

Performance Measure Summary

There are several inventory and performance measures listed in the pages of this Urban Area Report for the years from 1982 to 2005. There is no single performance measure that experts agree “says it all.” The best comparison of congestion levels and trends is done between regions of similar size, over several years, and with a few measures of congestion aspects. Examining a few measures over many years reduces the chance that data variations or the estimating procedures may have caused a “spike” in any single year. A few key points should be recognized by users of the Urban Mobility Report data.

Use the Trends – The multi-year performance measures are better indicators, in most cases, than any single year. *(5 years is 5 times better than 1 year).*

Use several measures – Each performance measure illustrates a different element of congestion. *(The view is more interesting from the top of a few measures).*

Compare to similar regions – Congestion analyses that compare areas with similar characteristics (for example population, growth rate, road and public transportation system design) are usually more insightful than comparisons of different regions. *(Los Angeles is not Peoria).*

Compare ranking changes and performance measure values – In some performance measures a small change in the value may cause a significant change in rank from one year to the next. This is the case when there are several regions with nearly the same value. *(15 hours is only 1 hour more than 14 hours).*

Consider the scope of improvement options – Any improvement project in a corridor within most of the regions will only have a modest effect on the regional congestion level. *(To have an effect on areawide congestion, there must be significant change in the system or service).*

Comparison of Several Key Mobility Performance Measures Large Group – 1 million to 3 million population urban areas

Urban Area	Delay per Traveler	Travel Time Index	Total Delay	1982 to 2005	
				Delay per Traveler	Total Delay
San Diego, CA	H+	H+	H+	F+	F+
Minneapolis-St. Paul, MN	H	0	H+	F+	F+
Baltimore, MD	H	H	H+	F	F+
Tampa-St. Petersburg, FL	H+	H	H+	S	F+
St. Louis, MO-IL	L	L-	0	S	0
Denver-Aurora, CO	H+	H+	H+	F+	F+
Pittsburgh, PA	L-	L-	L-	S-	S-
Riverside-San Bernardino, CA	H+	H+	H+	F+	F+
Cleveland, OH	L-	L-	L-	S-	S-
Sacramento, CA	H	H+	H	0	F+
Portland, OR-WA	0	H	0	0	0
San Jose, CA	H+	H+	H+	F	F+
Cincinnati, OH-KY-IN	L-	L	L	S	S-
Virginia Beach, VA	L	L	L	S-	S-
Kansas City, MO-KS	L-	L-	L-	S-	S-
Milwaukee, WI	L-	L-	L-	S-	S-
Las Vegas, NV	0	H	L	F	0
Orlando, FL	H+	H	H	F+	F+
San Antonio, TX	0	0	L	F	S
Providence, RI-MA	L-	L-	L-	0	S-
Columbus, OH	L	L	L	F	S-
Buffalo, NY	L-	L-	L-	S-	S-
New Orleans, LA	L-	L-	L-	S-	S-
Indianapolis, IN	H	0	L	0	S-
Memphis, TN-MS-AR	L	L-	L-	0	S-

0 – Average congestion levels or average congestion growth

H Higher congestion; H+ Much higher congestion; F Faster congestion growth; F+ Much faster growth

L Lower congestion; L- Much lower congestion; S Slower congestion growth; S- Much slower growth

Performance Measures and Definition of Terms

Travel Time Index – A measure of congestion that focuses on each trip and each mile of travel. The ratio of travel time in the peak period to travel time in free-flow. A value of 1.30 indicates a 20-minute free-flow trip takes 26 minutes in the peak.

Peak Travelers – Number of travelers (using any travel mode) who begin a trip during the morning or evening peak travel periods (6 to 9 a.m. and 4 to 7 p.m.).

Annual Delay per Traveler – A yearly sum of all the per-trip delays. This measure illustrates the effect of the per-mile congestion as well as the length of each trip. The extra time required to travel in the peak period is divided by the number of travelers who begin a trip during the peak period (6 to 9 a.m. and 4 to 7 p.m.).

Total Delay – The overall size of the congestion problem. Measured by the total travel time above that needed to complete a trip at free-flow speeds. The ranking of total delay usually follows the population ranking (larger regions usually have more delay).

Free-Flow Speeds (60 mph on freeways and 35 mph on arterials) – These values are used as the national comparison thresholds. Other speed values may be appropriate for urban areas or sub-regions.

