

## 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 Very Large Group – over 3 million population urban areas

Urban Area	Delay per Traveler	Travel Time Index	Total Delay	1982 to 2005	
				Delay per Traveler	Total Delay
New York-Newark, NY-NJ-CT	L	0	H+	0	F+
Los Angeles-Long Beach-Santa Ana, CA	H+	H+	H+	S	F+
Chicago, IL-IN	L	H+	H	0	F+
Miami, FL	L	0	L	0	0
Philadelphia, PA-NJ-DE-MD	L-	L-	L-	S-	S-
Dallas-Fort Worth-Arlington, TX	H	L	L	F+	F
Washington, DC-VA-MD	H	0	L	F+	S-
Atlanta, GA	H	L	L	0	S-
San Francisco-Oakland, CA	H	H	L	F	S-
Boston, MA-NH-RI	L	L-	L-	0	S-
Detroit, MI	0	L-	L-	S	S-
Houston, TX	H	0	L-	S	S-
<b>Phoenix, AZ</b>	<b>L</b>	<b>L</b>	<b>L-</b>	<b>S-</b>	<b>S-</b>
Seattle, WA	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
<b>2005 Values</b> 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
<b>1982 to 2005 Trends</b> Delay per Traveler - Total Delay -	5 Hours 5 Hours x Average Population	3 Hours 3 Hours x Average Population

### The Mobility Data for Phoenix, AZ

<b>Inventory Measures</b>	<b>2005</b>	<b>2004</b>	<b>2003</b>	<b>2002</b>	<b>2001</b>	<b>2000</b>
<b>Urban Area Information</b>						
Population (1000s)	3,270	3,130	3,005	2,950	2,900	2,825
Rank	13	13	13	13	13	13
Urban Area (square miles)	1,155	1,150	1,140	1,140	1,130	1,120
Popn Density (persons/sq mile)	2,831	2,722	2,636	2,588	2,566	2,522
Peak Travelers (1000s)	1,720	1,634	1,557	1,502	1,453	1,393
<b>Freeway</b>						
Daily Vehicle-Miles of Travel (1000s)	28,370	26,670	25,000	22,550	21,600	19,425
Lane Miles	1,405	1,350	1,325	1,230	1,140	1,030
<b>Arterial Streets</b>						
Daily Vehicle-Miles of Travel (1000s)	34,105	32,110	31,035	30,515	29,725	29,100
Lane Miles	6,535	6,230	6,000	5,800	5,620	5,455
<b>Public Transportation</b>						
Annual Psgr-Miles of Travel (millions)	260	224	216	182	176	169
Annual Unlinked Psgr Trips (millions)	60	55	54	44	41	40
<b>Cost Components</b>						
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)	2.42	2.04	1.59	1.47	1.62	1.52
<b>System Performance</b>						
<b>Congested Travel</b> (% of peak VMT)	72	67	63	63	65	64
<b>Congested System</b> (% of lane-miles)	54	49	49	44	45	41
<b>Congested Time</b> (number of "Rush Hours")	7.8	7.8	7.6	7.6	7.6	7.6
<b>Annual Increase Needed To Maintain Constant Congestion Level:</b>						
Lane-Miles	412	395	397	356	326	297
Transit Riders or Carpoolers (millions)	112	106	106	94	86	77
<b>Annual Excess Fuel Consumed</b>						
Total Fuel (1000 gallons)	58,922	48,534	44,608	41,480	44,008	39,321
Rank	14	15	15	15	15	15
Fuel per Peak Traveler (gallons)	34	30	29	28	30	28
Rank	13	18	18	20	16	16
<b>Annual Delay</b>						
Total Delay (1000s of person-hours)	81,727	68,260	63,754	60,212	62,148	55,077
Rank	14	15	15	15	14	15
Delay per Peak Traveler (person-hrs)	48	42	41	40	43	40
Rank	15	23	19	19	15	19
Delay due to Incidents (percent)	50	50	50	50	50	50
<b>Travel Time Index</b>						
Rank	1.31	1.27	1.26	1.25	1.28	1.26
Rank	15	23	23	23	12	15
<b>Congestion Cost</b>						
Total Cost (\$ millions)	1,687	1,342	1,204	1,115	1,143	983
Rank	14	14	14	14	14	15
Cost per Peak Traveler (\$)	981	821	774	743	787	706
Rank	10	16	14	13	10	12

