
For averaging calculations, a value of zero was employed for those results measured below the laboratory detection limit. For geometric mean calculations (fecal coliform and *Enterococcus*) a value of 1 was employed for those results measured below the laboratory detection limit.

1 *Klebsiella* is an indication of non-fecal coliform bacteria and is tested for at the North Outfall when fecal coliform concentration exceeds 5,000 cfu/100ml.

NA Not Analyzed

TSS Total Suspended Solids

NS Not Sampled. Due to construction, the Maverick Street Outfall could not be sampled during the January and February events. Due to weather and tidal conditions, a wet weather event was not conducted in March 2013.

Table J-13 Logan Airport 2013 Monthly Monitoring Results for First Quarter — Porter Street Stormwater Outfall

	Date	Event	Maximum Daily Flow (MGD)	Average Monthly Flow (MGD)	pH (S.U.)	Oil and Grease (mg/L)	TSS (mg/L)	Benzene (µg/L)	Surfactant (mg/L)	Fecal Coliform (cfu/100mL)	*Enterococcus* (cfu/100mL)
003 - Porter Street Outfall 1	1/16/2013	Wet Weather	-	-	7.00	5.0	98	<1.0	0.330	130	150
003 - Porter Street Outfall 2	1/16/2013	Wet Weather	-	-	**9.03**	8.2	23	<1.0	0.330	<10	100
003 - Porter Street Outfall 3	1/16/2013	Wet Weather	-	-	6.80	<4.0	24	<1.0	0.110	50	<10
003 - Porter Street Outfall Average		Wet Weather	1.09	0.16	7.61	4.4	48	0.0	0.257	19	25
003 - Porter Street Outfall 1	1/4/2013	Dry Weather				<4.0	<5.0	<1.0	0.090	<10	<10
003 - Porter Street Outfall 2	1/4/2013	Dry Weather				<4.0	6.6	<1.0	0.090	<10	1,800
003 - Porter Street Outfall 3	1/4/2013	Dry Weather				<4.0	16	<1.0	0.090	<10	20
003 - Porter Street Outfall Average		Dry Weather				0.0	7.5	0.0	0.090	1.0	33
003 - Porter Street Outfall 1	2/27/2013	Wet Weather	-	-	7.11	5.1	44	<1.0	0.210	120	1,800
003 - Porter Street Outfall 2	2/27/2013	Wet Weather	-	-	7.11	<4.0	<5.0	<1.0	0.070	<10	10
003 - Porter Street Outfall 3	2/27/2013	Wet Weather	-	-	7.15	<4.0	7.7	<1.0	0.140	170	110
003 - Porter Street Outfall Average		Wet Weather	4.62	0.57	7.12	1.7	17	0.0	0.140	27	126
003 - Porter Street Outfall 1	2/7/2013	Dry Weather				<4.0	31	<1.0	0.140	40	50
003 - Porter Street Outfall 2	2/7/2013	Dry Weather				<4.0	14	<1.0	0.220	<10	40
003 - Porter Street Outfall 3	2/7/2013	Dry Weather				<4.0	13	<1.0	0.160	10	<10
003 - Porter Street Outfall Average		Dry Weather				0.0	19	0.0	0.173	7.4	13
003 - Porter Street Outfall 1	-	Wet Weather	-	NS	NS	NS	NS	NS	NS	NS	-
003 - Porter Street Outfall 2	-	Wet Weather	-	NS	NS	NS	NS	NS	NS	NS	-
003 - Porter Street Outfall 3	-	Wet Weather	-	NS	NS	NS	NS	NS	NS	NS	-
003 - Porter Street Outfall Average		Wet Weather	3.18	0.40	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall 1	3/112013	Dry Weather				<4.0	82	<1.0	0.120	20	<10
003 - Porter Street Outfall 2	3/112013	Dry Weather				<4.0	10	<1.0	0.080	<10	20
003 - Porter Street Outfall 3	3/112013	Dry Weather				<4.0	6.0	<1.0	0.080	<10	10
003 - Porter Street Outfall Average		Dry Weather				0.0	33	0.0	0.093	2.7	5.8
Requirements are from NPDES Permit MA0000787, issued July 31, 2007.											
Discharge Limitations											
Maximum Daily			Report	Report	6.0 to 8.5	Report	Report	Report	Report	Report	Report
Average Monthly			Report	Report	6.0 to 8.5	—	Report	Report	Report	Report	Report

Source: Massport
Notes: **Bold** values exceed maximum daily discharge limitation.
For averaging calculations, a value of zero was employed for those results measured below the laboratory detection limit. For geometric mean calculations (fecal coliform and *Enterococcus*) a value of 1 was employed for those results measured below the laboratory detection limit.
TSS Total Suspended Solids
NS Not Sampled. Due to weather and tidal conditions, a wet weather event was not conducted in March 2013.

Table J-14 Logan Airport 2013 Monthly Monitoring Results for Second Quarter — North, West, and Maverick Street Stormwater Outfalls

	Date	Event	Maximum Daily Flow (MGD)	Average Monthly Flow (MGD)	pH (S.U.)	Oil and Grease (mg/L)	TSS (mg/L)	Benzene (µg/L)	Surfactant (mg/L)	Fecal Coliform (cfu/100mL)	*Enterococcus* (cfu/100mL)	*Klebsiella*[1] (cfu/100mL)
001A – North Outfall	4/11/2013	Wet Weather	1.41	0.31	7.41	<4.0	9.7	<1.0	0.630	71,000	44,000	18,000
002A – West Outfall	4/11/2013	Wet Weather	5.90	1.42	7.34	7.6	75	<1.0	0.380	7,700	1,800	NA
004A – Maverick Street Outfall	4/11/2013	Wet Weather	0.34	0.09	NS	NS	NS	NS	NS	NS	NS	NS
001C – North Outfall	4/23/2013	Dry Weather				<4.0	8.4	<1.0	0.210	3,700	20	NA
002C – West Outfall	4/23/2013	Dry Weather				<4.0	9.4	<1.0	0.130	3,500	1,100	NA
004C – Maverick Street Outfall	4/23/2013	Dry Weather				NS	NS	NS	NS	NS	NS	NS
001A – North Outfall	5/9/2013	Wet Weather	2.81	0.40	7.33	<4.0	7.5	<1.0	0.210	100	40	NA
002A – West Outfall	5/9/2013	Wet Weather	9.69	1.64	6.12	<4.0	33	<1.0	0.200	1,300	1,600	NA
004A – Maverick Street Outfall	5/9/2013	Wet Weather	0.69	0.09	NS	NS	NS	NS	NS	NS	NS	NS
001C – North Outfall	5/6/2013	Dry Weather				<4.0	12	<1.0	0.420	1,800	<10	NA
002C – West Outfall	5/6/2013	Dry Weather				<4.0	39	<1.0	0.060	70	230	NA
004C – Maverick Street Outfall	5/6/2013	Dry Weather				NS	NS	NS	NS	NS	NS	NS
001A – North Outfall	6/3/2013	Wet Weather	9.36	1.15	7.20	<4.0	<5.0	<1.0	0.190	10,000	1,000	14,000
002A – West Outfall	6/3/2013	Wet Weather	27.9	4.20	6.51	<4.0	14	<1.0	0.270	5,000	2,700	NA
004A – Maverick Street Outfall	6/3/2013	Wet Weather	2.53	0.28	NS	NS	NS	NS	NS	NS	NS	NS
001C – North Outfall	6/27/2013	Dry Weather				<4.0	19	<1.0	0.140	43,000	2,900	14,000
002C – West Outfall	6/27/2013	Dry Weather				<4.0	36	<1.0	0.120	1,500	200	NA
004C – Maverick Street Outfall	6/27/2013	Dry Weather				NS	NS	NS	NS	NS	NS	NS
Requirements are from NPDES Permit MA0000787, issued July 31, 2007.												
Discharge Limitations												
Maximum Daily			Report	Report	6.0 to 8.5	15 mg/L	100 mg/L	Report	Report	Report	Report	
Average Monthly			Report	Report	6.0 to 8.5	—	Report	Report	Report	Report	Report	

Source: Massport

Notes: Flow rates were estimated for outfalls 001, 002, and 004 by using the SWMM model developed for Logan Airport.
For averaging calculations, a value of zero was employed for those results measured below the laboratory detection limit. For geometric mean calculations (fecal coliform and *Enterococcus*) a value of 1 was employed for those results measured below the laboratory detection limit.

1 *Klebsiella* is an indication of non-fecal coliform bacteria and is tested for at the North Outfall when fecal coliform concentration exceeds 5,000 cfu/100ml.

NA Not Analyzed

NS Not Sampled. Due to construction, the Maverick Street Outfall could not be sampled during the Apri, May, and June events.

TSS Total Suspended Solids

Table J-15 Logan Airport 2013 Monthly Monitoring Results for Second Quarter — Porter Street Stormwater Outfall

	Date	Event	Maximum Daily Flow (MGD)	Average Monthly Flow (MGD)	pH (S.U.)	Oil and Grease (mg/L)	TSS (mg/L)	Benzene (µg/L)	Surfactant (mg/L)	Fecal Coliform (cfu/100mL)	*Enterococcus* (cfu/100mL)
003 - Porter Street Outfall 1	4/11/2013	Wet Weather	-	-	**5.62**	<4.0	19	<1.0	0.600	40	410
003 - Porter Street Outfall 2	4/11/2013	Wet Weather	-	-	7.65	<4.0	<5.0	<1.0	0.120	10	<10
003 - Porter Street Outfall 3	4/11/2013	Wet Weather	-	-	7.11	<4.0	<5.0	<1.0	0.250	110	240
003 - Porter Street Outfall Average		Wet Weather	1.15	0.20	6.79	0.0	6.3	0.0	0.323	35	46
003 - Porter Street Outfall 1	4/23/2013	Dry Weather				<4.0	<5.0	<1.0	0.110	<10	<10
003 - Porter Street Outfall 2	4/23/2013	Dry Weather				<4.0	<5.0	<1.0	0.230	<10	<10
003 - Porter Street Outfall 3	4/23/2013	Dry Weather				<4.0	7.2	<1.0	0.130	<10	90
003 - Porter Street Outfall Average		Dry Weather				0.0	2.4	0.0	0.157	1.0	4.5
003 - Porter Street Outfall 1	5/9/2013	Wet Weather	-	-	6.66	<4.0	<5.0	<1.0	0.280	40	260
003 - Porter Street Outfall 2	5/9/2013	Wet Weather	-	-	7.19	<4.0	<5.0	<1.0	0.140	<10	50
003 - Porter Street Outfall 3	5/9/2013	Wet Weather	-	-	6.80	<4.0	<5.0	<1.0	0.240	20	160
003 - Porter Street Outfall Average		Wet Weather	1.47	0.27	6.88	0.0	0.0	0.0	0.220	9.3	128
003 - Porter Street Outfall 1	5/6/2013	Dry Weather				<4.0	9.2	<1.0	0.090	<10	<10
003 - Porter Street Outfall 2	5/6/2013	Dry Weather				<4.0	50	<1.0	0.110	<10	<10
003 - Porter Street Outfall 3	5/6/2013	Dry Weather				<4.0	7.5	<1.0	0.170	<10	<10
003 - Porter Street Outfall Average		Dry Weather				0.0	22	0.0	0.123	1.0	1.0
003 - Porter Street Outfall 1	6/3/2013	Wet Weather	-	-	7.05	<4.0	<5.0	<1.0	0.280	2,500	2,000
003 - Porter Street Outfall 2	6/3/2013	Wet Weather	-	-	7.25	<4.0	<5.0	<1.0	0.080	<10	80
003 - Porter Street Outfall 3	6/3/2013	Wet Weather	-	-	7.44	<4.0	<5.0	<1.0	0.150	100	140
003 - Porter Street Outfall Average		Wet Weather	5.58	0.82	7.25	0.0	0.0	0.0	0.170	63	282
003 - Porter Street Outfall 1	6/27/2013	Dry Weather				<4.0	22	<1.0	0.160	180	10
003 - Porter Street Outfall 2	6/27/2013	Dry Weather				<4.0	<5.0	<1.0	0.120	<10	20
003 - Porter Street Outfall 3	6/27/2013	Dry Weather				<4.0	<5.0	<1.0	0.180	<10	550
003 - Porter Street Outfall Average		Dry Weather				0.0	7.3	0.0	0.153	5.6	48
Requirements are from NPDES Permit MA0000787, issued July 31, 2007.											
Discharge Limitations											
Maximum Daily			Report	Report	6.0 to 8.5	Report	Report	Report	Report	Report	Report
Average Monthly			Report	Report	6.0 to 8.5	—	Report	Report	Report	Report	Report

Source: Massport

Notes: **Bold** values exceed maximum daily discharge limitation.
For averaging calculations, a value of zero was employed for those results measured below the laboratory detection limit. For geometric mean calculations (fecal coliform and *Enterococcus*) a value of 1 was employed for those results measured below the laboratory detection limit.

TSS Total Suspended Solids

NS Not Sampled.

Table J-16 Logan Airport 2013 Monthly Monitoring Results for Third Quarter – North, West, and Maverick Street Stormwater Outfalls

	Date	Event	Maximum Daily Flow (MGD)	Average Monthly Flow (MGD)	pH (S.U.)	Oil and Grease (mg/L)	TSS (mg/L)	Benzene (µg/L)	Surfactant (mg/L)	Fecal Coliform (cfu/100mL)	*Enterococcus* (cfu/100mL)	*Klebsiella*[1] (cfu/100mL)
001A – North Outfall	7/23/2013	Wet Weather	5.82	0.35	NS	NS	NS	NS	NS	NS	NS	NS
002A – West Outfall	7/23/2013	Wet Weather	20.49	1.26	7.00	<4.0	60	<1.0	0.220	42,000	14,000	NA
004A – Maverick Street Outfall	7/23/2013	Wet Weather	1.49	0.074	NS	NS	NS	NS	NS	NS	NS	NS
001C – North Outfall	7/15/2013	Dry Weather				<4.0	9.8	<1.0	0.200	>80,000	60	42,000
002C – West Outfall	7/10/2013	Dry Weather				<4.0	17	<1.0	0.130	390	110	NA
004C – Maverick Street Outfall	7/10/2013	Dry Weather				NS	NS	NS	NS	NS	NS	NS
001A – North Outfall	8/9/2013	Wet Weather	5.62	0.22	7.83	<4.0	13	<1.0	0.390	65,000	420	>60,000
002A – West Outfall	8/9/2013	Wet Weather	19.42	0.76	6.70	<4.0	11	<1.0	0.070	2,100	110	NA
004A – Maverick Street Outfall	8/9/2013	Wet Weather	1.42	0.04	NS	NS	NS	NS	NS	NS	NS	NS
001C – North Outfall	8/16/2013	Dry Weather				<4.0	19	<1.0	0.130	63,000	430	2,700
002C – West Outfall	8/16/2013	Dry Weather				<4.0	10	<1.0	0.110	130	80	NA
004C – Maverick Street Outfall	8/16/2013	Dry Weather				NS	NS	NS	NS	NS	NS	NS
001A – North Outfall	-	Wet Weather	2.35	0.22	NS	NS	NS	NS	NS	NS	NS	NS
002A – West Outfall	-	Wet Weather	7.59	0.71	NS	NS	NS	NS	NS	NS	NS	NS
004A – Maverick Street Outfall	-	Wet Weather	0.51	0.05	NS	NS	NS	NS	NS	NS	NS	NS
001C – North Outfall	9/6/2013	Dry Weather				<4.0	15	<1.0	0.310	41,000	340	<10
002C – West Outfall	9/6/2013	Dry Weather				<4.0	34	<1.0	0.170	370	150	NA
004C – Maverick Street Outfall	9/6/2013	Dry Weather				NS	NS	NS	NS	NS	NS	NS
Requirements are from NPDES Permit MA0000787, issued July 31, 2007.												
Discharge Limitations												
Maximum Daily			Report	Report	6.0 to 8.5	15 mg/L	100 mg/L	Report	Report	Report	Report	Report
Average Monthly			Report	Report	6.0 to 8.5	----	Report	Report	Report	Report	Report	Report

Source: Massport

Notes: Flow rates were estimated for outfalls 001, 002, and 004 by using the SWMM model developed for Logan Airport.
For averaging calculations, a value of zero was employed for those results measured below the laboratory detection limit. For geometric mean calculations (fecal coliform and *Enterococcus*) a value of 1 was employed for those results measured below the laboratory detection limit.

1 *Klebsiella* is an indication of non-fecal coliform bacteria and is tested for at the North Outfall when fecal coliform concentration exceeds 5,000 cfu/100ml.

TSS Total Suspended Solids

NA Not Analyzed

NS Not Sampled. Due to construction, the Maverick Street Outfall could not be sampled during the July, August, and September events. Due to severe fog and poor visibility, Massport Operations denied access to sample the North Outfall during the July wet weather event. Due to weather and tidal conditions, a wet weather event was not conducted in September 2013.

Table J-17 Logan Airport 2013 Monthly Monitoring Results for Third Quarter — Porter Street Stormwater Outfall

	Date	Event	Maximum Daily Flow (MGD)	Average Monthly Flow (MGD)	pH (S.U.)	Oil and Grease (mg/L)	TSS (mg/L)	Benzene (µg/L)	Surfactant (mg/L)	Fecal Coliform (cfu/100mL)	*Enterococcus* (cfu/100mL)
003 - Porter Street Outfall 1	7/23/2013	Wet Weather	-	-	7.20	<4.0	21	<1.0	1.06	37,000	3,700
003 - Porter Street Outfall 2	7/23/2013	Wet Weather	-	-	8.46	<4.0	<5.0	<1.0	0.090	4,500	1,500
003 - Porter Street Outfall 3	7/23/2013	Wet Weather	-	-	8.25	<4.0	8.8	<1.0	0.280	5,500	2,100
003 - Porter Street Outfall Average		Wet Weather	3.97	0.21	7.97	0.0	9.9	0.0	0.477	9,711	2,267
003 - Porter Street Outfall 1	7/10/2013	Dry Weather				<4.0	12	<1.0	0.190	<10	<10
003 - Porter Street Outfall 2	7/10/2013	Dry Weather				<4.0	7.2	<1.0	0.100	<10	320
003 - Porter Street Outfall 3	7/15/2013	Dry Weather				<4.0	27	<1.0	0.320	<10	260
003 - Porter Street Outfall Average		Dry Weather				0.0	15	0.0	0.203	1.0	44
003 - Porter Street Outfall 1	8/9/2013	Wet Weather	-	-	7.34	<4.0	20	<1.0	0.480	75,000	1,200
003 - Porter Street Outfall 2	8/9/2013	Wet Weather	-	-	8.49	<4.0	<5.0	<1.0	0.050	80	100
003 - Porter Street Outfall 3	8/9/2013	Wet Weather	-	-	8.07	<4.0	<5.0	<1.0	0.220	180	3,300
003 - Porter Street Outfall Average		Wet Weather	2.62	0.13	7.97	0.0	6.7	0.0	0.250	1,026	734
003 - Porter Street Outfall 1	8/16/2013	Dry Weather				<4.0	9.9	<1.0	0.120	120	<10
003 - Porter Street Outfall 2	8/16/2013	Dry Weather				<4.0	<5.0	<1.0	0.060	<10	20
003 - Porter Street Outfall 3	8/16/2013	Dry Weather				<4.0	<5.0	<1.0	0.170	260	400
003 - Porter Street Outfall Average		Dry Weather				0.0	3	0.0	0.117	31	20
003 - Porter Street Outfall 1	-	Wet Weather	-	-	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall 2	-	Wet Weather	-	-	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall 3	-	Wet Weather	-	-	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall Average		Wet Weather	0.71	0.05	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall 1	9/6/2013	Dry Weather				<4.0	15	<1.0	0.410	<10	350
003 - Porter Street Outfall 2	9/6/2013	Dry Weather				<4.0	<5.0	<1.0	0.090	130	170
003 - Porter Street Outfall 3	9/6/2013	Dry Weather				<4.0	30	<1.0	0.410	160	620
003 - Porter Street Outfall Average		Dry Weather				0.0	15	0.0	0.303	28	333
Requirements are from NPDES Permit MA0000787, issued July 31, 2007.											
Discharge Limitations											
Maximum Daily			Report	Report	6.0 to 8.5	Report	Report	Report	Report	Report	Report
Average Monthly			Report	Report	6.0 to 8.5	—	Report	Report	Report	Report	Report

Source: Massport

Notes: For averaging calculations, a value of zero was employed for those results measured below the laboratory detection limit. For geometric mean calculations (fecal coliform and *Enterococcus*) a value of 1 was employed for those results measured below the laboratory detection limit.

TSS Total Suspended Solids

NS Not Sampled. Due to weather and tidal conditions, a wet weather event was not conducted in September 2013. Due to weather and tidal conditions, a wet weather event was not conducted in September 2013.