Excess Fuel Consumed – Increased fuel consumption due to travel in congested conditions rather than free-flow conditions.

Public Transportation – Regular route service from all public transportation providers in an urban area.

Operations Treatments – Freeway incident management, freeway ramp metering, arterial street signal coordination and arterial street access management.

Congestion Cost – Value of travel delay for 2005 (estimated at \$14.60 per hour of person travel and \$77.10 per hour of truck time) and excess fuel consumption (estimated using state average cost per gallon).

Annual Increase Needed to Maintain Constant Congestion Level – Number of lane-miles that must be added to the road system each year – or – the number of new transit riders or carpoolers that must be added to keep congestion levels the same as the previous year.

Urban Area – The developed area (population density more than 1,000 persons per square mile) within a metropolitan region. The urban area boundaries change frequently (every year for most growing areas). The annual change in miles traveled, therefore, includes both new travel due to growth and travel that previously occurred in areas designated as rural.

Number of Rush Hours – Time when system might have congestion

Key Mobility Performance Measure Labels

Note: Designation of an urban area congestion problem as “Much higher”, “Much faster growth”, etc. is determined using a general indicator of the accuracy of the congestion estimates. For regions with the same indicator label, there may be no difference in congestion levels. Different values are used for the indicators in regions over 1 million population and below 1 million population.

Measures	Differences Within These Values May Not Indicate a Difference in Congestion Level	
	Above 1M Population	Below 1M Population
2005 Values Delay per Traveler - Travel Time Index - Total Delay -	5 Hours 5 Index Points 5 Hours x Average Population	3 Hours 3 Index Points 3 Hours x Average Population
1982 to 2005 Trends Delay per Traveler - Total Delay -	5 Hours 5 Hours x Average Population	3 Hours 3 Hours x Average Population

The Mobility Data for Buffalo, NY

Inventory Measures	2005	2004	2003	2002	2001	2000
Urban Area Information						
Population (1000s)	1,130	1,130	1,130	1,115	1,115	1,110
Rank	36	36	36	36	36	35
Urban Area (square miles)	580	580	580	580	580	575
Popn Density (persons/sq mile)	1,948	1,948	1,948	1,922	1,922	1,930
Peak Travelers (1000s)	537	534	532	517	508	498
Freeway						
Daily Vehicle-Miles of Travel (1000s)	6,720	6,725	6,720	6,435	6,380	6,365
Lane Miles	640	640	640	635	635	635
Arterial Streets						
Daily Vehicle-Miles of Travel (1000s)	8,050	8,050	7,925	7,850	7,800	7,890
Lane Miles	2,315	2,315	2,310	2,305	2,305	2,300
Public Transportation						
Annual Psgr-Miles of Travel (millions)	77	70	73	75	77	85
Annual Unlinked Psgr Trips (millions)	24	23	24	25	26	29
Cost Components						
Value of Time (\$/hour)	14.60	14.10	13.75	13.45	13.25	12.85
Commercial Cost (\$/hour)	77.10	74.60	72.65	71.05	69.95	68.00
Fuel Cost (\$/gallon)	2.40	2.14	1.62	1.49	1.72	1.64
System Performance						
Congested Travel (% of peak VMT)	22	22	22	20	20	20
Congested System (% of lane-miles)	24	26	26	22	22	22
Congested Time (number of "Rush Hours")	3.0	3.0	3.0	2.9	2.9	2.9
Annual Increase Needed To Maintain Constant Congestion Level:						
Lane-Miles	21	25	36	47	69	84
Transit Riders or Carpoolers (millions)	4	4	6	8	12	14
Annual Excess Fuel Consumed						
Total Fuel (1000 gallons)	3,685	3,689	3,881	3,287	3,173	3,132
Rank	66	65	65	66	66	66
Fuel per Peak Traveler (gallons)	7	7	7	6	6	6
Rank	76	76	74	76	76	78
Annual Delay						
Total Delay (1000s of person-hours)	5,852	5,860	6,278	5,269	5,069	5,009
Rank	65	64	64	66	66	66
Delay per Peak Traveler (person-hrs)	11	11	12	10	10	10
Rank	77	76	75	79	78	78
Delay due to Incidents (percent)	57	57	59	58	58	58
Travel Time Index						
Rank	73	71	72	74	74	73
Congestion Cost						
Total Cost (\$ millions)	112	108	111	91	87	83
Rank	65	64	63	66	66	66
Cost per Peak Traveler (\$)	208	201	209	176	171	166
Rank	77	76	73	78	77	78

Note: System Performance statistics for 2000 through 2005 data reflect the effects of operational treatments.