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 Phoenix, AZ, Continued**

<b>Inventory Measures</b>	<b>1999</b>	<b>1998</b>	<b>1997</b>	<b>1996</b>	<b>1995</b>	<b>1994</b>
<b>Urban Area Information</b>						
Population (1000s)	2,700	2,550	2,450	2,340	2,220	2,130
Rank	13	15	15	15	15	16
Urban Area (square miles)	1,110	1,100	1,090	1,080	1,075	1,070
Popn Density (persons/sq mile)	2,432	2,318	2,248	2,167	2,065	1,991
Peak Travelers (1000s)	1,310	1,216	1,149	1,081	1,008	952
<b>Freeway</b>						
Daily Vehicle-Miles of Travel (1000s)	16,995	15,005	13,925	13,345	12,000	10,600
Lane Miles	960	900	870	825	790	740
<b>Arterial Streets</b>						
Daily Vehicle-Miles of Travel (1000s)	28,600	28,025	27,500	27,220	26,800	26,400
Lane Miles	5,315	5,300	5,260	5,185	5,100	5,040
<b>Public Transportation</b>						
Annual Psgr-Miles of Travel (millions)	169	161	155	145	157	146
Annual Unlinked Psgr Trips (millions)	41	37	36	34	38	35
<b>Cost Components</b>						
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)	1.38	1.19	1.32	1.26	1.20	1.19
<b>System Performance</b>						
<b>Congested Travel</b> (% of peak VMT)	60	57	53	53	50	48
<b>Congested System</b> (% of lane-miles)	40	39	39	34	34	34
<b>Congested Time</b> (number of "Rush Hours")	7.4	7.2	7.2	7.2	6.8	6.4
<b>Annual Increase Needed To Maintain Constant Congestion Level:</b>						
Lane-Miles	268	221	198	207	197	208
Transit Riders or Carpoolers (millions)	68	53	46	49	45	46
<b>Annual Excess Fuel Consumed</b>						
Total Fuel (1000 gallons)	36,476	30,671	28,303	26,261	21,757	22,283
Rank	16	16	16	15	19	16
Fuel per Peak Traveler (gallons)	28	25	25	24	22	23
Rank	17	20	19	21	28	13
<b>Annual Delay</b>						
Total Delay (1000s of person-hours)	53,403	45,878	42,367	39,707	33,292	34,403
Rank	16	16	16	15	20	15
Delay per Peak Traveler (person-hrs)	41	38	37	37	33	36
Rank	17	19	21	17	23	12
Delay due to Incidents (percent)	50	51	51	51	52	52
<b>Travel Time Index</b>						
Rank	1.26	1.23	1.22	1.20	1.17	1.19
Rank	18	22	21	21	30	21
<b>Congestion Cost</b>						
Total Cost (\$ millions)	917	770	705	645	528	527
Rank	15	15	15	15	15	15
Cost per Peak Traveler (\$)	700	633	613	596	524	553
Rank	12	13	11	10	13	10

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**The Mobility Data for Phoenix, AZ, Continued**

<b>Inventory Measures</b>	<b>1993</b>	<b>1992</b>	<b>1991</b>	<b>1990</b>	<b>1989</b>	<b>1988</b>
<b>Urban Area Information</b>						
Population (1000s)	2,070	2,022	1,930	1,895	1,875	1,830
Rank	17	17	18	18	18	18
Urban Area (square miles)	1,060	1,050	985	975	970	970
Popn Density (persons/sq mile)	1,953	1,926	1,959	1,944	1,933	1,887
Peak Travelers (1000s)	911	876	822	794	780	756
<b>Freeway</b>						
Daily Vehicle-Miles of Travel (1000s)	9,910	9,800	9,015	7,850	6,705	5,065
Lane Miles	680	675	660	580	500	400
<b>Arterial Streets</b>						
Daily Vehicle-Miles of Travel (1000s)	26,215	25,545	25,220	25,055	24,310	24,000
Lane Miles	5,020	4,970	4,915	4,820	4,710	4,575
<b>Public Transportation</b>						
Annual Psgr-Miles of Travel (millions)	143	152	156	138	107	84
Annual Unlinked Psgr Trips (millions)	35	34	31	32	27	22
<b>Cost Components</b>						
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)	1.18	1.22	1.06	1.07	1.11	1.02
<b>System Performance</b>						
<b>Congested Travel</b> (% of peak VMT)	48	46	44	46	46	44
<b>Congested System</b> (% of lane-miles)	34	33	33	37	36	36
<b>Congested Time</b> (number of "Rush Hours")	6.6	6.4	6.2	6.2	6.0	6.0
<b>Annual Increase Needed To Maintain Constant Congestion Level:</b>						
Lane-Miles	253	275	289	271	225	185
Transit Riders or Carpoolers (millions)	56	60	62	57	46	38
<b>Annual Excess Fuel Consumed</b>						
Total Fuel (1000 gallons)	21,354	21,165	18,689	17,977	17,982	15,942
Rank	16	16	16	17	16	16
Fuel per Peak Traveler (gallons)	23	24	23	23	23	21
Rank	13	11	13	12	12	12
<b>Annual Delay</b>						
Total Delay (1000s of person-hours)	33,083	32,704	29,316	28,671	29,369	27,074
Rank	15	16	18	17	16	16
Delay per Peak Traveler (person-hrs)	36	37	36	36	38	36
Rank	12	11	12	11	10	9
Delay due to Incidents (percent)	52	52	52	53	53	53
<b>Travel Time Index</b>						
Rank	1.19	1.19	1.17	1.17	1.18	1.17
Rank	20	18	21	19	16	15
<b>Congestion Cost</b>						
Total Cost (\$ millions)	493	476	414	396	380	333
Rank	15	15	16	16	15	15
Cost per Peak Traveler (\$)	542	544	504	499	487	441
Rank	10	9	9	8	8	6