Table J-18 Logan Airport Monthly Monitoring Results for Fourth Quarter — North, West, and Maverick Street Stormwater Outfalls

	Date	Event	Maximum Daily Flow (MGD)	Average Monthly Flow (MGD)	pH (S.U.)	Oil and Grease (mg/L)	TSS (mg/L)	Benzene (µg/L)	Surfactant (mg/L)	Fecal Coliform (cfu/100mL)	*Enterococcus* (cfu/100mL)	*Klebsiella*[1] (cfu/100mL)
001A – North Outfall	-	Wet Weather	0.72	0.11	NS	NS	NS	NS	NS	NS	NS	NS
002A – West Outfall	-	Wet Weather	2.62	0.47	NS	NS	NS	NS	NS	NS	NS	NS
004A – Maverick Street Outfall	-	Wet Weather	0.20	0.00	NS	NS	NS	NS	NS	NS	NS	NS
001C – North Outfall	10/15/2013	Dry Weather				<4.0	11	<1.0	0.170	>80,000	20	14,000
002C – West Outfall	10/15/2013	Dry Weather				<4.0	39	<1.0	0.070	370	<10	NA
004C – Maverick Street Outfall	10/15/2013	Dry Weather				NS	NS	NS	NS	NS	NS	NS
001A – North Outfall	11/22/2013	Wet Weather	6.62	0.37	7.84	<4.0	16	<1.0	0.160	>80,000	130	61,000
002A – West Outfall	11/22/2013	Wet Weather	23.32	1.46	7.87	<4.0	32	<1.0	<0.050	20	120	NA
004A – Maverick Street Outfall	11/22/2013	Wet Weather	1.63	0.08	8.27	<4.0	21	<1.0	0.050	120	30	NA
001C – North Outfall	11/14/2013	Dry Weather				<4.0	14	<1.0	0.240	180	40	NA
002C – West Outfall	11/14/2013	Dry Weather				<4.0	11	<1.0	0.050	20	120	NA
004C – Maverick Street Outfall	11/14/2013	Dry Weather				<4.0	6.8	<1.0	<0.050	10	<10	NA
001A – North Outfall	12/23/2013	Wet Weather	4.99	0.70	6.47	5.9	**120**	<1.0	0.360	5,400	460	4,400
001A - North Outfall Re-sample	12/27/2013	Wet Weather	4.99	0.70	6.09	NA	20	NA	NA	NA	NA	NA
002A – West Outfall	12/23/2013	Wet Weather	17.35	2.29	6.48	<4.0	15	<1.0	0.070	70	1,200	NA
004A – Maverick Street Outfall	12/23/2013	Wet Weather	0.16	1.23	6.53	<4.0	29	<1.0	0.050	4,600	80	NA
001C – North Outfall	12/21/2013	Dry Weather				<4.0	13	<1.0	0.170	360	2,200	NA
002C – West Outfall	12/21/2013	Dry Weather				<4.0	23	<1.0	0.140	220	2,200	NA
004C – Maverick Street Outfall	12/21/2013	Dry Weather				<4.4	22	<1.0	0.080	76	140	NA
Requirements are from NPDES Permit MA0000787, issued July 31, 2007.												
Discharge Limitations												
Maximum Daily			Report	Report	6.0 to 8.5	15 mg/L	100 mg/L	Report	Report	Report	Report	Report
Average Monthly			Report	Report	6.0 to 8.5	—	Report	Report	Report	Report	Report	Report

Source: Massport

Notes: Flow rates were estimated for outfalls 001, 002, and 004 by using the SWMM model developed for Logan Airport.
Bold values exceed maximum daily discharge limitation.
For averaging calculations, a value of zero was employed for those results measured below the laboratory detection limit. For geometric mean calculations (fecal coliform and *Enterococcus*) a value of 1 was employed for those results measured below the laboratory detection limit.

1 *Klebsiella* is an indication of non-fecal coliform bacteria and is tested for at the North Outfall when fecal coliform concentration exceeds 5,000 cfu/100ml.

TSS Total Suspended Solids

NA Not Analyzed

NS Not Sampled. Due to weather and tidal conditions, a wet weather event was not conducted in October 2013. Due to construction, the Maverick Street Outfall could not be sampled during the October dry weather event.

Table J-19 Logan Airport 2013 Monthly Monitoring Results for Fourth Quarter — Porter Street Stormwater Outfall

	Date	Event	Maximum Daily Flow (MGD)	Average Monthly Flow (MGD)	pH (S.U.)	Oil and Grease (mg/L)	TSS (mg/L)	Benzene (µg/L)	Surfactant (mg/L)	Fecal Coliform (cfu/100mL)	*Enterococcus* (cfu/100mL)
003 - Porter Street Outfall 1	-	Wet Weather	-	-	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall 2	-	Wet Weather	-	-	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall 3	-	Wet Weather	-	-	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall Average		Wet Weather	0.12	0.05	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall 1	10/15/2013	Dry Weather				<4.0	6.1	<1.0	0.100	<10	80
003 - Porter Street Outfall 2	10/15/2013	Dry Weather				<4.0	6.6	<1.0	0.060	<10	<10
003 - Porter Street Outfall 3	10/15/2013	Dry Weather				<4.0	<5.0	<1.0	0.130	110	10
003 - Porter Street Outfall Average		Dry Weather				0.0	4.2	0.0	0.097	5	9.3
003 - Porter Street Outfall 1	11/22/2013	Wet Weather	-	-	8.01	<4.0	36	<1.0	0.350	2,100	2,400
003 - Porter Street Outfall 2	11/22/2013	Wet Weather	-	-	**8.52**	<4.0	5.0	<1.0	0.050	100	360
003 - Porter Street Outfall 3	11/22/2013	Wet Weather	-	-	8.37	<4.0	37	<1.0	0.050	320	4,800
003 - Porter Street Outfall Average		Wet Weather	4.69	0.22	8.30	0.0	26	0.0	0.150	407	1,607
003 - Porter Street Outfall 1	11/14/2013	Dry Weather				<4.0	<5.0	<1.0	0.080	40	120
003 - Porter Street Outfall 2	11/14/2013	Dry Weather				<4.0	6.4	<1.0	0.080	100	30
003 - Porter Street Outfall 3	11/14/2013	Dry Weather				<4.0	24	<1.0	0.120	270	2,300
003 - Porter Street Outfall Average		Dry Weather				0.0	10	0.0	0.093	103	202
003 - Porter Street Outfall 1	12/23/2013	Wet Weather	-	-	7.27	17	150	<1.0	0.530	1,800	3,500
003 - Porter Street Outfall 2	12/23/2013	Wet Weather	-	-	7.66	4.0	36	<1.0	0.060	<10	40
003 - Porter Street Outfall 3	12/23/2013	Wet Weather	-	-	7.64	<4.0	160	<1.0	<0.250	60	370
003 - Porter Street Outfall Average		Wet Weather	3.47	0.29	7.52	7.0	115	0.0	0.197	48	373
003 - Porter Street Outfall 1	12/21/2013	Dry Weather				<4.0	33	<1.0	0.200	380	4,600
003 - Porter Street Outfall 2	12/21/2013	Dry Weather				16	29	<1.0	0.190	11	5.2
003 - Porter Street Outfall 3	12/21/2013	Dry Weather				5.2	140	<1.0	0.130	84	310
003 - Porter Street Outfall Average		Dry Weather				7.1	67	0.0	0.173	71	195
Requirements are from NPDES Permit MA0000787, issued July 31, 2007.											
Discharge Limitations											
Maximum Daily			Report	Report	6.0 to 8.5	Report	Report	Report	Report	Report	Report
Average Monthly			Report	Report	6.0 to 8.5	—	Report	Report	Report	Report	Report

Source: Massport
Notes: **Bold** values exceed maximum daily discharge limitation.
For averaging calculations, a value of zero was employed for those results measured below the laboratory detection limit. For geometric mean calculations (fecal coliform and *Enterococcus*) a value of 1 was employed for those results measured below the laboratory detection limit.
TSS Total Suspended Solids
NS Not Sampled. Due to weather and tidal conditions, a wet weather event was not conducted in October 2013.

Table J-20 Logan Airport 2013 Quarterly Wet Weather Monitoring Results – North, West, Maverick Street, and Porter Street Stormwater Outfalls

		Wet Weather									
	Date	pH (S.U.)	Benzo(a)-anthracene (µg/L)	Benzo(a)-pyrene (µg/L)	Benzo(b)-fluoranthene (µg/L)	Benzo(k)-fluoranthene (µg/L)	Chrysene (µg/L)	Dibenzo(a,h,)-anthracene (µg/L)	Indeno(1,2,3-cd)-pyrene (µg/L)	Naphthalene (µg/L)	Total PAHs (µg/L)
001 - North Outfall	4/11/2013	7.41	<10	<10	<10	<10	<10	<10	<10	<10	ND
002 - West Outfall	4/11/2013	7.34	<20	<20	<20	<20	<20	<20	<20	<20	ND
004 - Maverick Street Outfall	4/11/2013	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall 1	4/11/2013	**5.62**	<10	<10	<10	<10	<10	<10	<10	<10	ND
003 - Porter Street Outfall 2	4/11/2013	7.65	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	ND
003 - Porter Street Outfall 3	4/11/2013	7.11	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	ND
003 - Porter Street Outfall Average		6.79	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
001 - North Outfall	6/3/2013	7.20	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	ND
002 - West Outfall	6/3/2013	6.51	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	ND
004 - Maverick Street Outfall	6/3/2013	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall 1	6/3/2013	7.05	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	ND
003 - Porter Street Outfall 2	6/3/2013	7.25	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	ND
003 - Porter Street Outfall 3	6/3/2013	7.44	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	ND
003 - Porter Street Outfall Average		7.25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
001 - North Outfall	-	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
002 - West Outfall	-	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
004 - Maverick Street Outfall	-	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall 1	-	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall 2	-	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall 3	-	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
003 - Porter Street Outfall Average		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
001 - North Outfall	12/23/2013	6.47	<2.0	2.1	7.2	2.4	5.4	<2.0	4.0	<2.0	21.1
002 - West Outfall	12/23/2013	6.48	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.3	2.3
004 - Maverick Street Outfall	12/23/2013	6.53	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	ND
003 - Porter Street Outfall 1	12/23/2013	7.27	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	ND
003 - Porter Street Outfall 2	12/23/2013	7.66	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	ND
003 - Porter Street Outfall 3	12/23/2013	7.64	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	ND
003 - Porter Street Outfall Average		7.52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Requirements are from NPDES Permit MA0000787, issued July 31, 2007.											
Discharge Limitations											
Maximum Daily		6.0 to 8.5	Report	Report	Report	Report	Report	Report	Report	Report	Total

Source: Massport

Notes: **Bold** values exceed maximum daily discharge limitation.

ND Not Detected; NS Not Sampled. Due to construction, the Maverick Street Outfall could not be sampled during the 1st and 2nd Quarter wet weather event. Wet weather sampling was not conducted during the 3rd Quarter because there was not an appropriate sampling event (e.g., sufficient rainfall, appropriate tide cycle, weekday); PAH Polynuclear Aromatic Hydrocarbons

For averaging calculations, a value of zero was employed for those results measured below the laboratory detection limit.

Table J-21 Logan Airport 2013 Quarterly Wet Weather Monitoring Results – Northwest and Runway/Perimeter Stormwater Outfalls

	Date	Maximum Daily Flow (MGD)	Average Monthly Flow (MGD)	pH (SU)	Oil and Grease (mg/L)	Total Suspended Solids (mg/L)	Benzene (µg/L)
005 - Northwest Outfall	4/11/2013	0.17	0.03	6.30	<4.0	23	<1.0
006- Runway/ Perimeter Outfall (A9)	4/11/2013	0.047	0.038	6.88	<4.0	14	<1.0
006- Runway/ Perimeter Outfall (A18)	4/11/2013	0.007	0.005	6.89	<4.0	89	<1.0
006- Runway/ Perimeter Outfall (A19)	4/11/2013	0.009	0.004	6.47	<4.4	22	<1.0
006- Runway/ Perimeter Outfall (A21)	4/11/2013	0.294	0.264	6.19	<4.0	13	<1.0
006- Runway/ Perimeter Outfall (A23)	4/11/2013	0.033	0.026	6.34	<4.0	12	<1.0
006- Runway/ Perimeter Outfall (A33)	4/11/2013	0.031	0.027	6.71	<4.0	15	<1.0
006- Runway/ Perimeter Outfall (A38)	4/11/2013	0.016	0.012	5.77	<4.0	18	<1.0
006- Runway/Perimeter Outfall Average		0.062	0.054	6.46	0.0	26	0.0
005 - Northwest Outfall	6/3/2013	1.37	0.14	6.37	<4.0	19	<1.0
006- Runway/ Perimeter Outfall (A9)	6/3/2013	0.70	0.09	7.07	<4.0	<5.0	<1.0
006- Runway/ Perimeter Outfall (A18)	6/3/2013	0.11	0.01	7.09	<4.0	<5.0	<1.0
006- Runway/ Perimeter Outfall (A19)	6/3/2013	0.12	0.01	7.37	<4.0	<5.0	<1.0
006- Runway/ Perimeter Outfall (A21)	6/3/2013	5.59	0.69	7.34	<4.0	6.1	<1.0
006- Runway/ Perimeter Outfall (A23)	6/3/2013	0.56	0.07	7.76	<4.0	5.2	<1.0
006- Runway/ Perimeter Outfall (A33)	6/3/2013	0.34	0.05	8.33	<4.0	6.3	<1.0
006- Runway/ Perimeter Outfall (A38)	6/3/2013	0.86	0.08	7.01	<4.0	12	<1.0
006- Runway/Perimeter Outfall Average		1.18	0.14	7.42	0.0	4.2	0.0
005 - Northwest Outfall	-	NS	NS	NS	NS	NS	NS
006- Runway/ Perimeter Outfall (A9)	-	NS	NS	NS	NS	NS	NS
006- Runway/ Perimeter Outfall (A15)	-	NS	NS	NS	NS	NS	NS
006- Runway/ Perimeter Outfall (A17)	-	NS	NS	NS	NS	NS	NS
006- Runway/ Perimeter Outfall (A21)	-	NS	NS	NS	NS	NS	NS
006- Runway/ Perimeter Outfall (A23)	-	NS	NS	NS	NS	NS	NS
006- Runway/ Perimeter Outfall (A33)	-	NS	NS	NS	NS	NS	NS
006- Runway/ Perimeter Outfall (A38)	-	NS	NS	NS	NS	NS	NS
006- Runway/Perimeter Outfall Average		NS	NS	NS	NS	NS	NS
005 - Northwest Outfall	12/23/2013	0.65	0.07	6.29	<4.0	48	<1.0
006- Runway/ Perimeter Outfall (A9)	12/23/2013	0.36	0.05	6.75	<4.0	10	<1.0
006- Runway/ Perimeter Outfall (A15)	12/23/2013	0.15	0.02	5.24	<4.0	<5.0	<1.0
006- Runway/ Perimeter Outfall (A18)	12/23/2013	0.05	0.01	6.32	6.3	14	<1.0
006- Runway/ Perimeter Outfall (A21)	12/23/2013	2.87	0.37	5.59	<4.0	12	<1.0
006- Runway/ Perimeter Outfall (A23)	12/23/2013	0.28	0.04	5.10	<4.0	7.2	<1.0
006- Runway/ Perimeter Outfall (A33)	12/23/2013	0.19	0.03	5.38	<4.0	<5.0	<1.0
006- Runway/ Perimeter Outfall (A38)	12/23/2013	0.40	0.03	5.84	<4.0	<5.0	<1.0
006- Runway/Perimeter Outfall Average		0.61	0.08	5.75	0.9	6.2	0.0
Discharge Limitations		Report	Report	Report	Report	Report	Report

Source: Massport; Notes: Requirements are from NPDES Permit MA 0000787, issued July 31, 2007; NS Not Sampled. Wet weather sampling was not conducted during the 3rd Quarter because there was not an appropriate sampling event.

Table J-22 Logan Airport 2013 Wet Weather Deicing Monitoring Results – North, West and Porter Street Stormwater Outfalls

	Date	Ethylene Glycol, Total (mg/L)	Propylene Glycol, Total (mg/L)	BOD_5 (mg/L)	COD (mg/L)	Total Ammonia Nitrogen (mg/L of N)	Chloride (mg/L)	Nonylphenol (µg/L)	4-Methyl-1-H-benzotriazole (µg/L)	5-Methyl-1-H-benzotriazole (µg/L)	Tolytriazole (µg/L)	Whole Effluent Toxicity[1]
001 - North Outfall	1/16/2013	<10	<10	220	370	3.40	NA	1.95	63.337	45.218	108.555	NA
002 - West Outfall	1/16/2013	1,800	8,500	10,000	23,000	2.45	NA	2.48	491.30	520.04	1011.340	NA
003B - Porter Street 1	1/16/2013	<10	<10	53	1700	1.60	NA	2.30	1.998 J	2.224 J	4.222 J	NA
003B - Porter Street 2	1/16/2013	<10	<10	64	170	0.129	NA	2.39	5.494	5.988	11.482	NA
003B - Porter Street 3	1/16/2013	<10	<10	3.7	170	0.163	NA	1.28	1.494 J	1.441 J	2.935 J	NA
003B - Porter Street Outfall Average		0	0	40.2	680	0.631	NA	1.99	2.995 J	3.218 J	6.213 J	NA NA
001 - North Outfall	3/7/2013	670	2,200	2,800	5,100	0.212	590	<0.043	55.717	70.228	125.945	NA
002 - West Outfall	3/7/2013	1,000	11,000	10,000	17,000	0.979	2,800	<0.043	508.665	675.193	1183.858	NA
003B - Porter Street 1	3/7/2013	<7	<7	15	330	1.01	6,800	<0.041	1.002 J	1.191 J	2.193 J	NA
003B - Porter Street 2	3/7/2013	<7	11	4.7	32	0.082	19	2.14	1.031 J	0.847 J	1.878 J	NA
003B - Porter Street 3	3/7/2013	<7	7.4	4.6	110	0.379	3,200	2.11	<0.100	<0.100	ND	NA
003B - Porter Street Outfall Average		0	6.1	8.1	157	0.490	3,340	1.42	0.678 J	0.679 J	1.357 J	NA
Requirements are from NPDES Permit MA0000787, issued July 31, 2007.												
Discharge Limitations Maximum Daily		Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	Report

Source: Massport

Notes: For averaging calculations, a value of zero was employed for those results measured below the laboratory detection limit.
J = Value is an estimate calculated by the lab from the response factors of the other two triazole compounds.
Tolytriazole concentrations calculated as sum of 4-Methly-1-H-benzotriazole and 5-Methyl-1-H-benzotriazole.

1 Whole Effluent Toxicity sample conducted on March 7, 2013.
BOD_5 Five-day Biochemical Oxygen Demand
COD Chemical Oxygen Demand
NA Not Analyzed
ND Not Detected

Table J-23 Logan Airport 2013 Wet Weather Deicing Monitoring Results – Runway/ Perimeter Stormwater Outfalls

	Date	Ethylene Glycol, Total (mg/L)	Propylene Glycol, Total (mg/L)	BOD_5 (mg/L)	COD (mg/L)	Total Ammonia Nitrogen (mg/L of N)	Chloride (mg/L)	Nonylphenol (µg/L)	4-Methyl-1-H-benzotriazole (µg/L)	5-Methyl-1-H-benzotriazole (µg/L)	Tolytriazole (µg/L)[2]	Whole Effluent Toxicity[1]
006- Runway/ Perimeter (A9)	1/16/2013	<10	<10	<2.0	43	0.832	NA	3.25	5.845	1.599 J	7.444 J	NA
006- Runway/ Perimeter (A17)	1/16/2013	<10	<10	5.2	22	5.09	NA	1.40	19.422	4.256	23.676	NA
006- Runway/ Perimeter (A19)	1/16/2013	<10	<10	6.4	31	9.23	NA	2.00	21.813	5.331	27.141	NA
006- Runway/ Perimeter (A21)	1/16/2013	<10	<10	<10	660	1.16	NA	1.53	5.747	1.957 J	7.704 J	NA
006- Runway/ Perimeter (A23)	1/16/2013	<10	<10	<2.0	40	3.14	NA	2.35	17.951	3.473 J	21.423 J	NA
006- Runway/ Perimeter (A34)	1/16/2013	<10	<10	4.3	66	3.37	NA	1.05	18.780	4.041 J	22.821 J	NA
006- Runway/ Perimeter (A38)	1/16/2013	<10	<10	<5.0	290	0.363	NA	1.40	2.220 J	<0.100	2.220 J	NA
006- Runway/Perimeter Outfall												NA
Average		0.0	0.0	2.27	165	3.312	NA	1.85	13.111 J	2.951	16.061 J	NA
006- Runway/ Perimeter (A9)	3/7/2013	<7	<7	25	98	1.47	1,100	9.12	7.149	3.992	11.141	NA
006- Runway/ Perimeter (A17)	3/7/2013	<7	<7	46	82	4.86	14	4.64	16.155	7.452	23.607	NA
006- Runway/ Perimeter (A18)	3/7/2013	<7	<7	270	340	1.44	20	2.37	4.798	2.524	7.322	NA
006- Runway/ Perimeter (A21)	3/7/2013	<7	<7	110	310	0.848	5,500	2.21	9.321	5.300	14.621	NA
006- Runway/ Perimeter (A23)	3/7/2013	<7	<7	6.9	51	0.250	74	2.06	5.915	6.484	12.399	NA
006- Runway/ Perimeter (A33)	3/7/2013	<7	520	780	1,200	0.265	42	3.00	98.625	104.194	202.819	NA
006- Runway/ Perimeter (A38)	3/7/2013	<7	<7	<5.0	91	0.229	2,300	2.10	1.106 J	1.586 J	2.692 J	NA
006- Runway/Perimeter Outfall Average		0	74	177	310	1.34	1,293	3.64	20.438 J	18.790 J	39.229 J	NA
Requirements are from NPDES Permit MA0000787, issued July 31, 2007.												
Discharge Limitations												
Maximum Daily		Report	Report	Report	Report	Report	Report	Report	Report	Report	Report	NA

Source: Massport

Notes: For averaging calculations, a value of zero was employed for those results measured below the laboratory detection limit.

J = Value is an estimate calculated by the lab from the response factors of the other two triazole compounds.

Tolytriazole concentrations calculated as sum of 4-Methly-1-H-benzotriazole and 5-Methyl-1-H-benzotriazole.