Note: Zeroes in the table reflect values less than 0.5.

The Mobility Data for Buffalo, NY, Continued

Inventory Measures	1999	1998	1997	1996	1995	1994
Urban Area Information						
Population (1000s)	1,100	1,090	1,080	1,075	1,070	1,070
Rank	35	35	35	34	34	34
Urban Area (square miles)	575	575	570	570	570	565
Popn Density (persons/sq mile)	1,913	1,896	1,895	1,886	1,877	1,894
Peak Travelers (1000s)	486	474	462	453	443	435
Freeway						
Daily Vehicle-Miles of Travel (1000s)	6,050	5,850	5,700	5,530	5,565	5,645
Lane Miles	635	635	635	635	635	630
Arterial Streets						
Daily Vehicle-Miles of Travel (1000s)	8,115	7,950	7,500	7,100	6,800	6,500
Lane Miles	2,300	2,300	2,275	2,260	2,230	2,210
Public Transportation						
Annual Psgr-Miles of Travel (millions)	81	81	78	82	91	89
Annual Unlinked Psgr Trips (millions)	27	27	26	28	29	31
Cost Components						
Value of Time (\$/hour)	12.40	12.15	12.00	11.70	11.40	11.05
Commercial Cost (\$/hour)	65.80	64.35	63.40	61.95	60.20	58.50
Fuel Cost (\$/gallon)	1.19	1.15	1.31	1.37	1.27	1.15
System Performance						
Congested Travel (% of peak VMT)	17	16	14	14	14	14
Congested System (% of lane-miles)	21	20	15	15	15	15
Congested Time (number of "Rush Hours")	2.8	2.8	2.7	2.6	2.6	2.6
Annual Increase Needed To Maintain Constant Congestion Level:						
Lane-Miles	92	94	87	76	82	78
Transit Riders or Carpoolers (millions)	15	15	14	11	12	12
Annual Excess Fuel Consumed						
Total Fuel (1000 gallons)	2,776	2,376	2,036	1,838	1,759	1,706
Rank	66	68	67	67	67	66
Fuel per Peak Traveler (gallons)	6	5	4	4	4	4
Rank	79	80	83	83	81	80
Annual Delay						
Total Delay (1000s of person-hours)	4,449	3,871	3,325	2,988	2,867	2,744
Rank	66	65	67	67	68	68
Delay per Peak Traveler (person-hrs)	9	8	7	7	6	6
Rank	80	81	83	83	83	82
Delay due to Incidents (percent)	57	57	56	56	56	56
Travel Time Index						
Rank	78	79	81	80	78	78
Congestion Cost						
Total Cost (\$ millions)	70	59	51	44	41	38
Rank	66	64	67	66	66	66
Cost per Peak Traveler (\$)	144	125	109	98	93	88
Rank	79	81	82	83	82	80

Note: System Performance statistics for 2000 through 2005 data reflect the effects of operational treatments.

Note: Zeroes in the table reflect values less than 0.5.