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 Phoenix, AZ, Continued**

<b>Inventory Measures</b>	<b>1987</b>	<b>1986</b>	<b>1985</b>	<b>1984</b>	<b>1983</b>	<b>1982</b>
<b>Urban Area Information</b>						
Population (1000s)	1,820	1,735	1,650	1,590	1,520	1,430
Rank	17	19	19	20	20	20
Urban Area (square miles)	890	855	825	730	630	550
Popn Density (persons/sq mile)	2,045	2,029	2,000	2,178	2,413	2,600
Peak Travelers (1000s)	744	704	665	636	603	562
<b>Freeway</b>						
Daily Vehicle-Miles of Travel (1000s)	4,440	4,050	3,715	3,625	3,035	2,975
Lane Miles	340	300	275	260	220	210
<b>Arterial Streets</b>						
Daily Vehicle-Miles of Travel (1000s)	23,435	22,525	22,040	21,500	21,185	21,070
Lane Miles	4,440	4,310	4,205	4,185	4,100	4,040
<b>Public Transportation</b>						
Annual Psgr-Miles of Travel (millions)	74	67	88	78	78	78
Annual Unlinked Psgr Trips (millions)	19	19	20	19	19	19
<b>Cost Components</b>						
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)	1.03	1.00	1.31	1.33	1.36	1.42
<b>System Performance</b>						
<b>Congested Travel</b> (% of peak VMT)	43	43	43	43	43	43
<b>Congested System</b> (% of lane-miles)	32	32	32	32	31	31
<b>Congested Time</b> (number of "Rush Hours")	6.2	6.2	6.4	6.2	6.2	6.4
<b>Annual Increase Needed To Maintain Constant Congestion Level:</b>						
Lane-Miles	143	--	--	--	--	--
Transit Riders or Carpoolers (millions)	29	--	--	--	--	--
<b>Annual Excess Fuel Consumed</b>						
Total Fuel (1000 gallons)	14,505	14,316	13,205	12,394	11,409	11,702
Rank	16	15	14	12	12	10
Fuel per Peak Traveler (gallons)	19	20	20	19	19	21
Rank	9	8	6	6	5	2
<b>Annual Delay</b>						
Total Delay (1000s of person-hours)	23,692	23,391	21,655	20,293	19,180	19,774
Rank	15	14	13	12	10	10
Delay per Peak Traveler (person-hrs)	32	33	33	32	32	35
Rank	9	7	6	5	3	2
Delay due to Incidents (percent)	53	53	53	53	53	53
<b>Travel Time Index</b>						
Rank	12	8	8	7	6	4
<b>Congestion Cost</b>						
Total Cost (\$ millions)	281	268	248	225	205	206
Rank	15	12	12	9	10	8
Cost per Peak Traveler (\$)	378	381	373	354	340	366
Rank	6	5	6	3	3	2