1 Whole Effluent Toxicity sample conducted on March 7, 2013.

BOD_5 Five-day Biochemical Oxygen Demand

COD Chemical Oxygen Demand

NA Not Analyzed

ND Not Detected

Table J-24 Logan Airport Stormwater Outfall NPDES Water Quality Monitoring Results - 1993 to 2013

	1993	1994	1995	1996	1997	1998	1999	2000	2001[1]	2002	2003[1]	2004	2005	2006	2007	2008	2009	2010 [1,2]	2011[2]	2012	2013
#/# = Number of samples at or below NPDES limits / Total number of samples taken																					
Oil and Grease (mg/L)																					
North Outfall	30/31	35/36	33/35	29/35	30/35	35/36	29/30	34/36	28/28	36/36	30/32	32/34	33/35	33/33	29/29	23/23	24/24	24/24	24/24	21/21	20/20
West Outfall	29/30	36/36	34/34	36/36	34/35	36/36	30/30	35/35	27/28	36/36	31/32	33/34	35/35	32/33	28/28	22/23	24/24	24/24	22/24	21/21	21/21
Porter Street Outfall[2]	30/30	35/36	34/34	36/36	35/35	34/36	30/30	35/36	28/28	34/36	32/32	33/34	34/35	33/33	22/22	50/50	72/72	50/50	49/49	62/62	63/63
Maverick Street Outfall	29/29	36/36	35/35	36/36	35/35	35/36	30/30	34/34	26/28	35/36	32/32	34/34	35/35	32/33	29/29	22/23	20/21	19/19	23/23	15/15	4/4
Settleable Solids[3] (mg/L)																					
North Outfall	19/19	34/35	34/35	32/35	31/34	34/36	30/30	34/36	29/29	32/36	32/32	34/34	33/35	32/34	22/22	n/a	n/a	n/a	n/a	n/a	n/a
West Outfall	19/19	32/36	34/34	35/36	34/34	35/36	29/30	36/36	27/28	36/36	31/32	34/34	32/35	33/33	22/22	n/a	n/a	n/a	n/a	n/a	n/a
TSS (mg/L)																					
North Outfall	–	–	–	–	–	–	–	–	–	–	–	–	–	–	6/6	24/24	24/24	22/23	24/24	21/21	20/21
West Outfall	–	–	–	–	–	–	–	–	–	–	–	–	–	–	5/6	24/24	24/24	23/23	22/24	20/22	21/21
Maverick Street Outfall	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4/6	22/24	20/21	18/19	20/23	14/15	4/4
pH																					
North Outfall	34/35	33/36	35/35	35/35	35/35	36/36	30/30	36/36	29/29	36/36	32/32	34/34	35/35	34/34	26/26	12/12	16/16	11/11	12/12	9/9	8/8
West Outfall	34/34	28/36	33/34	35/36	35/35	36/36	30/30	36/36	29/29	36/36	32/32	34/34	35/35	33/33	26/26	12/12	16/16	11/11	12/12	9/9	9/9
Porter Street Outfall[2]	35/35	30/36	34/34	36/36	35/35	36/36	30/30	36/36	28/28	36/36	32/32	34/34	35/35	33/33	22/22	21/21	48/48	24/24	23/23	26/27	24/27
Maverick Street Outfall	35/35	35/36	35/35	36/36	34/35	36/36	30/30	35/35	28/28	36/36	32/32	34/34	35/35	33/33	26/26	10/10	16/16	10/10	11/11	6/6	2/2

Source: Massport

Notes: Sampling requirements changed in 2007 with the issuance of a new NPDES permit. Results through 2007 are based on NPDES Permit MA0000787, issued March 1, 1978. Stormwater outfall water quality monitoring results collected in accordance with the requirements of former NPDES permit. A portion of the Porter Street Drainage Area was incorporated into the West Drainage Area as part of roadway construction projects at Logan Airport.

1 In 2001, 2003, and 2010, exceptional weather, tidal conditions, or insufficient discharge precluded the collection of some samples, leading to a fewer number of samples collected than in other years.

2 In 2010 and 2011, Porter Street Outfall 1 and Porter Street Outfall 3 were not accessible due to construction, leading to a fewer number of samples collected than in other years. A new sampling location was established for Porter Street Outfall 3 and it was sampled for the first time on February 18, 2011. Porter Street Outfall 1 was accessible again in December 2011.

3 In 2013, due to construction, a fewer number of samples were collected at the Maverick Street outfall than in other years.

4 Settleable solids analyses were replaced with TSS in 2008.

Table J-25 Logan Airport Oil and Hazardous Material Spills[1] and Jet Fuel Handling - 1990 to 2013

Year	Total Number of all Spills	Total Number of all Spills >10 gallons	Total Volume of all Spills (Gallons)	Estimated Volume of Jet Fuel Handled (Gallons)	Total Volume of Jet Fuel Spilled (Gallons)
1990	173	NA	NA	438,100,000	3,745
1991	186	NA	NA	NA	2,471
1992	195	NA	NA	NA	4,355
1993	188	NA	NA	451,900,000	3,131
1994	217	NA	NA	476,700,000	4,046
1995	161	NA	NA	309,200,000	21,412[2]
1996	159	NA	NA	346,700,000	1,321
1997	147	NA	NA	377,488,161	2,029[3]
1998	191	NA	NA	387,224,004	10,047[4]
1999	196	43	7,151	425,937,051	7,012[5]
2000	136	20	1,318	441,901,932	1,227
2001	139	37	1,924	416,748,819	1,771
2002	101	16	653	358,190,362	559
2003	128	19	10,364	319,439,910	10,188[6]
2004	126	18	894	373,996,141	574
2005	97	15	2,319	368,645,932	585
2006	92	11	752	364,450,864	644
2007	108	7	604	367,585,187	361
2008	99	20	944	345,631,788	662
2009	95	6	1004	327,358,619	915
2010	87	15	476	335,693,997	360
2011	108	12	572	340,421,373	337
2012	132	5	593	343,731,127	439
2013	94	6	452	349,397,940	351

Source: Massport Fire-Rescue Department.
NA Not available.
1 Materials include: jet fuel, hydraulic oil, diesel fuel, gasoline, and other materials such as glycol and paint.
2 One tenant spill, which occurred on October 15, 1995, totaled 18,000 gallons (84 percent of the annual spill total). The spill did not enter the Airport's storm drain system.
3 On October 23, 1997, a fuel line on an aircraft failed, resulting in the release of approximately 2,500 gallons, all but 60 gallons of which were recovered in drums before reaching the ground. Only the 60 gallons is included in the 1997 total.
4 Includes a 7,200-gallon spill that was discovered on September 2, 1998, and a 1,300-gallon spill that occurred on June 3, 1998. Neither spill entered the Airport's storm drain system.
5 Includes a 5,000-gallon spill, none of which entered the Airport's storm drainage system.
6 In 2003, one fuel spill comprised 9,460 gallons or 94 percent of the total volume of the MassDEP/MCP reportable spills that year. The fuel spill was contained and did not enter the drainage system.

Table J-26 Type and Quantity of Oil and Hazardous Material Spills at Logan Airport - 1999 to 2013

	Jet Fuel			Hydraulic Oil			Diesel Fuel			Gasoline			Other		
Year	No. of Spills	Quantity (Gallons)	No. of Spills ≥10 Gallons	No. of Spills	Quantity (Gallons)	No. of Spills ≥10 Gallons	No. of Spills	Quantity (Gallons)	No. of Spills ≥10 Gallons	No. of Spills	Quantity (Gallons)	No. of Spills ≥10 Gallons	No. of Spills	Quantity (Gallons)	No. of Spills ≥10 Gallons
1999	151	7,012	40	24	67	1	13	49	2	5	7	0	3	16	0
2000	115	1,227	18	8	59	2	3	11	0	8	16	0	2	5	0
2001	104	1,771	32	21	92	3	5	30	1	6	26	1	3	5	0
2002	79	559	15	7	38	0	8	37	1	4	8	0	3	11	0
2003	89	10,188	15	15	91	3	15	30	0	7	24	0	2	31	1
2004	82	574	12	17	189	4	14	52	0	7	26	0	6[1]	53[2]	2[3]
2005	66	585	12	14	78	1	7	1,610	2	7	45	0	3[4]	1	0
2006	65	644	9	10	25	0	6	57	1	4	9	0	7	17	1
2007	66	361	4	16	37	0	16	57	1	3	8	0	7	141[5]	2
2008	74	662	19	15	56	2	5	14	0	1	7	0	4	205[6]	1
2009	95	915	6	21	51	0	9	20	0	3	3	0	11	15	0
2010	54	360	12	17	50	1	5	56	2	2	3	0	7	7	0
2011	69	337	10	21	149	1	7	55	1	4	16	0	7	15	0
2012	80	439	4	25	79	1	17	38	0	2	12	0	8	25	0
2013	56	351	5	15	51	0	13	32	0	2	<2	0	7	10	0

Source: Massport

Notes:

1 Includes two Unknown spills (14 gallons), plus one spill of each of the following: Ethylene Glycol, Propylene Glycol, AVGAS, and Paint.

2 Ethylene Glycol (25 gallons), Propylene Glycol (10 gallons), AVGAS (1 gallon) and Paint (3 gallons).

3 One spill of Ethylene Glycol; one spill of Propylene Glycol.

4 Includes two spills of an unknown substance and volume.

5 Includes one spill of motor oil (4 gallons); one spill of kerosene (5 gallons); one spill of cooking oil (120 gallons); one spill of fuel oil (10 gallons); one spill from a battery (1 gallon); two spills of an unknown substance (1 gallon).

6 Includes one spill of transformer oil (200 gallons).

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Capital Programs and Environmental Affairs

ENVIRONEWS

A Massport Tenant Newsletter

massport

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INSIDE THIS ISSUE:

EnviroNews is a newsletter published quarterly for Massport Tenants.

Your comments and suggestions are welcome—please contact Brenda Enos (benos@massport.com) at 617-568-5963.

Massport Environmental Management Systems: An Overview

An Environmental Management System (EMS) is a systematic approach to deal with the environmental aspects of an organization. Massport currently has three EMSs that are certified to the international ISO 140001 standard: Hanscom (the 1st ISO 140001 certified airport in the US); Conley Terminal (one of the 1st ISO certified container terminals in the US) and Logan Facilities. All are based on Massport's Environmental Management Policy, which among other commitments, states that Massport will "...minimize the impact of its operations on the environment through the continuous improvement of its environmental performance and the implementation of pollution prevention measures" and ..."ensure compliance with applicable environmental laws and regulations. Massport's EMSs were developed and are implemented by teams of Massport employees/managers and are the vehicle through which Massport tracks how well we manage programs established to achieve certain environmental performance targets. A key result of the concept of continuous improvement are new objectives, targets, and programs over time to continuously improve the environmental performance of these facilities. Although the targets differ at each facility based on operations and activities, they tend to focus on such topics as *Special and Hazardous Waste Management, Spill/Release Response and Prevention, Air Emissions, Resource Use, and Stormwater /Solid Waste Management and Energy Consumption.*

In order to maintain the ISO certification, outside auditors must periodically inspect the facilities; review the programs, procedures and documentation; and interview employees to verify that the systems are working as planned. Thanks to the good work of employees at Hanscom, Conley and Logan Facilities, these EMSs each have been recertified multiple times since their original certifications.

Employees and contractors who work at ISO 14001 certified Massport facilities can contribute to the continued success of these systems by:

- Being familiar with the Massport Environmental Management Policy. Copies are available on the intranet and posted prominently throughout the authority.
- Complying with EMS procedures
- Attending EMS training when required.
- Communicating any issues of concern to the EMS leader. They are:

  Jessica Shahdan - Conley

  John Bello - Logan

  Sharon Williams - Hanscom

Fire Extinguishers

Massport Fire Rescue and the State Building Code require fire extinguishers to be available in most areas. What does that mean?

The extinguisher must be serviced and inspected by a Fire Protection service company at least annually. To be sure extinguishers in your area are properly serviced, just look at the tag. The extinguisher is considered available one year from the month punched and the year printed on the tag. For example this extinguisher will need to be re-inspected in October of 2012. Please do not remove these tags. **If there is an extinguisher in your area that you think needs to be inspected, please notify your supervisor.**

Fire Extinguishers must be:

- Visible. Extinguishers should be labeled with a sign to alert you of its location.
- Stored in a cabinet or mounted to the wall. Extinguishers cannot be left on the floor. Do not use fire extinguishers for door stops.
- Unobstructed. Do not store anything in front of an extinguisher. This includes boxes, pallets, wheel chairs, carts, etc.

3 Types of Fire Extinguishers at MPA:

Type A - Ordinary Combustibles (Paper, Wood, ect)

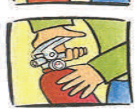
Type B - Flammable and Combustible Liquids (paint, oil, gas, etc.)

Type C - Electrical Fires.

How to Use a Fire Extinguisher?

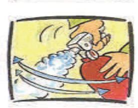
Remember PASS:

Pull the Extinguisher Pin in the Handle.



Aim at the base of the fire.

Squeeze the handle.



Sweep the stream at the base of the fire.

In fact, unless you are a firefighter, you shouldn't need to use a one, only in emergency situations. If you see smoke or fire, you should pull the nearest fire alarm pull station or contact Fire Rescue and Operations and exit the area. However, access to these safety devices is important if they are needed. Please play your part to be sure they are "available" and you know their location.

If you smell or see smoke, don't hesitate to activate the alarm!

Recycling Update

As the greening of Massport continues to march forward, there are some large and small changes coming down the pike in the next few years. Starting with the "Low hanging fruit" such as simply making our recycling barrels visually attractive and strategically located will help tremendously. Updating the entire airport branding theme with a consistent look and feel, internationally recognizable symbols, and clear, helpful guideposts will carry forth the effort. Converting all our recycling containers to Single Stream will bring us up to industry standards for materials reclamation. We are also looking into applying present technology toward age old practices. Massport is currently exploring anaerobic digesters for diverting the organic content from our waste stream and Waste-to-Energy gasifiers to convert a portion of our waste into electricity and heat, lowering costs across the board, and saving the environment one foam cup at a time. These efforts are all well and good, unless those efforts are derailed intentionally, like dumping trash in a container clearly marked as "Recycling Only", or accidently, like the example below.

Recycling with the best of intentions

In early January, Massport Environmental received a tip that an airline service company disposed of empty Jet Oil cans in a Single Stream container at Terminal E. Upon mobilizing Logan facilities personnel to enter the container to investigate, we actually found 5 cases and 2 large bags of "empty" metal oil cans. The word empty is in parenthesis because while the cans are indeed metal, and had been drained, they still contained residual oil, which combined with recyclable commodities means a contaminated load, 30 cubic yards to be exact. When a container of recyclables is deemed "contaminated" by our waste hauler, they are looking out for the best interest of Massport, the hauling company, and the environment. If a full vat of paper pulp (that's tons of pulp) has an oily sheen atop the mixing water, it is shipped out to a landfill. If a load of Single Stream materials enters a Material Reclamation Facility, the oily residue can damage sensitive optical scanners that separate different commodities. If blended commodities are baled and shipped to a single commodity purchaser, the bale will be rejected to, guess where, a landfill. So where did we go wrong with the assumption that metal cans are always recyclable?

First, yes, metal cans are recyclable; however, the oily residue is a regulated material. So the cans even through they had have been drained, should have been rinsed in a biodegradable degreaser. The waste liquid from that process can be recycled. Then, the "clean" metal containers may also be recycled.

Secondly, "When in doubt, ask". If you're not sure if something can be included in a Plastic-Aluminum-Glass or Single Stream container, contact Environmental. We are here to help! Handling materials, especially potentially hazardous ones, can sometimes be tricky. Ask yourself if you know the proper disposal method for that which you are about to toss. If you would like to recycle more and are unsure how to improve your processes, give us a call. If you have specialized materials that you're not sure can be handled by your waste hauler, give us a call. Massport Environmental is here to help guide Logan Airport, its tenants, concessionaires, and business partners to a healthier, greener future.

Questions about Environmental/Safety Issues

Who Should you contact?

Contact	Phone Number	Email Address
<u>Auditing/General</u>		
Brenda Enos	(617) 568-5963	benos@massport.com
<u>Rcycling/Unverisal Waste</u>		
Glenn Adams	(617) 568-3542	gadams@massport.com
<u>EMS/Sustainability</u>		
Jacki Wilkins	(617) 568-3558	jwilkins@massport.com
<u>Safety</u>		
Brian Dinneen	(617) 568-7427	bdinneen@massport.com
Jacqueline Conroy	(617) 568-7434	jcascarano@massport.com
Michael McAveeney	(617) 561-3390	mmcaveeney@massport.com
<u>Spill Follow-Up</u>		
James Stolecki	(617) 568-3552	jstolecki@massport.com
<u>NPDES Permitting</u>		
Rosanne Joyce	(617) 568-3516	rjoyce@massport.com
<u>Underground or Aboveground Storage Tanks</u>		
Erik Bankey	(617) 568-3514	ebankey@massport.com
<u>Air Quality/Hazardous Waste</u>		
Ian Campbell	(617) 568-3508	icampbell@massport.com

Earth Hour 2012—March 31, 8:30 PM

Massport will once again participate in Earth Hour with many others across the state, country and globe by turning off lights at the Logan Office Center and adjacent garage from 8:30-9:30 PM, on March 31, 2012. This tradition began in 2006 in Sydney Australia as a way to show support for climate change action. With the invitation to 'switch off' extended to everyone, Earth Hour quickly became an annual global event. Since then, the event has grown in support each year as more and more individuals, businesses, government agencies and others, turn their lights out for one hour to take a stand against climate change.

Earth Hour is scheduled on the last Saturday of every March – closely coinciding with the equinox to ensure most cities are in darkness as it rolled out around the Earth. Massport employees and tenants are encouraged to participate and to spread the word.

To sign up, see http://www.wwf.org.au/earthhour

2012 Logan Earth Day

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Capital Programs and Environmental Affairs

ENVIRONEWS

Volume 38, Issue 2
July 2012

A Massport Tenant Newsletter

INSIDE THIS ISSUE:

Good Ideas for Continuous Improvement Come from Everywhere!

Massport's ISO 14001 Certified Environmental Management System (EMS) currently includes Hanscom Field, Logan Facilities, and Conley Terminal, all of which: 1) have received EMS refresher training for its staff; 2) have convened productive Implementation and Management Review Teams for self evaluation and to explore opportunities for improvement; and 3) have undergone successful, third-party and internal audits recently. In addition, a baseline 'gap assessment "of Worcester Regional Airport was undertaken this past month. The gap assessment for Worcester is the first step towards adopting an EMS for that facility. All of these efforts are a sampling of Massport's commitment to continuous improvement of the environmental performance of Massport facilities.

During recent EMS audits, the auditor was impressed to learn of some *employee-generated ideas and initiatives* that demonstrate continuous improvement.

Examples at Logan Facilities:

Joanne Bowe, Sign Painter, has become a champion for recycling in the Sign Shop which generates recyclable materials primarily cardboard, plastics, metals. She encourages her colleagues to 'step up' the amount of recycling and began tracking (through estimation) recycled volumes in January of 2012. Her data will become part of the EMS.

James Tower, Central Stock Room, was ahead of the EMS Implementation Team which decided that one means of reducing the amount of hazardous chemicals used at Logan Facilities would involve looking at the current inventory for opportunities to make substitutions to 'greener' products. Our baseline includes several green substitutions already purchased by the Central Stock Room.

Thomas LaBella, Contract Services, proposed that Massport initiate a pilot using an ozone-based cleaning product that has the potential to eliminate the use of several chemicals for cleaning. The pilot in Terminal B has been underway for about two months and testing is being performed to compare the cleaning effectiveness of the green product to the chemical-based products typically used to clean floors, windows, restrooms, etc., shows great promise.

If you have an idea for improved environmental performance at your facility, no matter how big or small, please share it with your unit manager and/or EMS Team Leader. If it gets adopted, we want to capture it in the EMS and share it with others via the EnviroNews.Contact: Jacki Wilkins jwilkins@massport.com or (617) 568-3558.

EPA's Hot Tips for a Cool Summer

1. Energy Star savings for your home: The average home spends almost 20 percent of its utility bill on cooling. These cooling bills can be lowered by simply changing out incandescent light bulbs with EPA's Energy Star qualified lighting, which use less energy and produce approximately 75 percent less heat. Raising your thermostat by only two degrees and using your ceiling fan can lower cooling costs by up to14 percent . http://www.energystar.gov/index.cfm?c=products.es_at_home

2. Increase your gas mileage: Obey the speed limit; go easy on the breaks and avoid hard accelerations; reduce your time idling; and unload unnecessary items in your trunk to reduce weight. If you're not using your removable roof rack take it off to improve your fuel economy. http://www.fueleconomy.gov

3. Take EPA's apps with you on your smartphone: The AirNow app gives location-specific current air quality information to use to protect your health when planning daily activities and the Ultraviolet (UV) Index app provides daily and hourly forecast of the UV radiation levels from the sun so you can better prevent overexposure to the sun. http://m.epa.gov/apps/index.html

cont.. on page 4

2012 Boston GreenFest

Boston GreenFest 2012 is a fully inclusive festival filled with fun learning experiences to address the important changes we need to make in our daily lives and our neighborhoods. It will begin at Boston City Hall Plaza with a Kick-Off Concert on **Thursday, August 16, from 5:00 PM - 9:30 PM and will continue all day long, Friday-Saturday, August 17-18, from noon - 9:30 PM and 11:00 am-8:00 PM**. It is an event that will have something for everybody, young and old.

http://bostongreenfest.org/

EnviroNews is a newsletter published quarterly for Massport Tenants.

Your comments and suggestions are welcome—please contact Brenda Enos (benos@massport.com) at 617-568-5963.

2012 Logan and Hanscom Earth Day Hazardous Materials Collections

Massport's Environmental Management Department would like to extend a huge thank you to all those individuals and departments who contributed their time and resources to the 2012 Logan and Hanscom Earth Day Hazardous Materials Collections. Multiple MPA departments and service providers coordinated to provide a very successful and well-run event.

MPA Fire/Rescue Hazardous Materials Response Unit performed personnel training, equipment exercises, and helped unload vehicles during the Logan event.

For a second year, Clean Harbors provided hazardous materials services for packaging, consolidation, transportation and disposal of regulated waste.

This year we added a new member to the collection events. North East Materials Handling in Lowell, MA provided the labor and transportation to collect electronic computer waste, appliances, and batteries at "no cost" to the Authority.