The Mobility Data for Buffalo, NY, Continued

Inventory Measures	1993	1992	1991	1990	1989	1988
Urban Area Information						
Population (1000s)	1,070	1,070	1,065	1,065	1,060	1,055
Rank	34	34	33	33	33	31
Urban Area (square miles)	560	550	530	510	480	455
Popn Density (persons/sq mile)	1,911	1,945	2,009	2,088	2,208	2,319
Peak Travelers (1000s)	429	423	413	407	402	396
Freeway						
Daily Vehicle-Miles of Travel (1000s)	5,580	5,365	5,265	4,950	5,000	4,890
Lane Miles	650	645	655	640	635	630
Arterial Streets						
Daily Vehicle-Miles of Travel (1000s)	6,200	6,025	5,840	5,790	5,600	5,500
Lane Miles	2,170	2,120	2,080	2,060	2,055	2,055
Public Transportation						
Annual Psgr-Miles of Travel (millions)	88	94	89	89	85	99
Annual Unlinked Psgr Trips (millions)	31	32	32	30	30	32
Cost Components						
Value of Time (\$/hour)	10.75	10.50	10.25	10.00	9.25	8.80
Commercial Cost (\$/hour)	57.05	55.40	53.80	51.60	48.95	46.70
Fuel Cost (\$/gallon)	1.21	1.24	1.21	1.07	1.13	1.04
System Performance						
Congested Travel (% of peak VMT)	13	13	13	12	11	10
Congested System (% of lane-miles)	15	15	15	15	14	14
Congested Time (number of "Rush Hours")	2.6	2.5	2.5	2.4	2.4	2.4
Annual Increase Needed To Maintain Constant Congestion Level:						
Lane-Miles	72	74	79	80	96	108
Transit Riders or Carpoolers (millions)	10	11	11	11	13	15
Annual Excess Fuel Consumed						
Total Fuel (1000 gallons)	1,573	1,462	1,385	1,448	1,255	1,110
Rank	66	66	63	63	64	64
Fuel per Peak Traveler (gallons)	4	3	3	4	3	3
Rank	82	80	80	80	80	79
Annual Delay						
Total Delay (1000s of person-hours)	2,539	2,368	2,222	2,412	2,060	1,811
Rank	65	66	64	63	64	64
Delay per Peak Traveler (person-hrs)	6	6	5	6	5	5
Rank	83	81	81	79	80	80
Delay due to Incidents (percent)	56	56	56	57	55	56
Travel Time Index						
Rank	79	77	77	72	75	74
Congestion Cost						
Total Cost (\$ millions)	35	32	29	31	24	20
Rank	65	64	64	63	64	64
Cost per Peak Traveler (\$)	81	75	70	75	60	51
Rank	80	81	80	76	78	79

Note: System Performance statistics for 2000 through 2005 data reflect the effects of operational treatments.

Note: Zeroes in the table reflect values less than 0.5.

The Mobility Data for Buffalo, NY, Continued

Inventory Measures	1987	1986	1985	1984	1983	1982
Urban Area Information						
Population (1000s)	1,045	1,040	1,030	1,030	1,050	1,075
Rank	31	30	30	30	30	29
Urban Area (square miles)	435	415	405	395	385	375
Popn Density (persons/sq mile)	2,402	2,506	2,543	2,608	2,727	2,867
Peak Travelers (1000s)	389	383	376	373	377	382
Freeway						
Daily Vehicle-Miles of Travel (1000s)	4,680	4,475	4,280	4,000	3,775	3,980
Lane Miles	620	615	605	590	575	575
Arterial Streets						
Daily Vehicle-Miles of Travel (1000s)	5,300	5,150	5,000	4,900	4,750	4,630
Lane Miles	2,050	2,050	2,045	2,040	2,040	2,040
Public Transportation						
Annual Psgr-Miles of Travel (millions)	99	108	106	105	105	105
Annual Unlinked Psgr Trips (millions)	32	35	36	35	35	35
Cost Components						
Value of Time (\$/hour)	8.50	8.20	8.00	7.75	7.45	7.20
Commercial Cost (\$/hour)	44.85	43.30	42.50	41.05	39.35	38.10
Fuel Cost (\$/gallon)	1.05	1.02	1.34	1.35	1.38	1.44
System Performance						
Congested Travel (% of peak VMT)	9	8	9	8	7	8
Congested System (% of lane-miles)	14	14	14	14	13	13
Congested Time (number of "Rush Hours")	2.3	2.3	2.2	2.2	2.1	2.2
Annual Increase Needed To Maintain Constant Congestion Level:						
Lane-Miles	80	--	--	--	--	--
Transit Riders or Carpoolers (millions)	10	--	--	--	--	--
Annual Excess Fuel Consumed						
Total Fuel (1000 gallons)	979	797	908	827	719	751
Rank	64	65	63	63	62	60
Fuel per Peak Traveler (gallons)	3	2	2	2	2	2
Rank	76	79	75	73	75	73
Annual Delay						
Total Delay (1000s of person-hours)	1,635	1,304	1,547	1,394	1,251	1,319
Rank	63	65	62	62	62	60
Delay per Peak Traveler (person-hrs)	4	3	4	4	3	3
Rank	76	79	74	73	75	72
Delay due to Incidents (percent)	55	56	56	56	55	55
Travel Time Index						
Rank	75	78	68	70	70	68
Congestion Cost						
Total Cost (\$ millions)	17	14	16	14	12	12
Rank	63	65	62	62	61	59
Cost per Peak Traveler (\$)	45	35	43	38	32	32
Rank	76	79	74	73	75	72