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

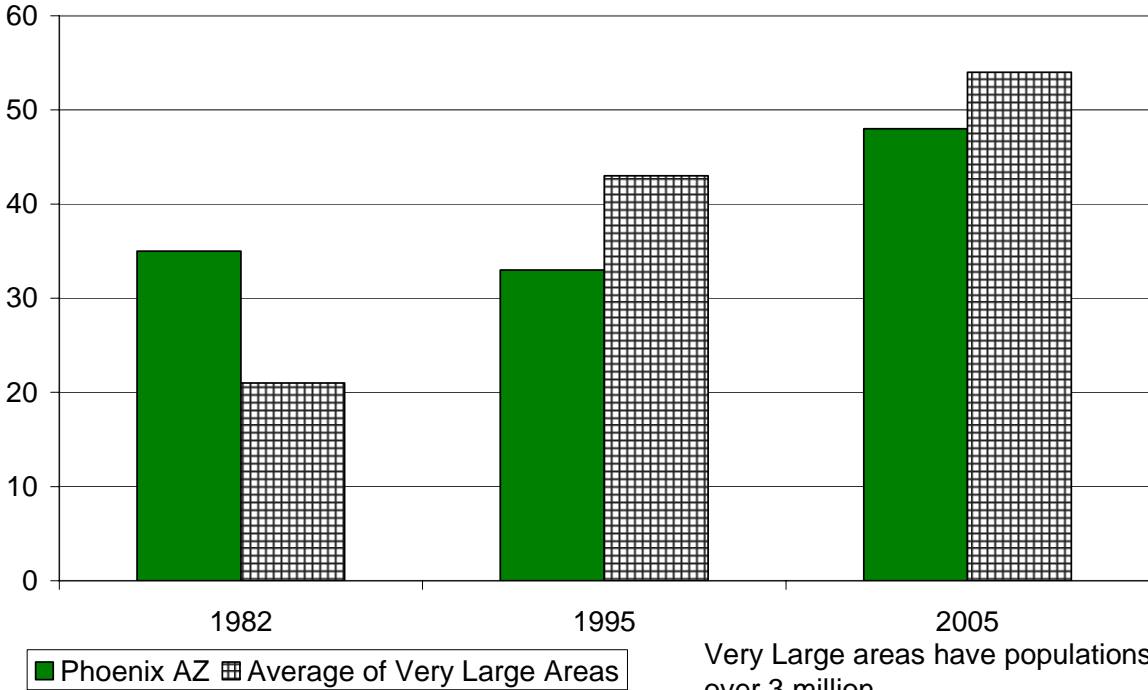
Note: Zeroes in the table reflect values less than 0.5.

## Benefits From Public Transportation Service and Operations Strategies for Phoenix, AZ

<b>Operations Strategies</b>	<b>2005</b>	<b>2004</b>	<b>2003</b>	<b>2002</b>	<b>2001</b>	<b>2000</b>
<b>Freeway Ramp Metering</b>						
Percent of Roadway Miles	53	40	38	40	44	49
Annual Delay Reduction (1000 hours)	1,356	1,114	883	486	787	712
<b>Freeway Incident Management</b>						
<b>Cameras</b>						
Percent of Roadway Miles	61	63	64	67	57	44
<b>Service Patrols</b>						
Percent of Roadway Miles	91	95	78	81	88	95
Annual Delay Reduction (1000 hours)	2,522	2,041	1,649	1,507	1,799	1,583
<b>Arterial Signal Coordination</b>						
Percent of Roadway Miles	78	79	78	78	78	79
Annual Delay Reduction (1000 hours)	588	548	461	528	603	528
<b>Arterial Access Management</b>						
Percent of Roadway Miles	23	22	23	20	21	21
Annual Delay Reduction (1000 hours)	817	667	614	648	698	595
<b>HOV Lanes</b>						
Daily Passenger-miles of Travel (1000s)	293	287	281	276	270	265
HOV User Delay Savings	521	427	397	379	457	445
<b>Total Effect of Operations Treatments</b>						
Annual Delay Reduction (1000 hours)	5,805	4,797	4,004	3,548	4,343	3,862
Annual Delay Saved per Peak Traveler (hours)	3	3	3	2	3	3
Annual Congestion Cost Savings (\$million)	116.7	92.0	73.9	64.4	78.1	67.5
Travel Time Index with Strategies	1.312	1.269	1.258	1.253	1.281	1.264
Travel Time Index (Base)	1.334	1.287	1.273	1.266	1.299	1.282
<b>Public Transportation Service</b>						
<b>Existing Service</b>						
Annual Passenger-miles of Travel (million)	260	224	216	182	176	169
Unlinked Passenger Trips (million)	60	55	54	44	41	40
Travel Time Index (combined road and transit)	1.307	1.265	1.254	1.249	1.277	1.261
<b>Condition if Public Transportation Service were Discontinued</b>						
Travel Time Index	1.340	1.290	1.277	1.269	1.304	1.288
Annual Delay Increase (1000 hours)	2,720	2,018	2,040	1,588	2,034	1,917
Annual Delay Increase per Peak Traveler (hours)	2	1	1	1	1	1
Annual Congestion Cost Increase (\$million)	55.6	39.2	38.0	28.9	36.5	33.6

### Growth in Delay per Peak Traveler

Hours of Delay



### Growth in Total Delay

Annual Hours of Delay (million)