Gary DePaolo and the BP Trucking team provided waste containers and transportation services for all the empty packaging, cans, buckets, cardboard, and rags. All of this waste is utilized at Covanta's Waste-To-Energy facility to produce electricity for the surrounding Massachusetts communities.

Below are the totals from the events.

2011-2012 Overall Earth Day Comparison

	2011	2012	diff.	
Number of vehicles	105	218	108%	increase
lbs. of waste	27,894	46,442	66%	increase
Cost of disposal	$23,911.00	$23,958.14	0%	net
Cost per Ton	$1,714.42	$1,031.74	-40%	savings

2011-2012 Hanscom Earth Day

	2011	2012	diff.	
Number of vehicles	20	24	20%	increase
lbs. of waste	8,410	6,002	-29%	decrease
Cost of disposal	$ 7,017.00	$ 5,620.14	-20%	net
Cost per Ton	$ 1,668.73	$ 1,872.76	12%	increase

2011-2012 Logan Earth Day

	2011	2012	diff.	
Number of vehicles	95	194	104%	increase
lbs. of waste	19,484	40,440	108%	increase
Cost of disposal	$ 16,894.00	$ 18,338.00	9%	net
Cost per Ton	$ 1,734.50	$ 906.92	-48%	savings

As a reminder, these collection events are intended to provide disposal of household waste for MPA and Tenant Employees. This is not intended to provide disposal services for waste generated from a business. The Resource Conservation and Recovery Act (RCRA) and Massachusetts hazardous waste regulations govern the generation, handling, storage and disposal of hazardous waste and establish long term liability for the generator of that waste. Massport tenants who generate hazardous waste as part of their operation are considered generators of hazardous waste and are therefore responsible for proper storage, handling and disposal of that waste. Storing regulated hazardous waste for a full calendar year in anticipation of a household hazardous waste event violates multiple provisions of RCRA and Massachusetts hazardous waste regulations, in addition, to posing hazards to employees and emergency personnel who may come in contact with this waste.

Clearing the Air About Smoking

Smokers and Non-smokers must responsibly coexist at all Massport locations. It is Massachusetts state law and Massport policy that smoking is prohibited in many locations at our facilities to reduce the risk of health effects from second hand smoke and to minimize the risk of fire by a lit cigarette.

The Massachusetts Department of Public Health reports that:

- Tobacco use is the leading cause of preventable death and illness in Massachusetts and in the nation.
- More than 8,000 Massachusetts residents die each year from the effects of smoking.
- Smoking costs the Massachusetts economy more than $5.5 billion each year.

The Massachusetts Smoke-free Workplace Law; MGL chapter 270, section 22, An Act to Improve the Public Health in the Commonwealth, effective 07/05/2004, prohibits smoking in workplaces, including private offices, taxis, restaurants and bars in order to protect employees and the public from secondhand smoke. This law amends the 1988 Massachusetts Clean Indoor Air Law.

The United Sates Fire Administration reports that almost 1,000 smokers and non-smokers are killed in home fires caused by cigarettes and other smoking materials each year. Fires caused by cigarettes and other smoking materials are preventable.

- One-in-four people killed in smoking related home fires is not the smoker whose cigarette caused the fire.
- More than one third were children of the smokers.
- Twenty-five percent were neighbors or friends of the smokers.
- Logan Fire Rescue has responded to dozens of mulch and trashcan fires this year alone!

So Please!

- Smoke outside in designated “Signed” smoking areas.
- Always discard cigarette and cigar butts in an ashtray. Make sure they are out. Never “flick” a cigarette butt out of a vehicle or into landscaping.
- Never smoke near fuel or in any area where these is an accumulation of combustible materials (paper, cardboard, pallets, etc).
- Never smoke in stairwells or near doorways. A fire in these areas could be devastating and cigarette smoke will freely enter the buildings.
- Please direct customers and visitors to proper smoking areas if you see them smoking in unauthorized areas.
- Be alert! If you see or smell a fire, don’t hesitate to activate the nearest fire alarm.

For more information, please contact the Massport Safety Department or you can check the following websites:

http://www.mass.gov/eohhs/provider/guidance-business/smoke-free-workplace/

http://www.usfa.fema.gov/campaigns/index.shtm

Questions about Environmental/Safety Issues

Who Should you contact?

Contact	Phone Number	Email Address
Auditing/General		
Brenda Enos	(617) 568-5963	benos@massport.com
Rcycling/Unverisal Waste		
Glenn Adams	(617) 568-3542	gadams@massport.com
EMS/Sustainability		
Jacki Wilkins	(617) 568-3558	jwilkins@massport.com
Safety		
Brian Dinneen	(617) 568-7427	bdinneen@massport.com
Jacqueline Conroy	(617) 568-7434	jcascarano@massport.com
Michael McAveeney	(617) 561-3390	mmcaveeney@massport.com
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Erik Bankey	(617) 568-3514	ebankey@massport.com
Air Quality/Hazardous Waste		
Ian Campbell	(617) 568-3508	icampbell@massport.com

More EPA's Hot Tips for a Cool Summer

4. Heading to the beach? Check the water: Americans take almost two billion trips to the beach every year. Beaches are a place to play, watch wildlife, fish, and swim. Learn more on how to plan a safe trip to the beach and check out state specific beach advisory and closing notifications.
http://water.epa.gov/type/oceb/beaches/whereyoulive_state.cfm

5. Enjoy the outdoors and capture the State of the Environment: Almost 40 years ago, EPA's Documerica project captured thousands of images across the nation as EPA's work was just beginning. Now it's your chance to mark the progress and submit environmental photos to EPA's State of the Environment photo project. http://blog.epa.gov/epplocations/about/

6. Protect yourself with insect repellents: Mosquitoes and ticks can carry diseases but you can protect yourself by choosing the right repellent and using it correctly. Read the product label before using; apply just enough to cover exposed skin and clothing; and look for the protection time that meets your needs. Children can use the same repellents as adults unless there is a restriction on the label. http://epa.gov/pesticides/insect/safe.htm

7. Clean greener: If you're going to wash the car, deck, boat, or RV– be sure to look for the Design for the Environment (DfE) label to quickly identify and choose cleaning products that are safer for families and also help protect the environment. Look for the DfE label on grill cleaners as well. http://www.epa.gov/dfe

8. Waste less and remember to recycle: Each year, Americans generate millions of tons of waste in homes and communities but it's easy to reduce, reuse, and recycle. Recycled items such as glass can be used in roadway asphalt (glassphalt) and recovered plastic can be used in carpeting and park benches. Learn what you can do to waste less. http://www.epa.gov/waste/wycd/summer.htm

9. Looking for a summer project and tired of the heat? Try composting: Composting can be a fun and educational summer project that saves landfill space, helps feed the soil and prevents methane, a potent greenhouse gas. http://www.epa.gov/waste/conserve/rrr/composting/basic.htm

10. Improve your indoor air: About 90 percent of people's time is spent indoors. While inside this summer, make sure to free your house of mold, test your home for radon, check your carbon monoxide detector and ask those who smoke to go outdoors. http://www.epa.gov/iaq

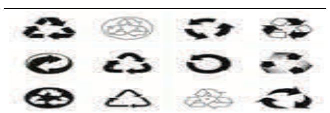
Capital Programs and Environmental Affairs

ENVIRONEWS

A Massport Tenant Newsletter

Volume 38, Issue 3
September 2012

INSIDE THIS ISSUE:



UNIVERSAL WASTE

EnviroNews is a newsletter published quarterly for Massport Tenants.

Your comments and suggestions are welcome—please contact Brenda Enos (benos@massport.com) at 617-568-5963.

Water, Water Everywhere, but Especially in the Terminal B Garage!

This June marked the inception of a rainwater collection system, a component of Capital Programs' Terminal B parking garage rehabilitation project, that also included the installation of solar panels and LED lighting. The system features two 1000-gallon water tanks which are currently providing approximately 50 gallons a day for use by Logan's Field Maintenance Department.

The rainwater harvesting system captures rooftop runoff for use by Massport's street sweepers and pressure washers, thereby reducing potable water consumption. "Integration has been seamless and extremely user friendly," explains Paul Brean, Manager of Airside and Landside Fleet Maintenance. "In addition to conserving water, the tanks offer convenience and a savings in man-hours for Field Maintenance." While it is too early to calculate cost savings, shift supervisors report time savings compared to travelling to a water hook up for the sweeper operators and pressure washing crews.

Brean highlighted the tanks' safety benefits as well. By curbing the use of fire hydrants for field maintenance purposes, the tanks reduce the risk of altering water pressure to the fire suppression system. Field Maintenance employees look forward to using harvested rainwater for the flower watering next spring.

The rainwater collection tanks are fully-integrated into the Logan Environmental Management System (EMS), fulfilling the formal objective to conserve water. "The addition of the rainwater collection tanks is in line with the EMS goals as it provides rainwater for activities such as landscaping and cleaning," notes John Bello, Manager of Facilities Services. "It also fulfills Massport's overall environmental goals."

As with any EMS objective, the tank usage and water savings will be tracked and documented to optimize their benefits.

OSHA Issues Industry Alert – Seat Belt Safety

In April of this year, the Occupational Safety and Health Administration (OSHA) sent an Industry Alert to airlines. OSHA is concerned about the risk of employees being ejected from baggage handling equipment. The letter states that employees who operate the equipment (which includes, but is not limited to bag tugs, belt loaders, cargo tractors, and bob-tail trucks) should wear seatbelts. If the equipment was manufactured without seatbelts or if they have been removed, companies should contact the manufacturer and make plans to install or replace them. For a copy of the letter, please go to this link:

http://www.osha.gov/dep/letters/michaels-to-airlineindustry.html

In general, when operating any equipment: a car, truck, forklift, tractor, fueler or bag cart:

- Employees should inspect equipment before operating it,
- If the vehicle is outfitted with a seatbelt, employees must wear it,
- No one should allow passengers on a vehicle that is not equipped to carry them and
- Operators must drive equipment at a safe speed and in a safe manner.

Encouraging these behaviors, including seat belt use, will minimize or eliminate injuries and fatalities of vehicle operators. Buckle up in your truck!

Universal Waste — Light Bulbs — Compliance Remainder

Massachusetts has bans on the disposal of certain hazardous and recyclable items. Included in this list are mercury and mercury-containing products and those containing polychlorinated byphenyls (or PCBs). These products must be separated from trash, contained during transport and storage, and disposed of properly. Many pieces of equipment that you encounter on a daily basis contain mercury, such as fluorescent light bulbs and thermostats, and PCBs can be found in lighting ballasts. During normal use of these items, small amounts of mercury and PCBs contained within pose no harm to you or the public. However, when mishandled or improperly disposed, the chemicals can be released into the environment.

The following steps should be followed to properly handle, store and dispose of those items containing mercury or PCBs:

1. PLACE items in a container, such as a plastic bin or cardboard box.
   a. Reinserting in the original box (for instance, in the case of spent fluorescent bulbs) is acceptable.
   b. Broken bulbs must be stored in a sealed container (such as a 5 gallon bucket with a lid) marked as “Hazardous Waste”, since the mercury has now been released from its original manufacturer’s sealed condition.
2. LABEL the container as to its contents and date collection begins.
3. STORE the container within the Universal Waste Storage Area.
   In case of breakage, a spill cleanup kit should be readily available.
   Reclaimed debris from breakage or spills should be placed in a sealed container.

Together, we can effectively manage our mercury containing refuse, protect our working environment, and ensure a clean sustainable environment for future generations.

Recycling at Home

Compact fluorescent lamps (CFLs) contain a small amount of mercury, about 3-4 milligrams each, sealed within the glass tubing. As with many household items such as paints, cleaners, and pesticides, CFLs should be handled properly and disposed of according to state requirements. EPA encourages consumers to recycle their spent CFLs to protect human health and avoid unsafe releases to the environment.

Increasingly, communities, neighborhoods, and even some retailers are offering CFL collection opportunities. For more details, including local recycling locations and contact information for recycling in your area, visit **www.earth911.com** or **www.epa.gov/bulbrecycling** and click on “Where You Live.”

State Requirements

Requirements for CFL recycling vary by state. Some states require recycling mercury-containing light bulbs after they burn out. For more information about state-specific requirements, please contact your state or local environmental regulatory agency.

Actions You Can Take to Prevent Broken Compact Fluorescent Light Bulbs

Fluorescent bulbs are made of glass and can break if dropped or roughly handled. To avoid breaking a bulb, follow these general practices:

- Always switch off and allow a working CFL bulb to cool before handling.
- Always handle CFL bulbs carefully to avoid breakage.
  - If possible, screw/unscrew the CFL by holding the plastic or ceramic base, not the glass tubing.
  - Gently screw in the CFL until snug. Do not over-tighten.
  - Never forcefully twist the glass tubing.
- Do not install CFLs in table lamps and floor lamps that can be easily knocked over, in unprotected light fixtures, or in lamps that are incompatible with the spiral or folded shape of many CFLs.
- Do not use CFL bulbs in locations where they can easily be broken, such as play spaces.
- Use CFL bulbs that have a glass or plastic cover over the spiral or folded glass tube, if available. These types of bulbs look more like incandescent bulbs and may be more durable if dropped.
- Consider using a drop cloth (e.g., plastic sheet or beach towel) when changing a fluorescent light bulb in case a breakage should occur. The drop cloth will help prevent mercury contamination of nearby surfaces and can be bundled with the bulb debris for disposal.

Don’t be left in the dark.

Safely clean up and recycle CFLs.

EPA
United States Environmental Protection Agency
EPA530-f-11-001

Questions about Environmental/Safety Issues

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Greendex Calculator

Consumer Choice and the Environment – A Worldwide Tracking Survey

Are you a Green Consumer?

National Geographic and GlobeScan have developed an international research approach to measure and monitor consumer progress toward environmentally sustainable consumption. The key objectives of this unique consumer tracking survey are to provide regular quantitative measures of consumer behavior and to promote sustainable consumption. If you want to see how your consumption patterns rate, take the short survey at:

http://environment.nationalgeographic.com/environment/greendex/calculator/

LOGAN SAFETY FAIR

RED CROSS BLOOD DRIVE

BBQ

WIN PRIZES

FREE Electronic WASTE COLLECTION
computers, appliances & batteries only

SEPTEMBER 19, 2012
10:30 TO 14:30
Amelia Earhart Hangar*

***Next to Massport Fire Rescue Headquarters. Accessible from Airside and Landside.**

Badged and Unbadged employees welcome!

The Safety Fair is for anyone working airside or landside with tools, GSE, baggage or other equipment: come try the newest work safety tools, equipment and techniques. Free to all airline, tenant, construction and Massport employees.

The 2012 SAFETY FAIR is sponsored by the Airport Safety Alliance and JetBlue.

Questions: Contact Brian Dinneen, Massport Safety Manager at 617-568-7427 or bdinneen@massport.com.
For "Electronic Waste" collection please contact Glenn Adams at 617-568-3542 or gadams@massport.com.

Capital Programs and Environmental Affairs

EnviroNews

A Massport Tenant Newsletter

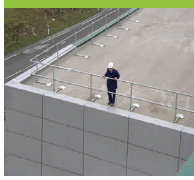
Volume 38, Issue 4
January 2013

INSIDE THIS ISSUE:

EnviroNews is a newsletter published quarterly for Massport Tenants.

Your comments and suggestions are welcome—please contact Brenda Enos (benos@massport.com) at 617-568-5963.

Safely Working on Roofs



Any fall from a roof inevitably involves at least a serious injury. The risks are substantial, however working on a roof is often taken lightly. Many people have been killed when they climbed onto a roof for a few minutes “to have a quick look” or to “make a small repair”.

Falls occur:

- From the edges of roofs
- Through gaps or holes in roofs; and
- Through sky lights.

In addition, many people have been seriously injured by material falling or thrown from roofs. Accidents don’t happen just to roofers, but often to people maintaining equipment on roofs such as HVAC equipment, lighting, antennas and cameras.

Above and beyond the risk of injury, companies can face penalties from the Occupational Health and Safety Administration (OSHA). OSHA’s position is that distance alone from the edge of a roof is not adequate to protect workers. At a minimum, for maintenance of equipment on a roof, a warning line must be placed 15 feet from a roof’s edge and employees must be prohibited from crossing it. If the work is within 15 feet of the edge, then employees must be protected with a guardrail, a fall protection system or a net.

All roof work must be planned. Considerations for roof work are:

- Make sure employees working on roofs are aware of potential hazards,
- A way to get workers and equipment on and off the roof safely,
- Provide a warning line and/or fall protection as necessary and
- Make sure security personnel know workers will be on the roof.

For more information, please go to the www.osha.gov. There are a number of tools and letters of interpretation that can assist in setting up a safe and efficient roof operation. As always, you can contact the Massport Safety Department at 617-568-7427 with questions.

Conley Terminal Environmental Management System Recertified

Conley Terminal underwent a 2-day audit of its ISO 14001-Certified Environmental Management System (EMS) in mid- December and passed with flying colors. As a result, the facility’s certification to this international standard will be extended another three years, through 2015. Preparation for the audit involved a team effort that was acknowledged in the audit report which included the following positive comments:

Conley EMS Team Leader Jessica Shahdan reviews EMS documentation with environmental compliance auditor.

Continued on Page 2

Conley Terminal Environmental Management System Recertified continued.

- Massport has invested in providing additional training to promote awareness of the environmental management system and environmental responsibility in general. The result has been increased involvement and commitment by Conley Terminal personnel.

- As a result of the increased awareness and commitment of Conley Terminal personnel, the overall condition of maintenance shops and garages has noticeably improved from previous audits.

- The organization has been evaluating and using environmentally responsible cleaning products under a state green procurement program. Facilities personnel report that the products work better than the conventional products.

Conley has been IS0 14001 certified since 2004.

2012 UST Operator Certification Requirements Reminder

The Massachusetts Department of Environmental Protection (MassDEP) promulgated regulations (UST Operator Training and Certification, 310 CMR 80.01 and 80.02) on February 3, 2012, that require facilities with underground storage tanks (USTs) to designate personnel as "Operators" of these USTs, and to provide training to personnel responsible for operating these USTs. The MassDEP UST Operator Certification Program ensures that those responsible for operating and maintaining UST systems have the necessary baseline knowledge and understanding of how these systems work.

What are UST System Owner/Operator Responsibilities?
If you own or operate one or more UST systems, you have to:

- Designate at least one certified Class A, B and C Operator for each UST system.
- Document that each designated Class A or B Operator is correctly trained on the UST system(s) for which s/he is responsible.
- Document that each Class C Operator has received site-specific training from a Class A, or B Operator.

What are the UST Operator Qualifications?

- To become certified as a Class A or B UST Operator, you must:
  1. Take and pass a state-administered Class A or B or Reciprocity UST Operator Exam;
  2. Receive a MassDEP issued certificate indicating the level of operator certification received;
  3. Be designated by the facility owner as the responsible UST Operator; and
  4. Obtain training on the type(s) of UST system (s) for which you have been designated an Operator.

- To become a Class C Operator, you must:
  Receive one-time, site-specific training from a Class A or B Operator on the UST system(s) for which you will be responsible, including how to respond to alarms and emergencies.

How Can I get Class C Operator Training?

- A site specific computer-based training module has been prepared by Massport's Class A/B UST Operator, and can be accessed from any Massport facility.
- The training video is approximately 15 minutes in length, and is followed by a brief quiz. You must view the video and complete the quiz to receive credit for having attended the training. A training certificate will be issued to you, within 2 weeks of completing the training. For access to this training module, contact Erik Bankey in the Environmental Management Unit at 617-568-3514 or ebankey@massport.com.

What Can Be Done With Old Batteries and Cell Phones

CALL2RECYCLE: ABOUT OUR PROGRAM

- A NO-COST PROGRAM
- ALL COLLECTION MATERIALS PROVIDED
- DEDICATED CUSTOMER SERVICE
- DETAILED MONTHLY REPORTS PROVIDED
- R2 CERTIFIED

Massport uses Call2Recycle ®, a non-profit, product stewardship organization,that is dedicated to the collection and recycling of rechargeable batteries and cell phones. Since the first collections in 1996, Call2Recycle, headquartered in Atlanta, GA, has diverted 70 million pounds of batteries from landfills in North America. With over 30,000 collection locations in the U.S. and Canada, Call2Recycle provides an easy and responsible solution for municipalities, businesses and the public to recycle batteries and cell phones.

The Call2Recycle program is funded by battery and product manufacturers across the globe and is offered at no cost for those signing up as a collection site. Call2Recycle provides all the necessary collection and shipping materials needed to collect batteries. Since its inception in 2006 Massport has recycled 501 pounds of material.

TYPES OF BATTERIES ACCEPTED:

Nickel Cadmium (Ni-Cd)

Nickel Metal Hydride (Ni-MH)

Lithium Ion (Li-Ion)

Nickel Zinc (Ni-Zn)

Small Sealed Lead (SSLA/Pb)

All types of cell phones are accepted regardless of size, make, model or age.

If you are interested in setting up a program for your location, contact Glenn Adams at (617) 568-35422 or gadams@massport.com.

Questions about Environmental/Safety Issues

Who should you contact?

Contact	Phone Number	Email Address
Auditing/General		
Brenda Enos	(617) 568-5963	benos@massport.com
Rcycling/Unverisal Waste		
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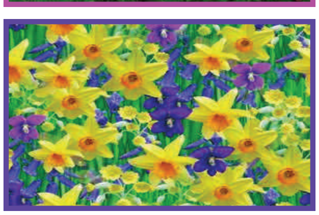
Capital Programs and Environmental Affairs

ENVIRONEWS

Volume 39, Issue 1
June 2013

A Massport Tenant Newsletter

INSIDE THIS ISSUE:



Reminder: Tenant Environmental Audits Due

Massport reminds its tenants to review the environmental provisions of their lease or operating agreements. If required, tenants must submit environmental compliance audits annually, usually on their lease commencement date. Audits must be performed and documented by an experienced professional. Any deficiencies identified during the audit must be addressed by the tenant in an appropriate timeframe, and at the tenant's expense.