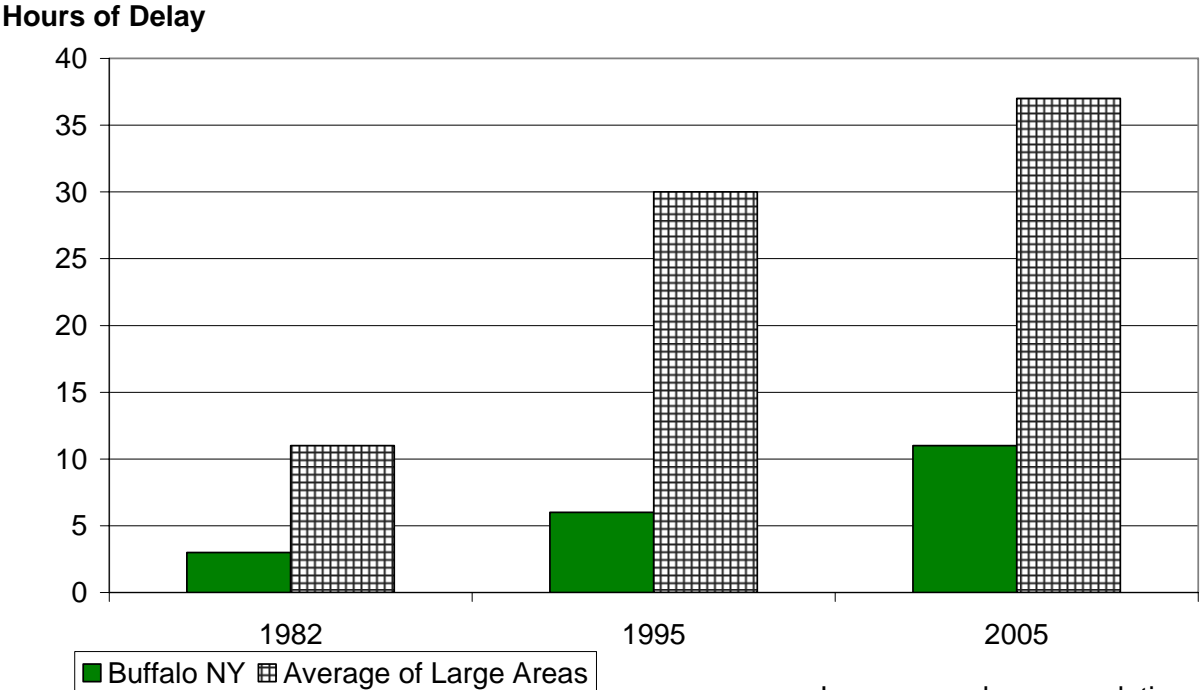
Note: System Performance statistics for 2000 through 2005 data reflect the effects of operational treatments.

Note: Zeroes in the table reflect values less than 0.5.

Benefits From Public Transportation Service and Operations Strategies for Buffalo, NY

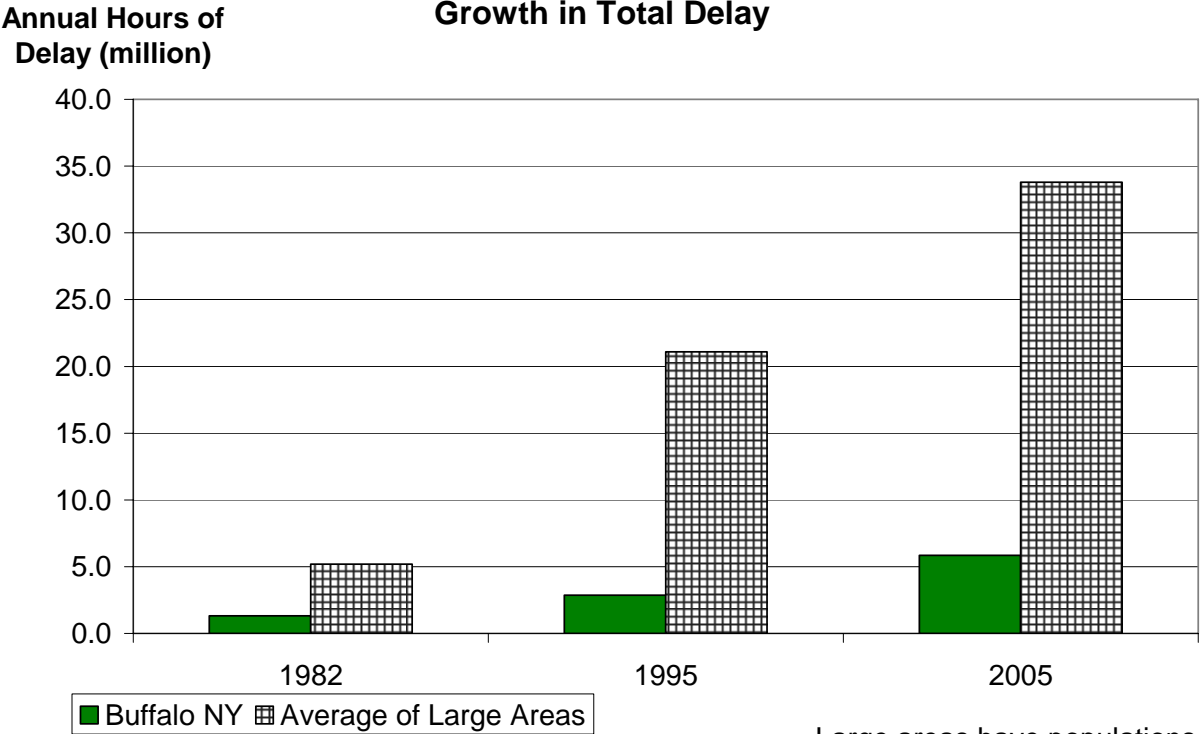
Operations Strategies	2005	2004	2003	2002	2001	2000
Freeway Ramp Metering						
Percent of Roadway Miles	--	--	--	--	--	--
Annual Delay Reduction (1000 hours)	--	--	--	--	--	--
Freeway Incident Management						
Cameras						
Percent of Roadway Miles	90	90	10	10	10	10
Service Patrols						
Percent of Roadway Miles	16	16	16	16	35	54
Annual Delay Reduction (1000 hours)	71	71	65	47	84	117
Arterial Signal Coordination						
Percent of Roadway Miles	51	51	51	51	51	51
Annual Delay Reduction (1000 hours)	26	26	24	22	29	28
Arterial Access Management						
Percent of Roadway Miles	9	9	8	7	7	7
Annual Delay Reduction (1000 hours)	85	85	65	82	66	52
HOV Lanes						
Daily Passenger-miles of Travel (1000s)	--	--	--	--	--	--
HOV User Delay Savings	--	--	--	--	--	--
Total Effect of Operations Treatments						
Annual Delay Reduction (1000 hours)	181	182	154	151	178	197
Annual Delay Saved per Peak Traveler (hours)	0	0	0	0	0	0
Annual Congestion Cost Savings (\$million)	3.5	3.4	2.7	2.6	3.1	3.3
Travel Time Index with Strategies	1.075	1.075	1.080	1.069	1.067	1.066
Travel Time Index (Base)	1.077	1.077	1.082	1.071	1.069	1.068
Public Transportation Service						
Existing Service						
Annual Passenger-miles of Travel (million)	77	70	73	75	77	85
Unlinked Passenger Trips (million)	24	23	24	25	26	29
Travel Time Index (combined road and transit)	1.074	1.074	1.079	1.068	1.066	1.064
Condition if Public Transportation Service were Discontinued						
Travel Time Index	1.080	1.079	1.084	1.073	1.072	1.071
Annual Delay Increase (1000 hours)	382	273	364	309	351	348
Annual Delay Increase per Peak Traveler (hours)	1	1	1	1	1	1
Annual Congestion Cost Increase (\$million)	7.4	5.1	6.6	5.4	6.1	5.9

Growth in Delay per Peak Traveler



Large areas have populations between 1 and 3 million

Growth in Total Delay



Large areas have populations between 1 and 3 million