Independent of this tenant requirement, Massport's Environmental Management Unit (EMU) staff will conduct a complementary environmental audit of each tenant's leased premises periodically. This is consistent with Massport's Environmental Management Policy, to monitor tenant environmental compliance, provide training, and communicate regulatory requirements. Massport environmental audits are meant to be educational. Note that an audit conducted by EMU staff does not take the place of or exempt tenants from conducting their own independent audit, nor does it supersede tenants' obligation to comply with all applicable laws, rules and regulations.

During an EMU audit, tenants can expect a review of their chemical storage and handling, recycling, stormwater pollution prevention practices, and hazardous waste management. After the visit, a written summary of findings will be provided. As with third party audits, deficiencies are required to be corrected by the tenant.

If you have any questions about the audit process, please contact Brenda L. Enos, Massport's Assistant Director, Capital Programs & Environmental Management at 617-568-5963 or benos@massport.com.

What are some common tenant audit findings?

- Minimal or no recycling;
- Lack of employee training, on subjects such as the Right-to-Know Law;
- Improperly stored or labeled Hazardous Waste or Waste Oil containers & storage areas;
- Unregistered Hazardous Waste or Waste Oil Generator.

EnviroNews is a newsletter published quarterly for Massport Tenants.

Your comments and suggestions are welcome. Please contact

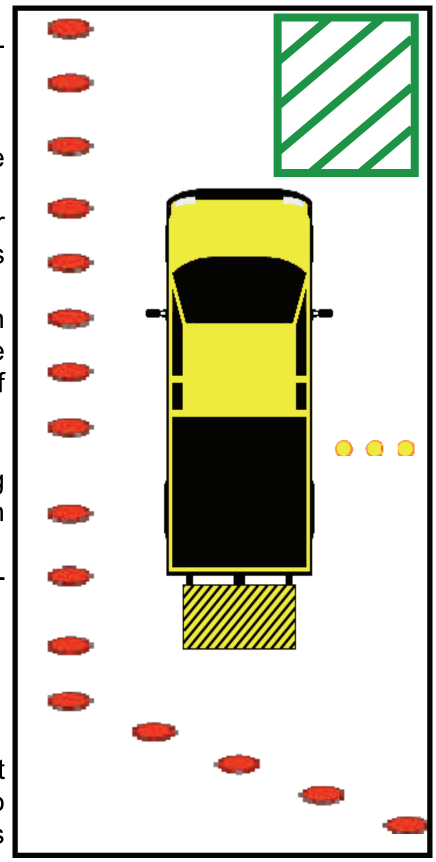
Brenda Enos (benos@massport.com) at 617-568-5963.

Road Safety Is No Accident

Do you work in the road? Before you answer, think of all the times you get in and out of a vehicle in an average day? Do you walk down a sidewalk or cross the street?

You do not have to be on a paving crew to "work in the road". The fact is that most of us work around moving vehicles each day. It is important to stop and think each time you are working in or around traffic. If you are crossing the street:

- Use crosswalks.
- If there is one, use the crossing signal (and wait for it to turn).
- Do not run. If you feel you need to jog to "beat" a car, then you should wait or cross in another location.



When you are performing work in or near the road, please consider the following precautions:

- Have a plan. Know what work you need to perform and get all the equipment you need before you start.
- Be careful getting out of the vehicle. Opening a door is a hazard for vehicles and pedestrians. In addition, watch your step as many slips and falls happen when getting in and out of vehicles.
- BE SEEN. Wear a high visibility vest. If you have a vehicle with warning lights, use them. It is a good idea to put on your vest at the start of a shift since you never know when you may have to get out of your vehicle to correct something.
- Face traffic. Be aware of your surroundings.
- Place a barrier between you and traffic. Use cones and pre-warning signs if possible. Park your vehicle so it shields you from traffic when working. Turn the wheels of the vehicle away from you.
- Consult the Manual Uniform Traffic Control Devices (MUTCD) standard for lane closures. http://mutcd.fhwa.dot.gov/
- Schedule a police detail when appropriate.
- Wear appropriate footwear for the job. Shoes should have slip resistant soles with a good tread.

It is important that we do not underestimate the risks of common events that can hurt us ("That would never happen to me — I'm careful"). Feel free to contact the Massport Safety Department at 617-568-7427 with any questions about working safely in the road.

Interesting Recycling Facts/Water

- **A running faucet wastes 2.5 gallons of water each minute.**
- **A dishwasher uses 11 gallons of water per use.**
- **75 percent of all water used in the household is used in the bathroom.**
- **A toilet made in 1992 or earlier uses up to 60 percent more water per flush than newer high efficiency toilets.**
- **Turning off the tap while brushing your teeth in the morning and before bedtime can save up to 8 gallons per day. This is a savings of 240 gallons per month.**
- **Running the faucet for 5 minutes uses up enough energy to run a 60 watt light bulb for 14 hours.**
- **A full bath tub uses 70 gallons of water. A 5 minute shower only uses 10-25 gallons.**

NEW EPA Report: Initial Data Shows Significant Gains in Fuel Economy for 2012

WASHINGTON – EPA recently released its annual report that tracks the fuel economy of vehicles sold in the United States, underscoring the major increases made in the efficiency of the vehicles Americans drive, reducing oil consumption and cutting carbon emissions. According to the report, EPA estimates that between 2007 and 2012 fuel economy values increased by 16 percent while carbon dioxide (CO_2) emissions have decreased by 13 percent, and in 2012 alone the report indicates a significant one year increase of 1.4 miles per gallon (mpg) for cars and trucks.

The expected 1.4 mpg improvement in 2012 is based on sales estimates provided to EPA by automakers. EPA's projections show a reduction in CO_2 emissions to 374 grams per mile and an increase in average fuel economy to 23.8 mpg. These numbers represent the largest annual improvements since EPA began reporting on fuel economy.

Fuel economy is expected to continue improving significantly under the National Clean Car Program standards. The program cuts greenhouse gas emissions and would double fuel economy standards by 2025. The standards will save American families $1.7 trillion dollars in fuel costs, and by 2025 will result in an average fuel savings of more than $8,000 per vehicle. The program will also save 12 billion barrels of oil, and by 2025 will reduce oil consumption by more than 2 million barrels a day – as much as half of the oil imported from OPEC every day.

FAA Funds Logan Airport Sustainability Management Plan

Massport has been selected by the FAA to receive a grant of $750,000 to be used to develop a $1M Sustainability Management Plan (SMP) for Logan Airport. The FAA began providing grants to airports in 2010 to develop comprehensive sustainability plans to reduce environmental impacts, achieve economic benefits, and improve community relations. Logan Airport is now among 25 airports that have been deemed worthy to receive a grant and the Logan Airport funding is among the largest amount provided by the FAA.

The Logan SMP will involve a two - year, two- phased effort that will employ baseline assessments of environmental resources and stakeholder outreach to identify sustainability objectives. It also will utilize the framework of the ISO 14001 certified Environmental Management System to develop, prioritize, implement and track the programs and initiatives that will help us achieve our sustainability objectives. Incorporating the plan into our Logan EMS will facilitate expanding the plan to other Massport facilities over time. It will differ from other FAA funded airport SMPs in that it will include outreach and engagement of airport tenants. The FAA will use the Logan SMP and lessons learned from our efforts to benefit other airports.

Interesting Recycling Facts / Paper

- Recycling 1 ton of paper saves 17 mature trees, 7,000 gallons of water, 3 cubic yards of landfill space, 2 barrels of oil, and 4000 kilowatt hours of electricity. This is enough energy to power the average American home for 5 months.
- The process of recycling paper instead of making it from new materials generates 74 percent less air pollution and uses 50 percent less water.
- Manufacturing recycled paper uses 60 percent of the energy needed to make paper from new materials.
- Over 73 percent of all newspapers are recovered for recycling. About 33 percent of this is used to make newsprint the rest is used to make paperboard, tissue, or insulation.
- A little more than 48 percent of all office paper is recycled. This is used to make writing papers, paper board, tissue, and insulation.

Questions about Environmental/Safety Issues

Who should you contact?

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Capital Programs and Environmental Affairs

EnviroNews

A Massport Tenant Newsletter

Volume 39, Issue 2
November 2013

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Brenda Enos (benos@massport.com) at 617-568-5963.

Toaster Ovens: Friend or Foe

Everyone enjoys a good hot breakfast or lunch. Very often, we heat those meals in a toaster oven. Although very handy, they can be hazardous causing burns and starting fires. Here are a few requirement to think about before plugging in and using a toaster oven.

- Not every outlet and flat surface is a kitchen. Cooking appliances should be in designated break areas that are clean and free from chemical and combustible storage.
- Make sure the oven is in good shape. Don't bring in old toaster ovens from home or used toaster ovens. If it's not good enough for your kitchen counter, it shouldn't be used at work.
- Toaster ovens and most other appliances must be plugged directly into an outlet. They cannot be plugged into extension cords.
- Make sure there is enough room around the toaster oven.
    - Don't push the oven back against the wall. Leave a few inches behind the oven for the cord. Pushing it too close will cause the cord insulation to melt.
    - Don't store anything on top of the oven.
    - Keep napkins, towels and other combustibles far away from the oven.
- Keep it clean! Clean the toaster oven's crumb tray regularly and wipe out any grease that may have splattered on the interior. Keeping the oven clean will go a long way toward preventing a fire.
- Often, people place aluminum foil in a toaster oven to catch falling food. That foil should be replaced frequently.
- Stay with it. If you are cooking something in the toaster oven, don't walk away. Stay with the oven until you are done using it.
- If you have a toaster oven, you should have an oven mitt to prevent burns. Use the mitt to take hot items out of the oven.
- Is it off? Once you are done cooking your food, make sure you turn it off. Twice.
- Unplug It. It is a good practice to pull the plug when you're done using it.

Trash Talk

Over the past twenty-nine months, there has been a lot going on behind the scenes regarding Massport's recycling program. Through a concert of efforts including performing dumpster waste sorts, data analysis, Facility and Terminal Managers meetings, Massport has shifted its Environmental focus from trash collection to recycling. A new contract has recently been awarded to Republic Services.

Massport will no longer simply haul trash. The new service agreement focuses on recycling, liquids and organics. By eliminating liquids and organics from the waste stream, commodities can be recycled or diverted to composting. The point is to extract the intrinsic value from the waste stream and only pay to dispose of material that no longer has value, such as food-contaminated paper/fiber, grit and fines from street sweepings, or items that are a combination of materials and are difficult to handle. Everything else should be composted or recycled.

Beginning last week, new dumpsters were brought in to various locations. The next initiative is to complete the Single Stream collection system. Every recycling container will accept plastic bottles, plastic bags and packaging, glass, paper, cardboard, metal, and tin. If you think something may be recyclable, toss it in! Republic Services' Material Reclamation Facility uses computer based sorting equipment to separate and bale commodities for shipment to manufactures. In addition, changes that will increase the efficiency of collections, including wireless container monitoring and utilizing CNG trucks will be next.

Considering 95% of the material in our trash has intrinsic value if handled properly, we can strive to achieve the MassDEP goal of "Zero Waste by 2020".

Please Recycle

REUSE
REDUCE
RECYCLE

Recycling Facts

- **It takes 80-100 years for an aluminum can to decompose (break down) in a landfill.**
- **Aluminum cans can be recycled into: soda cans, pie plates, license plates, thumbtacks, aluminum foil, and many other items.**
- **Recycling one aluminum can saves enough energy to power a television for up to three hours.**
- **Glass takes over 1,000,000 (one million) years to decompose in a landfill.**
- **Glass can be recycled into jars, jewelry, bottles, dishes, drinking glasses, coffee mugs and many other items.**
- **It can take up to 700 years for plastic to decompose in a landfill.**
- **Polyethylene Terephthalate (PET) plastic can be recycled into: clothing, fiberfill for sleeping bags, toys, stuffed animals, rulers and more.**

Engaging Employees in Logan's First Sustainability Management Plan

Did you know that a Logan Airport Sustainability Management Plan Project was just launched? To engage a broad spectrum of employees across the organization, 19 Massport employees representing many facets of Logan Airport were selected to be leaders in the development and implementation of the Plan. In September, the SWG met for the first time to kick off the Project. The SWG was first tasked with trying to answer the question "what does sustainability mean to you?" using just three words. The exercise resulted in a piece of word art (shown below) which demonstrates how the group envisions sustainability. The words appearing in larger font were the words most repeated by members. The SWG also learned about the four essential elements of airport sustainability - *economic viability, operational efficiency, natural resources conservation, and social responsibility*. The results of this exercise show that the SWG is already thinking about sustainability as it relates to these four key elements.

Word Art Exercise by SWG

The Sustainability Management Plan will include the following highlights:

- Establish a baseline assessment of a variety of resource areas including water use, waste management and recycling, air quality, people and employee well-being, among others
- Establish sustainability goals, objectives and initiatives for the Plan
- Develop implementation recommendations
- Develop a tracking and monitoring program

This effort is specific to Logan Airport, but has the potential to serve as a Massport-wide sustainability program. Massport recognizes that employee engagement, participation and leadership are critical to advancing implementable sustainability solutions. The SWG will serve as a two-way communication channel. As a result of break-out group exercises, members identified opportunities where Massport could improve sustainability performance as well as where Massport could improve communication to better support and foster engagement with employees. SWG members look forward to meeting with the Project Team on a regular basis to contribute their own ideas. Their recommendations will be invaluable to the success of the Project.

Congratulations to the Massport employees participating in the Sustainability Working Group (SWG)!

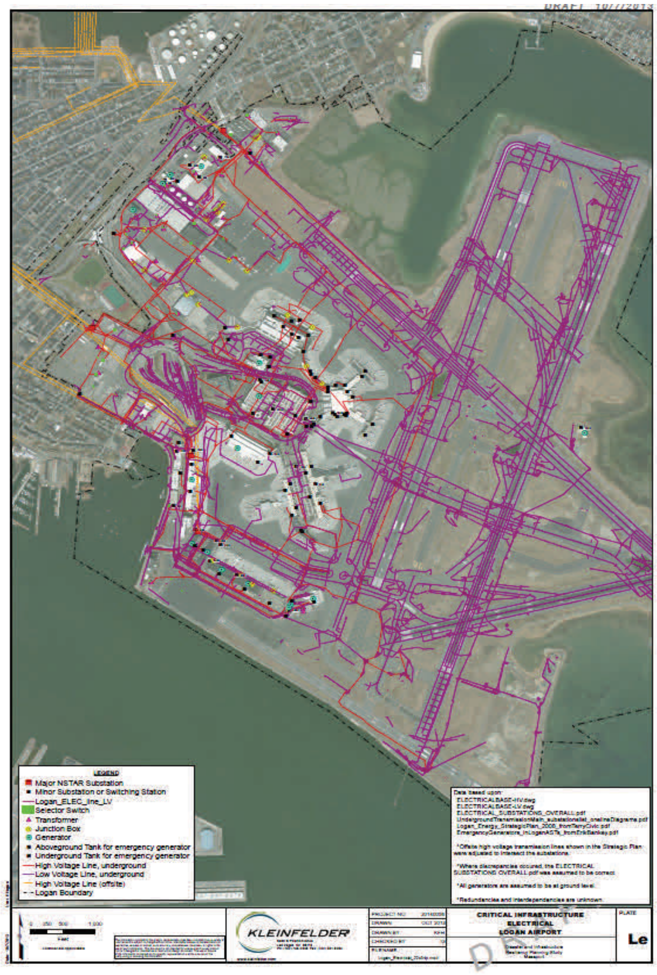
Continued on page 4

Engaging Employees in Logan's First Sustainability Management Plan cont….

SWG Members include the following:

- Glenn Adams, Capital Programs
- Dave Albrecht, Information Technology
- Terry Civic, Capital Programs
- Stewart Dalzell, Economic Planning & Development
- Brenda Enos, Capital Programs
- Kathryn Glowik, Administration and Finance
- Anthony Guerriero, Community Relations
- Flavio Leo, Aviation
- Ralph Nicosia-Rusin, FAA
- Jennifer Revill, Capital Programs
- Wendy Riggs-Smith, Capital Programs
- Tammie Rivard, Human Resources
- Kari Scavotto, Human Resources
- Alaina Travaglini, Community Relations
- Dennis Treece, Corporate Security
- Toni Marie Vaughn, Administration and Finance
- Jacki Wilkins, Capital Programs

Massport Disaster and Infrastructure Resiliency Planning Study



The purpose of this project is to assess Massport facilities to determine short and long term susceptibility to disasters and identify and implement improvements to improve resiliency. Kleinfeld (KLF) is the consultant leading the effort. The project involves three main tasks: Hazard Analysis, Vulnerability Assessment and a Mitigation Action Plan.

The following is a brief Status of the Project:

Task 1: Hazard Analysis

KLF's team of experts is currently compiling data on the climatic parameters set by historic events, including, among other, Hurricanes Sandy and Irene and Winter Storm Nemo. These and other extreme precipitation, storm surge, and winter storms events will be documented in a database and summarized in tabular form. In addition, KLF is documenting past storm damage to Massport facilities and infrastructure. These two sets of information will help give Massport a better understanding of climate risks and will inform the Short-term Action Plan.

Massport's longer term adaptation plan will require a better understanding of how climate will change over the planning horizon, in this case 30 years. KLF's partners are currently developing the modeled climate projections that will provide the raw data for simulated annual/seasonal values of each of the secondary indicators for temperature and mean precipitations. The team is also developing best approaches for factoring Sea Level Rise (SLR) and Storm Surge impacts. . These will be used as input to subsequent analyses.

Task 2: Vulnerability Assessment

KLF is proceeding with the compilation, development, and analysis of geospatial information for Massport's existing infrastructure and assets. With GIS, KLF is creating multi-layer maps showing the relationship and location of different infrastructure and assets that may be affected by climate events.

In the fall, KLF held numerous meetings with Massport stakeholders to review information collected to date, assess missing information, and set the process for filling data gaps. Coordination is ongoing to complete the data gathering process.

Task 3: Mitigation Action Plan

The next step will be to focus on the Short-Term Action Plan to address the urgent concerns for short-term climate preparedness of Massport, looking at the next 5 years (2013-2018). This action plan will be based on historic extreme climate events that will be used to determine the key threats and the consequences to Massport. The focus will be on addressing the possible consequences of a hurricane similar to Hurricane Sandy hitting Boston Logan Airport and south Boston Maritime facilities at high tide.

The final report will be issued in March 2014.

Questions about Environmental/Safety Issues

Who should you contact?

Contact	Phone Number	Email Address
Auditing/General EMS/Sustainability		
Brenda Enos	(617) 568-5963	benos@massport.com
Recycling/Universal Waste		
Glenn Adams	(617) 568-3542	gadams@massport.com
Safety		
Brian Dinneen	(617) 568-7427	bdinneen@massport.com
Michael McAveeney	(617) 561-3390	mmcaveeney@massport.com
Karisa Morin	(617) 568-7434	kmorin@massport.com
Spill Follow-Up		
James Stolecki	(617) 568-3552	jstolecki@massport.com
NPDES Permitting		
Rosanne Joyce	(617) 568-3516	rjoyce@massport.com
Underground/Aboveground Storage Tanks		
Erik Bankey	(617) 568-3514	ebankey@massport.com
Air Quality/Hazardous Waste		
Ian Campbell	(617) 568-3508	icampbell@massport.com

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2012/2013 Peak Period Pricing Monitoring Report

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BOSTON-LOGAN INTERNATIONAL AIRPORT MONITORING REPORT ON SCHEDULED AND NON-SCHEDULED FLIGHT ACTIVITY

Peak Period Surcharge Regulation
740 CMR 27:00: Massachusetts Port Authority

Report Number:	**011**
Monitoring Period:	**Through Sept. 2014**
Report Issue Date:	**June 2014**

massport

<u>Note</u>: This report reflects the Boston-Logan Airport flight activity monitoring under 740 CMR 27.03 Peak Period Surcharge Regulation on Aircraft Operations at Boston-Logan International Airport.

<u>Findings</u>: This report includes actual and projected activity data **<u>through September 2014</u>**. Current and projected near-term flight levels at Boston Logan are well below Logan's good weather (VFR) throughput of approximately 120 flights per hour. **As a result, average VFR delays are projected to be minimal and well below the 15 minutes threshold through September 2014.**

In the event demand conditions at the airport change significantly from the current projection, Massport will issue updates to this report.

<u>Attachments</u>

Table 1: Summary Overview of Peak Period Surcharge Program

Table 2: Summary Overview of Forecast Methodology

Table 3: Projected Aircraft Operations at Logan Airport Projected

Table 4: Projected Hourly Operations, Average Weekday

Table 5: Forecast Logan Average Weekday Operations

<u>Massport Contact:</u>

Mr. Flavio Leo
Deputy Director, Aviation Planning and Strategy
617-568-3528
fleo@massport.com

Table 1: Summary Overview of Peak Period Surcharge Program

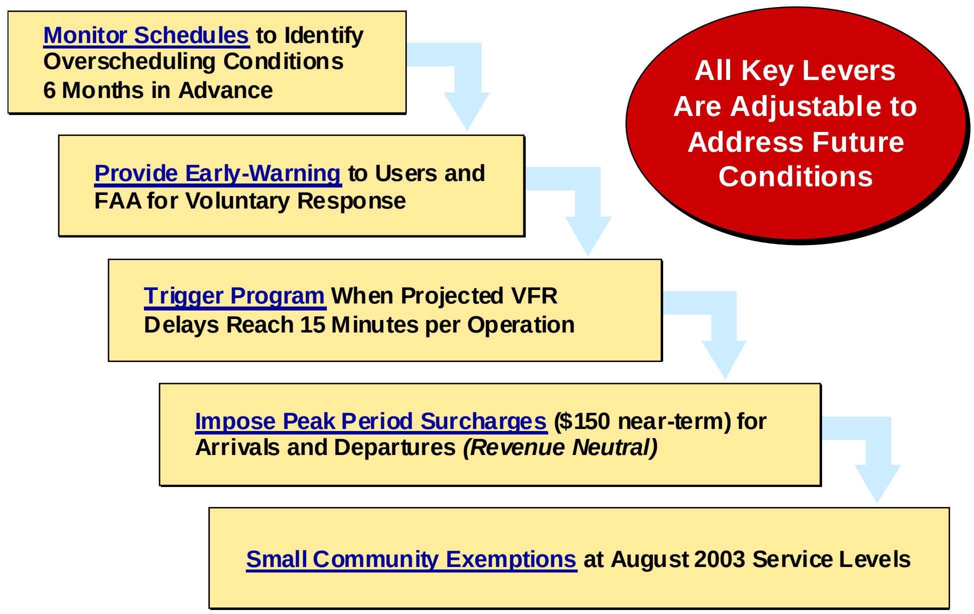
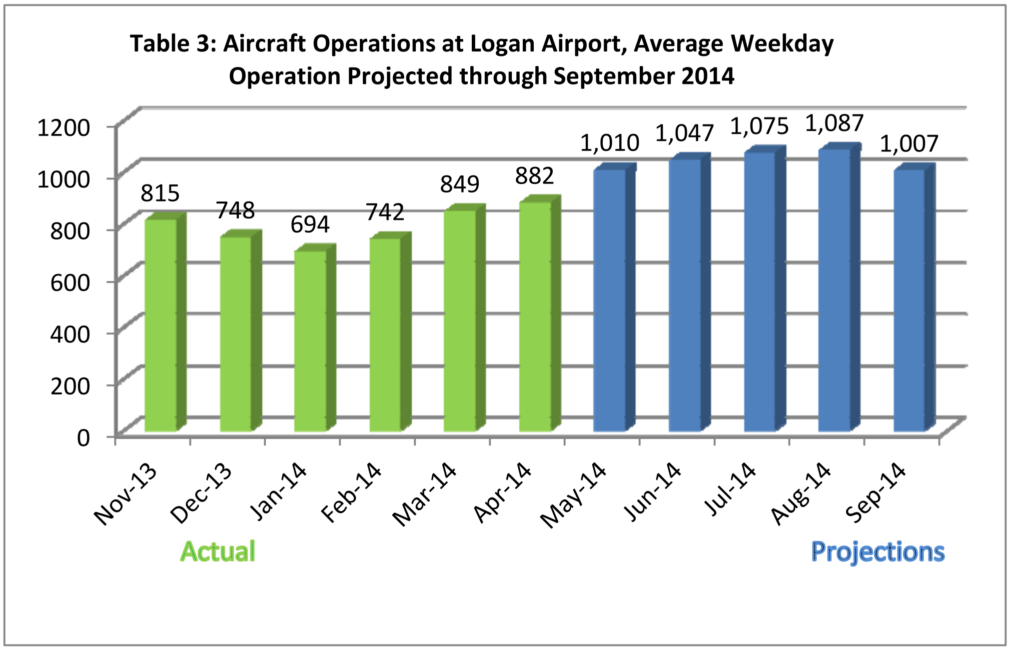


Table 2: Summary Overview of Forecast Methodology

- Scheduled passenger airline flights represent more than 93 percent of total aircraft operations. Passenger airline activity for the Spring and Summer periods were projected based on published advance airline schedules
- Forecasts of monthly activity for other segments (GA, Cargo, Charter) are based on the past three months of actual flight volume and historic patterns of monthly seasonality
- Day-of-week and time of day distributions for non-scheduled segments are based on analysis of Logan radar data
- Projections for each segment were combined to produce the forecast pattern of hourly flight activity for an average weekday, Saturday, and Sunday for the period from February through September

Table 3: Aircraft Operations at Logan Airport, *Average Weekday Operations Projected Through September*



Actual	Projections

Note: Actual Operations are based on Massport data/air carrier reports and reflect flight cancellations due to weather and other operational impacts.

Table 4: Projected Hourly Operations, *Average Weekday, August*

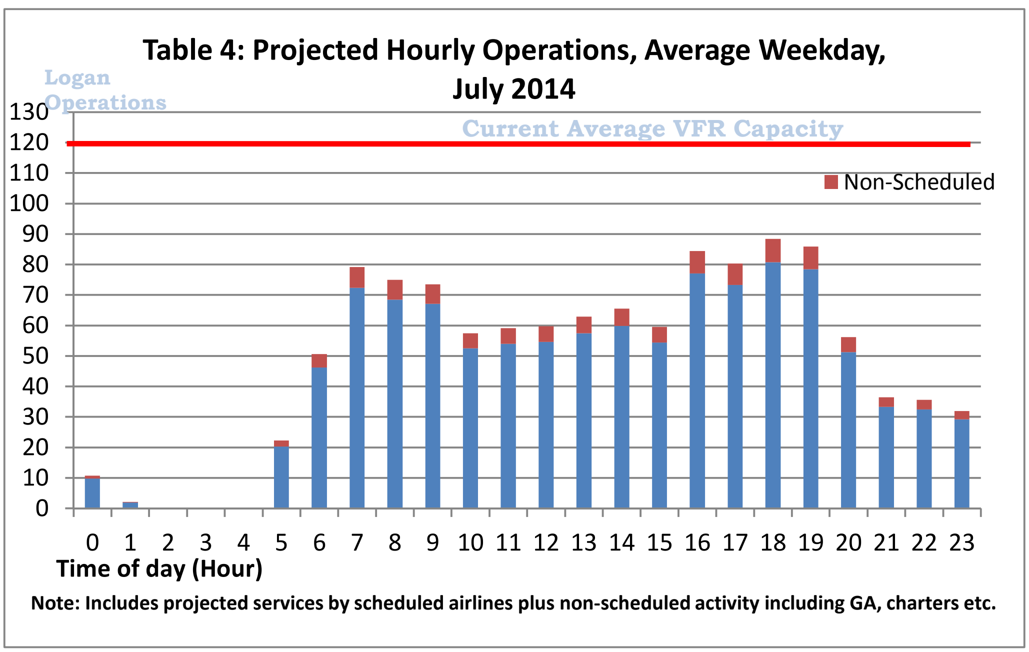


Table 5: Forecast Logan Average Weekday Operations, *Feb. – Sep.*

	Forecast Daily Operations							
Hour Range	Feb-14	Mar-14	Apr-14	May-14	Jun-14	Jul-14	Aug-14	Sep-14
0	9	12	13	10	9	10	8	6
1	2	2	3	2	3	2	2	1
2	1	0	1	0	1	0	0	0
3	0	0	0	0	0	0	0	0
4	1	2	1	0	0	0	0	0
5	8	9	11	15	18	20	18	12
6	35	42	45	47	48	46	46	47
7	45	53	56	67	72	72	74	68
8	46	49	55	65	66	68	68	63
9	48	53	53	60	64	67	69	59
10	43	49	49	48	49	52	51	47
11	40	44	47	55	56	54	57	58
12	32	38	43	59	55	55	57	56
13	33	41	46	48	53	57	57	54
14	36	46	44	56	57	60	61	55
15	40	50	49	51	54	54	59	60
16	46	54	54	70	75	77	76	66
17	49	56	56	76	69	73	77	80
18	52	56	57	81	84	81	81	76
19	50	57	58	64	71	78	77	66
20	46	47	49	47	50	51	53	46
21	35	37	38	34	33	33	36	35
22	25	28	29	31	32	32	34	30
23	20	24	24	24	29	29	27	22
Total	**742**	**849**	**882**	**1,010**	**1,047**	**1,075**	**1,087**	**1,007**

February - April are actual data

May - September is forecast data

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Reduced/Single Engine Taxiing at Logan Airport Memoranda

This Appendix provides detailed information in support of *Chapter 7, Air Quality/ Emissions Reduction:*

- Memorandum from Edward C. Freni, Massport Director of Aviation, to the Boston Logan Airline Committee, Regarding Single/Reduced Engine Taxiing at Boston Logan, Dated January 24, 2012
- Memorandum from Edward C. Freni, Massport Director of Aviation, to the Boston Logan Airline Committee, Regarding Single/Reduced Engine Taxiing at Boston Logan, Dated April 26, 2013
- Simaiakis, I, Khadilkar, H., Balakrishnan, H., Reynolds, T.G., Hansman, R.J., Reilly, B., and Urlass, S. "Demonstration of Reduced Airport Congestion Through Pushback Rate Control." *Ninth USA/Europe Air Traffic Management Research and Development Seminar (ATM2011).*

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Massachusetts Port Authority
One Harborside Drive
East Boston, MA 02128-2909
Telephone (617) 568-5000
www.massport.com

To: Boston Logan Air Carrier, Chief Pilots

From: Edward C. Freni
Director of Aviation

Date: January 24, 2012

RE: Single/Reduced-Engine Taxiing and the Use of Idle Reverse Thrust as Strategies to Reduce Aircraft-Generated Noise at Boston Logan

As an important user of Boston-Logan International Airport ("Boston Logan"), you are critical to our efforts to ensure that Boston Logan is the safest, most dependable and environmentally responsible airport it can be. Working together, we have successfully implemented cutting-edge safety technologies, including: the Runway Status Lights (including the unique application at the intersection of Runways 15R and R9), installation of the ASDE-X ground radar, and construction of new airside facilities Runway 14/32, Taxiway Mike and other taxiway improvements. Our partnerships with the air carriers, the FAA, and aviation industry organizations continues with the testing of the newest FAA surveillance technology ADS-B this winter and FAA-sponsored research on optimizing taxi procedures which is being conducted by MIT.

Our success in implementing airfield improvements and conducting cutting-edge research at Boston Logan is based, in part, on continuing to evaluate and promote operational measures that could reduce environmental impacts from various landside and airside operations.

One such important operational measure that has been identified is single/reduced engine taxiing. I have written to you before to encourage your use of single-engine taxiing (subject to safety considerations). Based on previous outreach to the air carrier community serving Boston Logan and a previous survey conducted by MIT, it seems clear that single or reduced engine taxiing is being voluntarily utilized by the vast majority of air carriers at Boston Logan. I write to you again to encourage continued use of this emissions reduction strategy subject to pilot discretion and consistent with air carrier operating procedures. While fuel savings is a significant benefit and possibly the primary motivation for air carriers, the consequential reduction in aircraft emissions is also an important additional benefit and our primary environmental goal.

I also encourage your use of idle reverse thrust (or minimize the use of reverse thrust) on landing, as a second operational measure, again, only at the discretion of the pilot and when consistent with air carrier operational safety procedures. This measure would provide noise relief to our closest neighbors and, at the same time, provide ancillary benefits to you, such as reducing fuel burn and engine wear. Clearly the use of this procedure must also be consistent with operational conditions at Boston Logan, including runway surface conditions, whether LAHSO is in use, and acceptable runway occupancy time.

Finally, I want to report the results of the most recent research on optimizing taxi procedures conducted at Boston Logan by MIT. This research was sponsored by the FAA and involved the collaboration of the local Boston Tower, air carriers serving Boston Logan, and Massport staff. Two trials were conducted: one in the summer of 2010 and a second in the summer of 2011. The tests demonstrated that there is opportunity to optimize the amount of time aircraft taxi without impacting efficiency, while at the same time, saving fuel and reducing emissions and noise. The MIT paper titled "Demonstration of Reduced Airport Congestion Through Pushback Rate Control" (also attached to this letter for your convenience) focuses on the 2010 research and concludes with the following finding:

> *Results show that during eight demonstration periods(about 24 hours) of controlling pushback rates, over 1,077 minutes (nearly 18 hours) of gate holds were experienced during the demonstration period across 247 flights, at an average of 4.3 minutes of gate hold per flight (which correlated well to the observed decreases in taxi-out time). Preliminary fuel burn savings from gate-holds with engines off were estimated to be between 12,000-15,000 kg (depending on whether APUs were on or off at the gate).*

Thank you for participating in this ground-breaking research. This work clearly demonstrates there are opportunities for the airline industry, the FAA and airports to work together to seek solutions that improve operational efficiency, while reducing our impact on the environment.

I encourage you to share this letter and the attached research paper with your flight crews and I thank you for the continued work with Massport to make Boston Logan an environmentally friendly and responsible airport. If you have any questions or would like to discuss any aspect of this letter, please feel free to contact me or Mr. Flavio Leo, Deputy Director of Planning and Strategy, at 617-568-3528.

Edward C. Freni
Director of Aviation

Massachusetts Port Authority
One Harborside Drive
East Boston, MA 02128-2909
Telephone (617) 568-5000
www.massport.com

TO: Boston Logan Air Carriers and Chief Pilots

FROM: Edward C. Freni
Director of Aviation

Date: April 26, 2013

RE: Single/Reduced-Engine Taxiing and the Use of Idle Reverse Thrust as Strategies to Reduce Aircraft-Generated Emissions and Noise at Boston Logan

As an important user of Boston-Logan International Airport ("Boston Logan"), you are essential to our efforts to ensure that Boston Logan is the safest, most dependable and environmentally responsible airport it can be. Working together, we have successfully implemented cutting-edge safety technologies and construction of new airside facilities at Boston Logan. Our partnership with the air carriers, the FAA, and aviation industry organizations continues with the completion of the Runway 33L Safety Area Project extension (including the installation of an EMAS bed designed to stop a 747-400 entering at 70 knots), the recent upgrade of R33L to Category III and the ongoing testing of ADSB transponder technology to enhance situational awareness of ground vehicle drivers on the airfield.

Our success in implementing physical and technological improvements and conducting cutting-edge research at Boston Logan, is based, in part, on continuing to evaluate and promote operational measures with the potential to reduce environmental impacts from various landside and airside operations. Two such important operational measures that have been identified are single/reduced- engine taxiing and the use of idle-reverse thrust.

I have written to you before to encourage your use of single-engine taxiing when operationally appropriate. Based on our outreach to the air carrier community serving Boston Logan and survey information, it is clear that single- or reduced-engine taxiing is being voluntarily utilized by the vast majority of air carriers at Boston Logan. I write to you again to encourage continued use of this fuel saving and emissions reduction strategy subject to pilot discretion and consistent with air carrier operating procedures.

I also encourage your use of idle reverse thrust (or minimize the use of reverse thrust) on landing, as a second operational measure, again, only at the discretion of the pilot and when consistent with air carrier operational safety procedures. This measure would provide noise relief to our closest neighbors and, at the same time, provide companion benefits to you, such as reducing fuel burn and engine wear. Clearly, the use of this procedure must also be consistent with operational conditions at Boston Logan, including runway surface conditions, whether LAHSO is in use, and acceptable runway occupancy time.

Finally, as with last year's letter to you, I am including a copy of a recent MIT study on optimizing taxi procedures at Boston Logan. This research was sponsored by the FAA and involved the collaboration of the local Boston Tower, air carriers serving Boston Logan, and Massport staff. Two trials were conducted in the summer of 2010 and 2011. The tests demonstrated that optimizing the amount of time aircraft taxi, reduces fuel-burn without affecting efficiency. The MIT paper titled "Demonstration of Reduced Airport Congestion Through Pushback Rate Control" (again attached to this letter for your convenience) concludes with the following finding:

> *Results show that during eight demonstration periods(about 24 hours) of controlling pushback rates, over 1,077 minutes (nearly 18 hours) of gate holds were experienced during the demonstration period across 247 flights, at an average of 4.3 minutes of gate hold per flight (which correlated well to the observed decreases in taxi-out time). Preliminary fuel burn savings from gate-holds with engines off were estimated to be between 12,000-15,000 kg (depending on whether APUs were on or off at the gate).*

This work has informed the FAA's ongoing work on surface optimization as part of its NextGen initiatives. The MIT research clearly demonstrates there are opportunities for the airline industry, the FAA and airport operators to work together to seek solutions that improve operational efficiency, while reducing our collective impact on the environment.

Again, I encourage you to share this letter and the attached research paper with your flight crews and I thank you for the continued work with Massport to make Boston Logan an environmentally friendly and responsible airport. If you have any questions or would like to discuss any aspect of this letter, please feel free to contact me or Mr. Flavio Leo, Deputy Director of Planning and Strategy, at 617-568-3528.

Edward C. Freni
Director of Aviation

Demonstration of Reduced Airport Congestion Through Pushback Rate Control

I. Simaiakis, H. Khadilkar, H. Balakrishnan,
T. G. Reynolds and R. J. Hansman
Department of Aeronautics and Astronautics
Massachusetts Institute of Technology
Cambridge, MA, USA

B. Reilly
Boston Airport Traffic Control Tower
Federal Aviation Administration
Boston, MA, USA

S. Urlass
Office of Environment and Energy
Federal Aviation Administration
Washington, DC, USA

***Abstract*—Airport surface congestion results in significant increases in taxi times, fuel burn and emissions at major airports. This paper describes the field tests of a congestion control strategy at Boston Logan International Airport. The approach determines a suggested rate to meter pushbacks from the gate, in order to prevent the airport surface from entering congested states and to reduce the time that flights spend with engines on while taxiing to the runway. The field trials demonstrated that significant benefits were achievable through such a strategy: during eight four-hour tests conducted during August and September 2010, fuel use was reduced by an estimated 12,000-15,000 kg (3,900-4,900 US gallons), while aircraft gate pushback times were increased by an average of only 4.3 minutes for the 247 flights that were held at the gate.**

Keywords- departure management, pushback rate control, airport congestion control, field tests

I. Introduction

Aircraft taxiing on the surface contribute significantly to the fuel burn and emissions at airports. The quantities of fuel burned, as well as different pollutants such as Carbon Dioxide, Hydrocarbons, Nitrogen Oxides, Sulfur Oxides and Particulate Matter, are proportional to the taxi times of aircraft, as well as other factors such as the throttle settings, number of engines that are powered, and pilot and airline decisions regarding engine shutdowns during delays.

Airport surface congestion at major airports in the United States is responsible for increased taxi-out times, fuel burn and emissions [1]. Similar trends have been noted in Europe, where it is estimated that aircraft spend 10-30% of their flight time taxiing, and that a short/medium range A320 expends as much as 5-10% of its fuel on the ground [2]. Domestic flights in the United States emit about 6 million metric tonnes of CO_2, 45,000 tonnes of CO, 8,000 tonnes of NOx, and 4,000 tonnes of HC taxiing out for takeoff; almost half of these emissions are at the 20 most congested airports in the country. The purpose of the Pushback Rate Control Demonstration at Boston Logan International Airport (BOS) was to show that a significant portion of these impacts could be reduced through measures to limit surface congestion.

This work was supported by the Federal Aviation Administration's Office of Environment and Energy through MIT Lincoln Laboratory and the Partnership for AiR Transportation Noise and Emissions Reduction (PARTNER).

A simple airport congestion control strategy would be a state-dependent pushback policy aimed at reducing congestion on the ground. The *N-control* strategy is one such approach, and was first considered in the Departure Planner project [3]. Several variants of this policy have been studied in prior literature [4, 5, 6, 7]. The policy, as studied in these papers, is effectively a simple threshold heuristic: if the total number of departing aircraft on the ground exceeds a certain threshold, further pushbacks are stopped until the number of aircraft on the ground drops below the threshold. By contrast, the *pushback rate control* strategy presented in this paper does not stop pushbacks once the surface is in a congested state; instead it regulates the rate at which aircraft pushback from their gates during high departure demand periods so that the airport does not reach undesirable highly congested states.

A. Motivation: Departure throughput analysis

The main motivation for our proposed approach to reduce taxi times is an observation of the performance of the departure throughput of airports. As more aircraft pushback from their gates onto the taxiway system, the throughput of the departure runway initially increases because more aircraft are available in the departure queue. However, as this number, denoted N, exceeds a threshold, the departure runway capacity becomes the limiting factor, and there is no additional increase in throughput. We denote this threshold as N^*. This behavior can be further parameterized by the number of arrivals. The dependence of the departure throughput on the number of aircraft taxiing out and the arrival rate is illustrated for one runway configuration in Figure 1 using 2007 data from FAA's Aviation System Performance Metrics (ASPM) database. Beyond the threshold N^*, any additional aircraft that pushback simply increase their taxi-out times [8]. The value of N^* depends on the airport, arrival demand, runway configuration, and meteorological conditions. During periods of high demand, the pushback rate control protocol regulates pushbacks from the gates so that the number of aircraft taxiing out stays close to a specified value, N_{ctrl}, where $N_{\mathrm{ctrl}} > N^*$, thereby ensuring that the airport does not reach highly-congested states. While the choice of N_{ctrl} must be large enough to maintain runway utilization, too large a value will be overly conservative, and result in a loss of benefit from the control strategy.

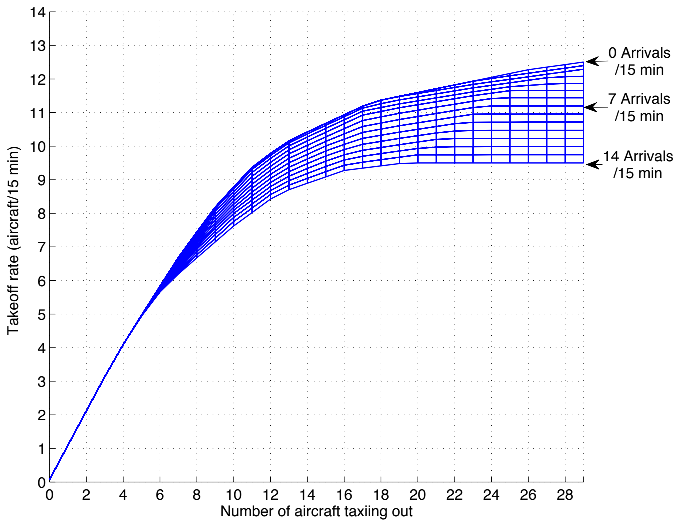

Fig. 1: Regression of the departure throughput as a function of the number of aircraft taxiing out, parameterized by the arrival rate for 22L, 27 | 22L, 22R configuration, under VMC [9].

II. Design of the pushback rate control protocol

The main design consideration in developing the pushback rate control protocol was to incorporate effective control techniques into current operational procedures with minimal additional controller workload and procedural modifications. After discussions with the BOS facility, it was decided that suggesting a rate of pushbacks (to the BOS Gate controller) for each 15-min period was an effective strategy that was amenable to current procedures.

The two important parameters that need to be estimated in order to determine a robust control strategy are the N^* threshold and the departure throughput of the airport for different values of N. These parameters can potentially vary depending on meteorological conditions, runway configuration and arrival demand (as seen in Figure 1), but also on the fleet mix and the data sources we use.

A. Runway configurations

BOS experiences Visual Meteorological Conditions (VMC) most of the time (over 83% of the time in 2007). It has a complicated runway layout consisting of six runways, five of which intersect with at least one other runway, as shown in Figure 2. As a result, there are numerous possible runway configurations: in 2007, 61 different configurations were reported. The most frequently-used configurations under VMC are 22L, 27 | 22L, 22R; 4L, 4R | 4L, 4R, 9; and 27, 32 | 33L, where the notation 'R1, R2 | R3, R4' denotes arrivals on runways R1 and R2, and departures on R3 and R4. The above configurations accounted for about 70% of times under VMC.

We note that, of these frequently used configurations, 27, 32 | 33L involves taxiing out aircraft across active runways. Due to construction on taxiway "November" between runways 15L and 22R throughout the duration of the demo, departures headed to 22R used 15L to cross runway 22R onto taxiway

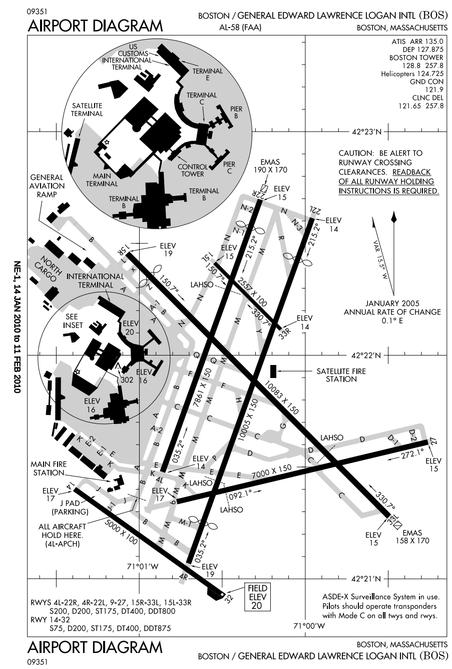

Fig. 2: BOS airport diagram, showing alignment of runways.

"Mike". This resulted in departing aircraft crossing active runways in the 27, 22L | 22L, 22R configuration as well.

During our observations prior to the field tests as well as during the demo periods, we found that under Instrument Meteorological Conditions (IMC), arrivals into BOS are typically metered at the rate of 8 aircraft per 15 minutes by the TRACON. This results in a rather small departure demand, and there was rarely congestion under IMC at Boston during the evening departure push. For this reason, we focus on configurations most frequently used during VMC operations for the control policy design.

B. Fleet mix

Qualitative observations at BOS suggest that the departure throughput is significantly affected by the number of propeller-powered aircraft (props) in the departure fleet mix. In order to determine the effect of props, we analyze the tradeoff between takeoff and landing rates at BOS, parameterized by the number of props during periods of high departure demand.

Figure 3 shows that under Visual Meteorological Conditions (VMC), the number of props has a significant impact on the departure throughput, resulting in an increase at a rate of nearly one per 15 minutes for each additional prop departure. This observation is consistent with procedures at BOS, since air traffic controllers fan out props in between jet departures, and therefore the departure of a prop does not significantly interfere with jet departures. The main implication of this observation for the control strategy design at BOS was that props could be exempt from both the pushback control as well as the counts of aircraft taxiing out (N). Similar analysis also shows that heavy departures at BOS do not have a significant

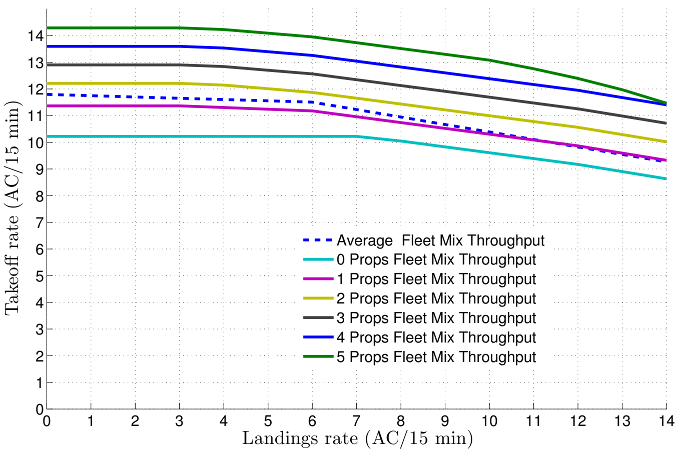

Fig. 3: Regression of the takeoff rate as a function of the landing rate, parameterized by the number of props in a 15-minute interval for 22L, 27 | 22L, 22R configuration, under VMC [9].

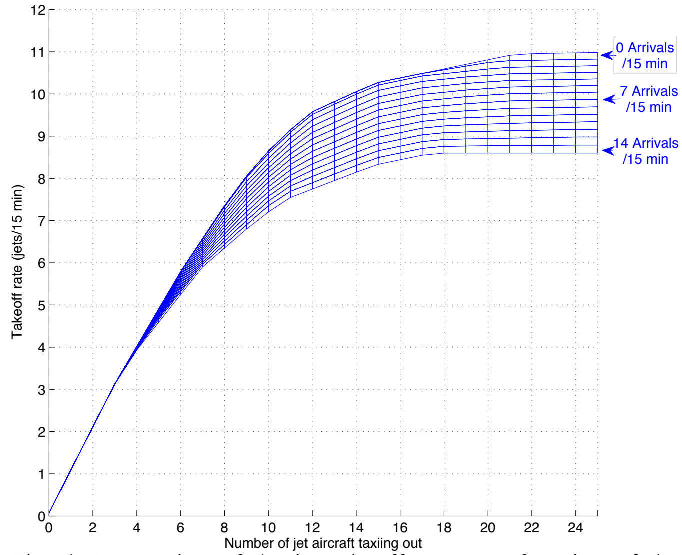

Fig. 4: Regression of the jet takeoff rate as a function of the number of departing jets on the ground, parameterized by the number of arrivals for 22L, 27 | 22L, 22R configuration, under VMC [9].

impact on departure throughput, in spite of the increased wake-vortex separation that is required behind heavy weight category aircraft. This can be explained by the observation that air traffic controllers at BOS use the high wake vortex separation requirement between a heavy and a subsequent departure to conduct runway crossings, thereby mitigating the adverse impact of heavy weight category departures [9].

Motivated by this finding, we can determine the dependence of the jet (i.e., non-prop) departure throughput as a function of the number of jet aircraft taxiing out, parameterized by the number of arrivals, as illustrated in Figure 4. This figure illustrates that during periods in which arrival demand is high, the jet departure throughput saturates when the number of jets taxiing out exceeds 17 (based on ASPM data).

C. Data sources

It is important to note that Figure 1, Figure 3 and Figure 4 are determined using ASPM data. Pushback times in ASPM are determined from the brake release times reported through the ACARS system, and are prone to error because about 40% of the flights departing from BOS do not automatically report these times [10]. Another potential source of pushback and takeoff times is the Airport Surface Detection Equipment Model X (or ASDE-X) system, which combines data from airport surface radars, multilateration sensors, ADS-B, and aircraft transponders [11]. While the ASDE-X data is likely to be more accurate than the ASPM data, it is still noisy, due to factors such as late transponder capture (the ASDE-X tracks only begin after the pilot has turned on the transponder, which may be before or after the actual pushback time), aborted takeoffs (which have multiple departure times detected), flights cancelled after pushback, etc. A comparison of both ASDE-X and ASPM records with live observations made in the tower on August 26, 2010 revealed that the average difference between the number of pushbacks per 15-minutes as recorded by ASDE-X and by visual means is 0.42, while it is -3.25 for ASPM and visual observations, showing that the ASPM records differ considerably from ASDE-X and live observations. The above comparison motivates the recalibration of airport performance curves and parameters using ASDE-X data in addition to ASPM data. This is because ASPM data is not available in real-time and will therefore not be available for use in real-time deployments, and the ASDE-X data is in much closer agreement to the visual observations than ASPM.

We therefore conduct similar analysis to that shown in Figure 4, using ASDE-X data. The results are shown in Figure 5. We note that the qualitative behavior of the system is similar to what was seen with ASPM data, namely, the jet throughput of the departure runway initially increases because more jet aircraft are available in the departure queue, but as this number exceeds a threshold, the departure runway capacity becomes the limiting factor, and there is no additional increase in throughput. By statistically analyzing three months of ASDE-X data from Boston Logan airport using the methodology outlined in [9], we determine that the average number of active jet departures on the ground at which the surface saturates is 12 jet aircraft for the 22L, 27 | 22L, 22R configuration, during periods of moderate arrival demand. This value is close to that deduced from Figure 5, using visual means.

D. Estimates of N^*

Table I shows the values of N^* for the three main runway configurations under VMC, that were used during the field tests based on the ASDE-X data analysis. For each runway configuration, we use plots similar to Figure 5 to determine the expected throughput. For example, if the runway configuration is 22L, 27 | 22L, 22R, 11 jets are taxiing out, and the expected arrival rate is 9 aircraft in the next 15 minutes, the expected departure throughput is 10 aircraft in the next 15 minutes.

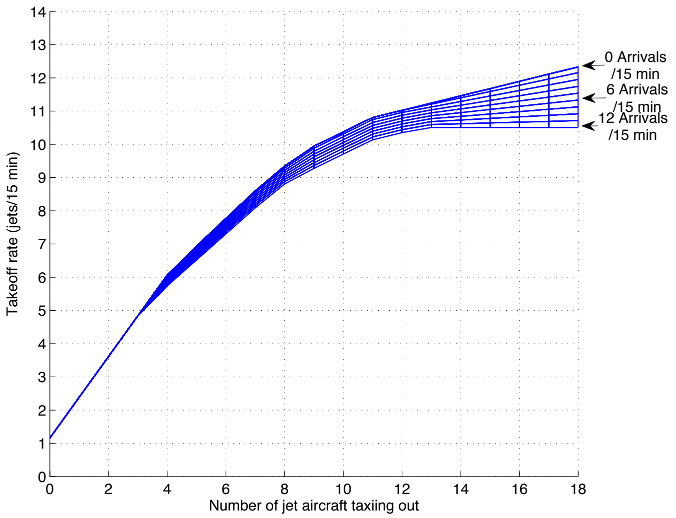

Fig. 5: Regression of the takeoff rate as a function of the number of jets taxiing out, parameterized by the number of arrivals, using ASDE-X data, for the 22L, 27 | 22L, 22R configuration.

III. Implementation of Pushback Rate Control

The pushback rate was determined so as to keep the number of jets taxiing out near a suitable value (N_{ctrl}), where N_{ctrl} is greater than N^*, in order to mitigate risks such as under-utilizing the runway, facing many gate conflicts, or being unable to meet target departure times. Off-nominal events such as gate-use conflicts and target departure times were carefully monitored and addressed. Figure 6 shows a schematic of the decision process to determine the suggested pushback rate.

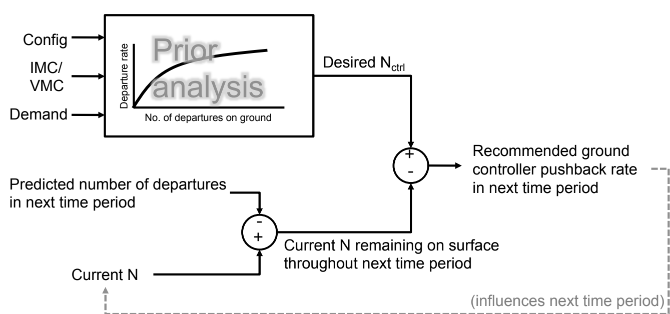

Fig. 6: A schematic of the pushback rate calculation.

The determination of the pushback rate is conducted as follows. Prior to the start of each 15-minute period, we:

1) Observe the operating configuration, VMC/IMC, and the predicted number of arrivals in the next 15 minutes (from ETMS) and using these as inputs into the appropriate departure throughput saturation curves (such as Figure 5), determine the expected jet departure throughput.
2) Using visual observations, count the number of departing jets currently active on the surface. We counted a departure as active once the pushback tug was attached to the aircraft and it was in the process of pushing back.
3) Calculate the difference between the current number of active jet departures and the expected jet departure throughput. This difference is the number of currently active jets that are expected to remain on the ground through the next 15 min.
4) The difference between N_{ctrl} and the result of the previous step provides us with the additional number of pushbacks to recommend in next 15 minutes.
5) Translate the suggested number of pushbacks in the next 15 minutes to an approximate pushback rate in a shorter time interval more appropriate for operational implementation (for example, 10 aircraft in the next 15 minutes would translate to a rate of "2 per 3 minutes.").

TABLE I
Values of N^* estimated from the analysis of ASDE-X data.

Configuration	N^*
22L, 27 | 22L, 22R	12
27, 32 | 33L	12
4L, 4R | 4L, 4R, 9	15

A. Communication of recommended pushback rates and gate-hold times

During the demo, we used color-coded cards to communicate suggested pushback rates to the air traffic controllers, thereby eliminating the need for verbal communications. We used one of eight 5 in × 7.5 in cards, with pushback rate suggestions that ranged from "1 per 3 minutes" (5 in 15 minutes) to "1 aircraft per minute" (15 in 15 minutes), in addition to "Stop" (zero rate) and "No restriction" cards, as shown in Figure 7 (left). The setup of the suggested rate card in the Boston Gate controllers position is shown in Figure 7 (right).

Fig. 7: (Left) Color-coded cards that were used to communicate the suggested pushback rates. (Right) Display of the color-coded card in the Boston Gate controller's position.

The standard format of the gate-hold instruction communicated by the Boston Gate controller to the pilots included both the current time, the length of the gate-hold, and the time at which the pilot could expect to be cleared. For example:
Boston Gate: "AAL123, please hold push for 3 min. Time is now 2332, expect clearance at 2335. Remain on my frequency, I will contact you."

In this manner, pilots were made aware of the expected gate-holds, and could inform the controller of constraints such as gate conflicts due to incoming aircraft. In addition, ground crews could be informed of the expected gate-hold time, so that they could be ready when push clearance was given. The post-analysis of the tapes of controller-pilot communications showed that the controllers cleared aircraft for push at the times they had initially stated (i.e., an aircraft told to expect to push at 2335 would indeed be cleared to push at 2335), and that they also accurately implemented the push rates suggested by the cards.

B. Handling of off-nominal events

The implementation plan also called for careful monitoring of off-nominal events and system constraints. Of particular concern were gate conflicts (for example, an arriving aircraft is assigned a gate at which a departure is being held), and the ability to meet controlled departure times (Expected Departure Clearance Times or EDCTs) and other constraints from Traffic Management Initiatives. After discussions with the Tower and airlines prior to the field tests, the following decisions were made:

1) Flights with EDCTs would be handled as usual and released First-Come-First-Served. Long delays would continue to be absorbed in the standard holding areas. Flights with EDCTs did not count toward the count of active jets when they pushed back; they counted toward the 15-minute interval in which their departure time fell. An analysis of EDCTs from flight strips showed that the ability to meet the EDCTs was not impacted during the field tests.
2) Pushbacks would be expedited to allow arrivals to use the gate if needed. Simulations conducted prior to the field tests predicted that gate-conflicts would be relatively infrequent at BOS; there were only two reported cases of potential gate-conflicts during the field tests, and in both cases, the departures were immediately released from the gate-hold and allowed to pushback.

C. Determination of the time period for the field trials

The pushback rate control protocol was tested in select evening departure push periods (4-8PM) at BOS between August 23 and September 24, 2010. Figure 8 shows the average number of departures on the ground in each 15-minute interval using ASPM data. There are two main departure pushes each day. The evening departure push differs from the morning one because of the larger arrival demand in the evenings. The morning departure push presents different challenges, such as a large number of flights with controlled departure times, and a large number of tow-ins for the first flights of the day.

IV. Results of field tests

Although the pushback rate control strategy was tested at BOS during 16 demo periods, there was very little need to control pushbacks when the airport operated in its most

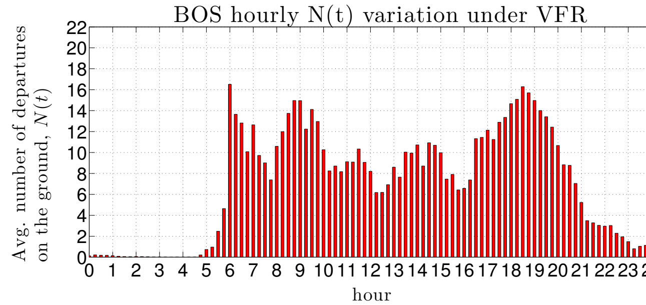

Fig. 8: Variation of departure demand (average number of active departures on the ground) as a function of the time of day.

efficient configuration (4L, 4R | 4L, 4R, 9), and in only eight of the demo periods was there enough congestion for gate-holds to be experienced. There was insufficient congestion for recommending restricted pushback rates on August 23, September 16, 19, 23, and 24. In addition, on September 3 and 12, there were no gate-holds (although departure demand was high, traffic did not build up, and no aircraft needed to be held at the gate). For the same reason, only one aircraft received a gate-hold of 2 min on September 17. The airport operated in the 4L, 4R | 4L, 4R, 9 configuration on all three of these days. In total, pushback rate control was in effect during the field tests for over 37 hours, with about 24 hours of test periods with significant gate-holds.

A. Data analysis examples

In this section, we examine three days with significant gate-holds (August 26, September 2 and 10) in order to describe the basic features of the pushback rate control strategy.

Figure 9 shows taxi-out times from one of the test periods, September 2. Each green bar in Figure 9 represents the actual taxi-out time of a flight (measured using ASDE-X as the duration between the time when the transponder was turned on and the wheels-off time). The red bar represents the gate-hold time of the flight (shown as a negative number). In practice, there is a delay between the time the tug pushes them from the gate and the time their transponder is turned on, but statistical analysis showed that this delay was random, similarly distributed for flights with and without gate-holds, and typically about 4 minutes. We note in Figure 9 that as flights start incurring gate-holds (corresponding to flights departing at around 1900 hours), there is a corresponding decrease in the active taxi-out times, i.e., the green lines. Visually, we notice that as the length of the gate-hold (red bar) increases, the length of the taxi-out time (green bar) proportionately decreases. There are still a few flights with large taxi-out times, but these typically correspond to flights with EDCTs. These delays were handled as in normal operations (i.e., their gate-hold times were not increased), as was agreed with the tower and airlines. Finally, there are also a few flights with no gate-holds and very short taxi-out times, typically corresponding to props.

The impact of the pushback rate control strategy can be further visualized by using ASDE-X data, as can be seen in

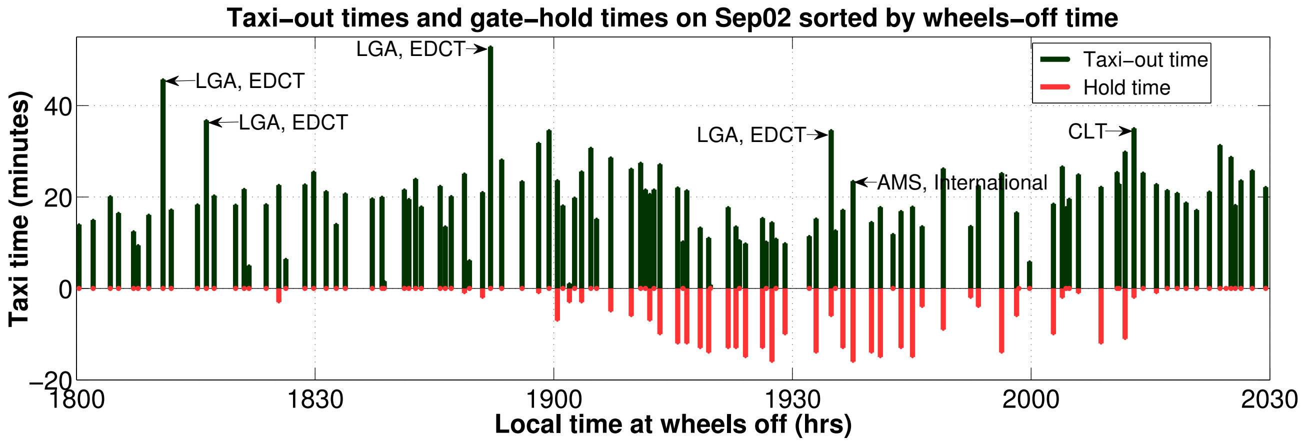

Fig. 9: Taxi-out and gate-hold times from the field test on September 2, 2010.

Fig. 10: Snapshots of the airport surface, (left) before gate-holds started, and (right) during gate-holding. Departing aircraft are shown in green, and arrivals in red. We note that the line of 15 departures between the ramp area and the departure runway prior to commencement of pushback rate control reduces to 8 departures with gate-holds. The white area on the taxiway near the top of the images indicates the closed portion of taxiway "November".

the Figure 10, which shows snapshots of the airport surface at two instants of time, the first before the gate-holds started, and the second during the gate-holds. We notice the significant decrease in taxiway congestion, in particular the long line of aircraft between the ramp area and the departure runway, due to the activation of the pushback rate control strategy.

Looking at another day of trials with a different runway configuration, Figure 11 shows taxi-out times from the test period of September 10. In this plot, the flights are sorted by pushback time. We note that as flights start incurring gate-holds, their taxi time stabilizes at around 20 minutes. This is especially evident during the primary departure push between 1830 and 1930 hours. The gate-hold times fluctuate from 1-2 minutes up to 9 minutes, but the taxi-times stabilize as the number of aircraft on the ground stabilizes to the specified N_{ctrl} value. Finally, the flights that pushback between 1930 and 2000 hours are at the end of the departure push and derive the most benefit from the pushback rate control strategy: they have longer gate holds, waiting for the queue to drain and then taxi to the runway facing a gradually diminishing queue.

Figure 12 further illustrates the benefits of the pushback rate control protocol, by comparing operations from a day with pushback rate control (shown in blue) and a day without it (shown in red), under similar demand and configuration. The upper plot shows the average number of jets taxiing-out, and the lower plot the corresponding average taxi-out time, per 15-minute interval. We note that after 1815 hours on September 10, the number of jets taxiing out stabilized at around 15. As a result, the taxi-out times stabilized at about 16 minutes. Pushback rate control smooths the rate of the pushbacks so as to bring the airport state to the specified state, N_{ctrl}, in a controlled manner. Both features of pushback rate control, namely, smoothing of demand and prevention of congestion can be observed by comparing the evenings of September 10 and September 15. We see that on September 15, in the absence of pushback rate control, as traffic started accumulating at 1745 hours, the average taxi-out time grew to over 20 minutes. During the main departure push (1830 to

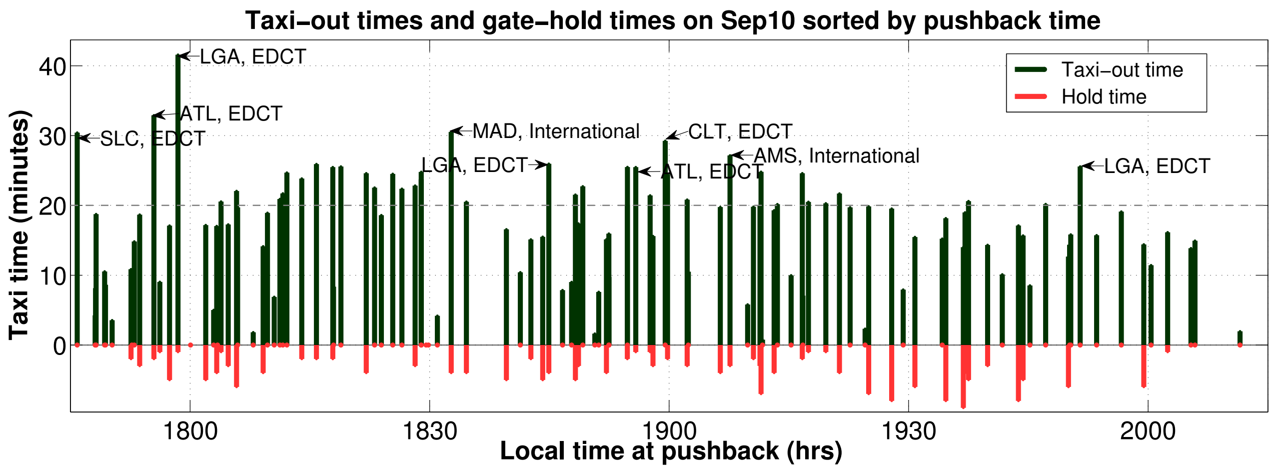

Fig. 11: Taxi-out and gate-hold times from the field test on September 10, 2010.

1930), the average number of jets taxiing out stayed close to 20 and the average taxi-out time was about 25 minutes.

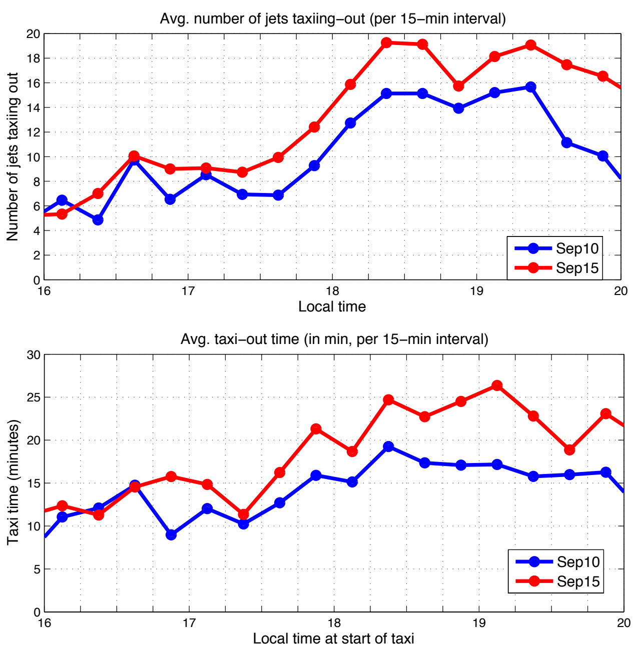

Fig. 12: Surface congestion (top) and average taxi-out times (bottom) per 15-minutes, for (blue) a day with pushback rate control, and (red) a day with similar demand, same runway configuration and visual weather conditions, but without pushback rate control. Delay attributed to EDCTs has been removed from the taxi-out time averages.

Similarly, Figure 13 compares the results of a characteristic pushback rate control day in runway configuration 27, 22L | 22L, 22R, August 26, to a similar day without pushback rate control. We observe that for on August 26, the number of jets taxiing out during the departure push between 1830 and 1930 hours stabilized at 15 with an average taxi-out time of about 20 minutes. On August 17, when pushback rate control was not in effect, the number of aircraft reached 20 at the peak of the push and the average taxi-out times were higher than those of August 26.

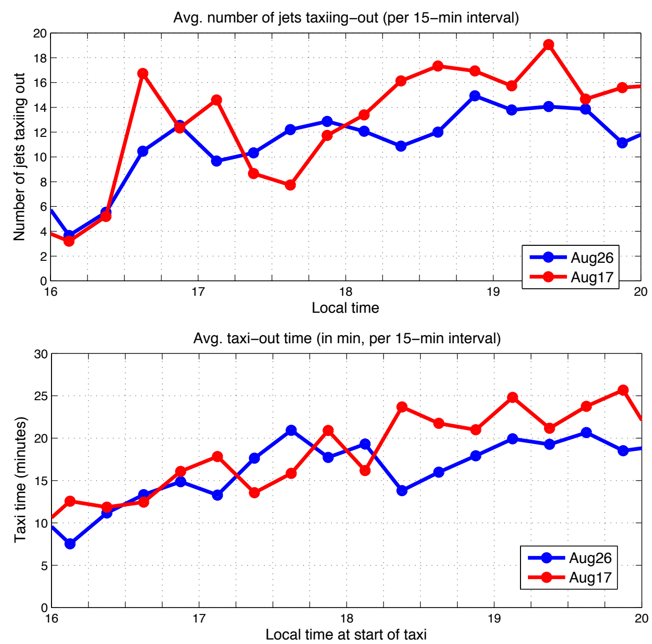

Fig. 13: Ground congestion (top) and average taxi-out times (bottom) per 15-minutes, for (blue) a day with pushback rate control, and (red) a day with similar demand, same runway configuration and weather conditions, but without pushback rate control. Delay attributed to EDCTs has been removed from the taxi-out time averages.

B. Runway utilization

The overall objective of the field test was to maintain pressure on the departure runways, while limiting surface congestion. By maintaining runway utilization, it is reasonable to expect that gate-hold times translate to taxi-out time reduction, as suggested by Figure 9. We therefore also carefully analyze runway utilization (top) and departure queue sizes (bottom) during periods of pushback rate control, as illustrated in Figure 14.

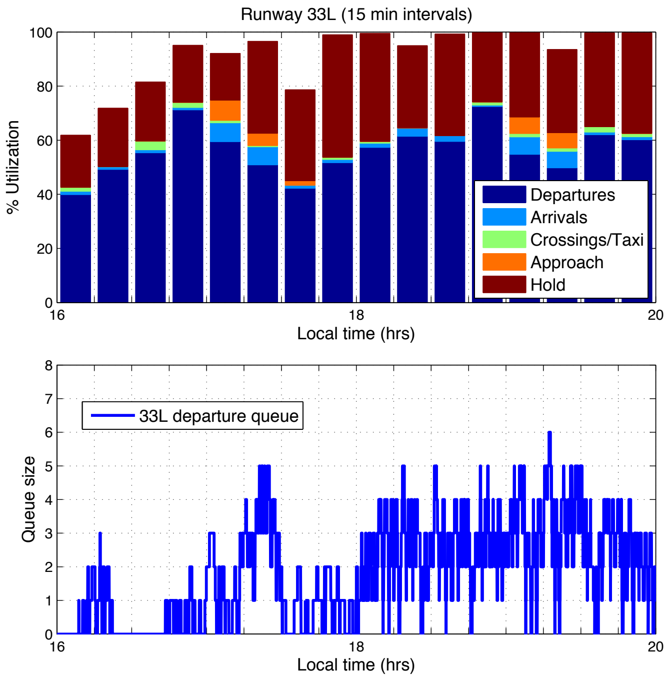

Fig. 14: Runway utilization plots (top) and queue sizes (bottom) for the primary departure runway (33L) during the field test on September 10, 2010. These metrics are evaluated through the analysis of ASDE-X data.

In estimating the runway utilization, we determine (using ASDE-X data) what percentage of each 15-min interval corresponded to a departure on takeoff roll, to aircraft crossing the runway, arrivals (that requested landing on the departure runway) on final approach, departures holding for takeoff clearance, etc. We note that between 1745 and 2000 hours, when gate-holds were experienced, the runway utilization was kept at or close to 100%, with a persistent departure queue as well.

Runway utilization was maintained consistently during the demo periods, with the exception of a three-minute interval on the third day of pushback rate control. On this instance, three flights were expected to be at the departure runway, ready for takeoff. Two of these flights received EDCTs as they taxied (and so were not able to takeoff at the originally predicted time), and the third flight was an international departure that had longer than expected pre-taxi procedures. Learning from this experience, we were diligent in ensuring that EDCTs were gathered as soon as they were available, preferably while the aircraft were still at the gate. In addition, we incorporated the longer taxi-out times of international departures into our predictions. As a result of these measures, we ensured that runway utilization was maintained over the remaining duration of the trial. It is worth noting that the runway was "starved" in this manner for only 3 minutes in over 37 hours of pushback rate control, demonstrating the ability of the approach to adapt to the uncertainties in the system.

V. Benefits analysis

Table II presents a summary of the gate-holds on the eight demo periods with sufficient congestion for controlling pushback rates. As mentioned earlier, we had no significant congestion when the airport was operating in its most efficient configuration (4L, 4R | 4L, 4R, 9).

TABLE II
Summary of gate-hold times for the eight demo periods with significant gate-holds.

	Date	Period	Configuration	No. of gate-holds	Average gate-hold (min)	Total gate-hold (min)
1	8/26	4.45-8PM	27,22L | 22L,22R	63	4.06	256
2	8/29	4.45-8PM	27,32 | 33L	34	3.24	110
3	8/30	5-8PM	27,32 | 33L	8	4.75	38
4	9/02	4.45-8PM	27,22L | 22L,22R	45	8.33	375
5	9/06	5-8PM	27,22L | 22L,22R	19	2.21	42
6	9/07	5-7.45PM	27,22L | 22L,22R	11	2.09	23
7	9/09	5-8PM	27,32 | 33L	11	2.18	24
8	9/10	5-8PM	27,32 | 33L	56	3.7	207
Total				247	4.35	1075

A total of 247 flights were held, with an average gate-hold of 4.3 min. During the most congested periods, up to 44% of flights experienced gate-holds. By maintaining runway utilization, we traded taxi-out time for time spent at the gate with engines off, as illustrated in Figures 9 and 11.

A. Translating gate-hold times to taxi-out time reduction

Intuitively, it is reasonable to use the gate-hold times as a surrogate for the taxi-out time reduction, since runway utilization was maintained during the demonstration of the control strategy. We confirm this hypothesis through a simple "what-if" simulation of operations with and without pushback rate control. The simulation shows that the total taxi-out time savings equaled the total gate-hold time, and that the taxi time saving of each flight was equal, in expectation, to its gate holding time. The total taxi-out time reduction can therefore be approximated by the total gate-hold time, or 1077 minutes (18 hours).

In reality, there are also second-order benefits due to the faster travel times to the runway due to reduced congestion, but these effects are neglected in the preliminary analysis.

B. Fuel burn savings

Supported by the analysis presented in Section V-A, we conduct a preliminary benefits analysis of the field tests by using the gate-hold times as a first-order estimate of taxi-out time savings. This assumption is also supported by the taxi-out time data from the tests, such as the plot shown in Figure 9. Using the tail number of the gate-held flights, we determine the aircraft and engine type and hence its ICAO taxi fuel burn index [12]. The product of the fuel burn rate index, the number of engines, and the gate-hold time gives us an estimate of the fuel burn savings from the pushback rate control strategy. We can also account for the use of Auxiliary Power Units (APUs) at the gate by using the appropriate fuel burn rates

[13]. This analysis (not accounting for benefits from reduced congestion) indicates that the total taxi-time savings were about 17.9 hours, which resulted in fuel savings of 12,000-15,000 kg, or 3,900-4,900 US gallons (depending on whether APUs were on or off at the gate). This translates to average fuel savings per gate-held flight of between 50-60 kg or 16-20 US gallons, which suggests that there are significant benefits to be gained from implementing control strategies during periods of congestion. It is worth noting that the per-flight benefits of the pushback rate control strategy are of the same order-of-magnitude as those of Continuous Descent Approaches in the presence of congestion [14], but do not require the same degree of automation, or modifications to arrival procedures.

C. Fairness of the pushback rate control strategy

Equity is an important factor in evaluating potential congestion management or metering strategies. The pushback rate control approach, as implemented in these field tests, invoked a First-Come-First-Serve policy in clearing flights for pushback. As such, we would expect that there would be no bias toward any airline with regard to gate-holds incurred, and that the number of flights of a particular airline that were held would be commensurate with the contribution of that airline to the total departure traffic during demo periods. We confirm this hypothesis through a comparison of gate-hold share and total departure traffic share for different airlines, as shown in Figure 15. Each data-point in the figure corresponds to one airline, and we note that all the points lie close to the 45-degree line, thereby showing no bias toward any particular airline.

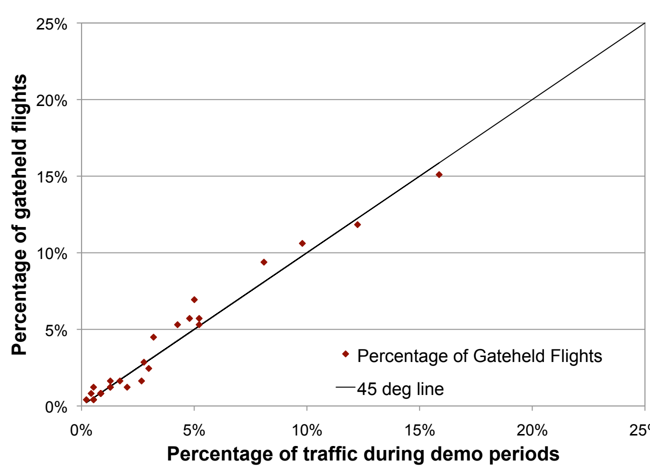

Fig. 15: Comparison of gate-hold share and total departure traffic share for different airlines.

We note, however, that while the number of gate-holds that an airline receives is proportional to the number of its flights, the actual fuel burn benefit also depends on its fleet mix. Figure 16 shows that while the taxi-out time reductions are similar to the gate-holds, some airlines (for example, Airlines 3, 4, 5, 19 and 20) benefit from a greater proportion of fuel savings. These airlines are typically ones with several heavy jet departures during the evening push.

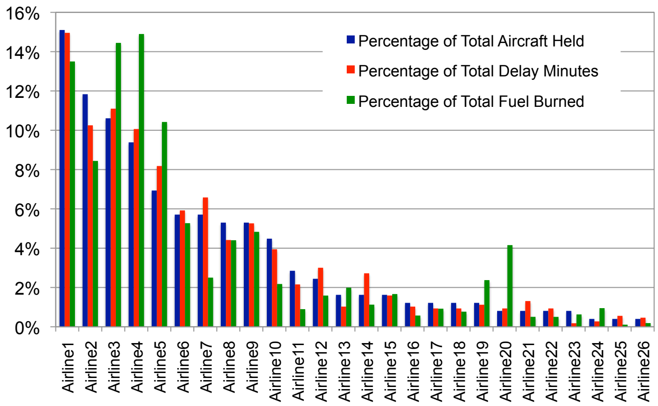

Fig. 16: Percentage of gate-held flights, taxi-out time reduction and fuel burn savings incurred by each airline.

VI. Observations and Lessons Learned

We learned many important lessons from the field tests of the pushback rate control strategy at BOS, and also confirmed several hypotheses through the analysis of surveillance data and qualitative observations. Firstly, as one would expect, the proposed control approach is an aggregate one, and requires a minimum level of traffic to be effective. This hypothesis is further borne by the observation that there was very little control of pushback rates in the most efficient configuration (4L, 4R | 4L, 4R, 9). The field tests also showed that the proposed technique is capable of handling target departure times (e.g., EDCTs), but that it is preferable to get EDCTs while still at gate. While many factors drive airport throughput, the field tests showed that the pushback rate control approach could adapt to variability. In particular, the approach was robust to several perturbations to runway throughput, caused by heavy weight category landings on departure runway, controllers' choice of runway crossing strategies, birds on runway, etc. We also observed that when presented with a suggested pushback rate, controllers had different strategies to implement the suggested rate. For example, for a suggested rate of 2 aircraft per 3 minutes, some controllers would release a flight every 1.5 minutes, while others would release two flights in quick succession every three minutes. We also noted the need to consider factors such as ground crew constraints, gate-use conflicts, and different taxi procedures for international flights. By accounting for these factors, the pushback rate control approach was shown to have significant benefits in terms of taxi-out times and fuel burn.

VII. Summary

This paper presented the results of the demonstration of a pushback rate control strategy at Boston Logan International Airport. Sixteen demonstration periods between August 23 and September 24, 2010 were conducted in the initial field trial phase, resulting in over 37 hours of research time in the BOS tower. Results show that during eight demonstration periods (about 24 hours) of controlling pushback rates, over 1077 minutes (nearly 18 hours) of gate holds were experienced during the demonstration period across 247 flights, at an average of 4.3 minutes of gate hold per flight (which correlated well to the observed decreases in taxi-out time). Preliminary fuel burn savings from gate-holds with engines off were estimated to be between 12,000-15,000 kg (depending on whether APUs were on or off at the gate).

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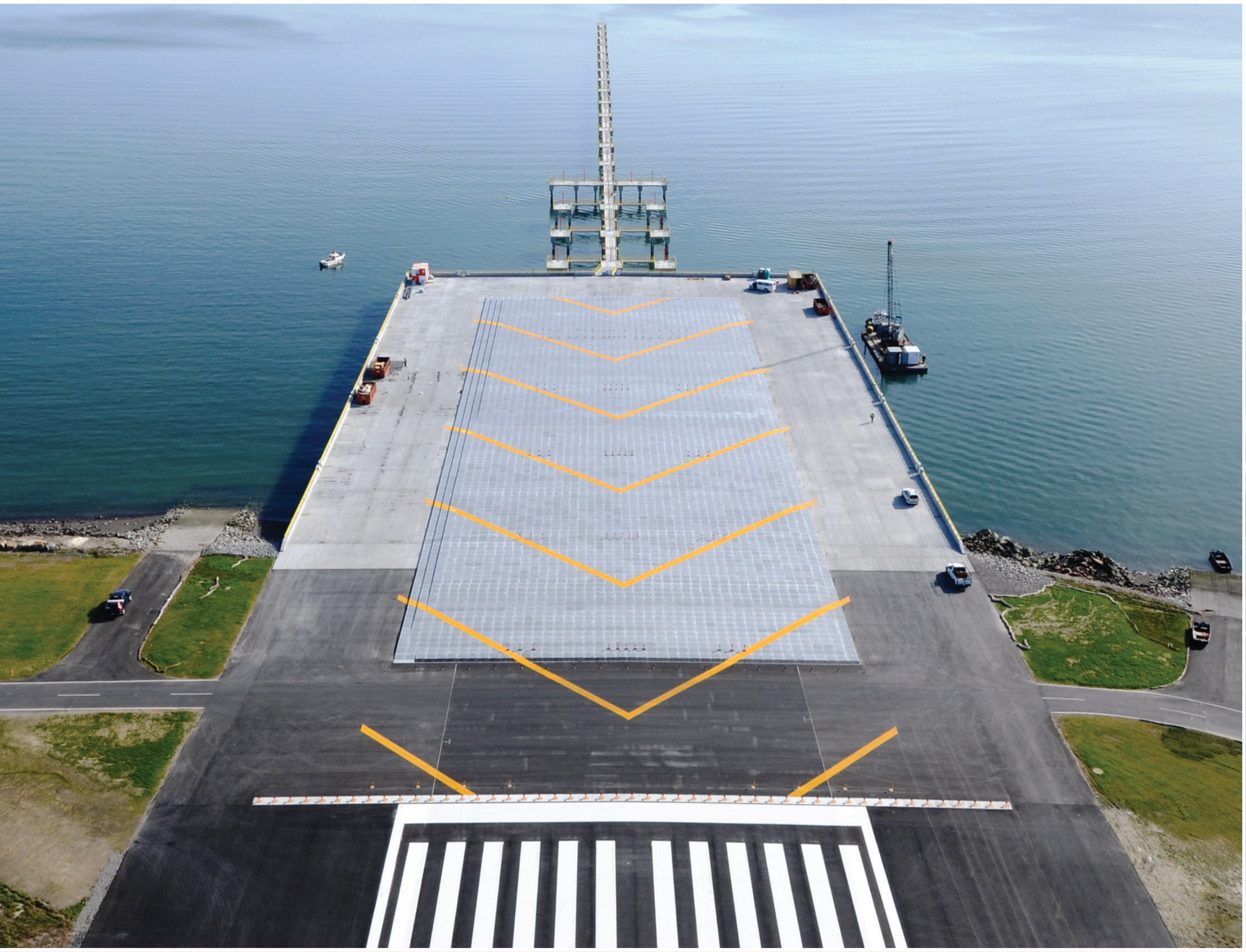

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