

Survey methodology

Aerial photography was selected as the best means of collecting mobility data across the large planning region, for several reasons. First, aircraft move rapidly and are not slowed by congestion on the highway, making for a low per-mile cost of data collection; second, the aerial point-of-view provides for photography that clearly shows not only how traffic on the highways is flowing, but also reveals the underlying cause of most congested bottlenecks, and shows the presence or absence of congestion on crossing streets. Third, use of a remote sensing methodology means that no equipment needs to be installed on the ground that interferes with the movement of traffic, or exposes workers to the dangerous highway environment.

During survey operations, overlapping aerial photographs are acquired of all surveyed highway links at a frequency of one sample per hour, repeated during each hour of the morning and evening commuter periods. So that the effects of incidents can be identified and removed, and to reduce the effects of daily fluctuations, coverage is repeated over four different mornings and evenings.

Performance measures

Two different measures are used to rate the flow of traffic on each highway link, depending on the type of highway. For uninterrupted-flow highways such as freeways and toll roads, the density of vehicles on each link is first determined by taking counts from the aerial photographs; the units of density are *passenger cars per lane per mile*, or *pcplpm*. (Trucks and buses are converted to *passenger-car equivalents* for this calculation.) Once average density values have been determined for both directions of each link, they are converted to *level-of-service* (or *LOS*) ratings based on the following conversion table:

<u>Density (pcplpm)</u>	<u>LOS</u>	<u>Traffic description</u>
0 to 11	A	Very light traffic
12 to 18	B	Light traffic
19 to 26	C	Moderate traffic
27 to 35	D	Moderate to heavy traffic without significant slowing
36 to 45	E	Heavy traffic with minor slowing
>45	F	Congested traffic involving slowing and stopping

Use of the LOS scale makes it easy for non-technical persons to appreciate the nature of the flow on each highway link. For this reason, LOS is promoted in the *2000 Highway Capacity Manual (HCM 2000)* as a recommended way to convey the nature of traffic flow to stakeholders and decision-makers.

HCM 2000 also defines a way to determine LOS for the other primary type of facility, interrupted-flow highways (characterized by signalized intersections). However, for signalized highways density is not a suitable measure because interruptions caused by traffic signals serve to cluster vehicles and release them in groups (or “platoons”); this causes density measurements vary wide when conditions are fundamentally the same. Instead, *HCM 2000* uses *average travel time* as the primary basis for defining LOS on this type of highway. This type of data is often collected by driving instrumented cars through the traffic stream, called the “floating car technique”.

However, average travel time cannot be cost-effectively measured from photographs taken from fast-moving aircraft. Instead, a surrogate methodology for approximating

arterial LOS has been developed by Skycomp, Inc. This surrogate methodology uses the presence and population of vehicle platoons, and the degree of queuing at signalized intersections, to define the six *surrogate LOS ratings*:

<u>Surrogate LOS</u>	<u>Nature of traffic flow</u>
<u>A</u>	Very light traffic flow;
<u>B</u>	Light flow without clearly defined platoons;
<u>C</u>	Platoons less than 15 vehicles per lane (vpl);
<u>D</u>	Platoons between 15 and 25 vpl;
<u>E</u>	Platoons > 25 vpl; queue > 20 vpl at no more than 2 signals;
<u>F</u>	Three or more signal queues >20 vpl; or one severely congested signal (>40 vpl)

(Note: these values are underlined to emphasize that they are *surrogate* LOS measures, not true HCM 2000 LOS measures.)

Products

1. For each surveyed year, a database is produced containing LOS or surrogate LOS ratings for all surveyed highway links, by direction, for each surveyed hour. For display, LOS ratings are also copied into time/space tables, and then colors are applied to depict degree of mobility and severity of congestion (colors range from green to yellow to orange to red). These tables are compiled into a written report, also available in digital (pdf) format.
2. Notes are produced for all bottlenecks, detailing the location, direction and typical extent of the queue, the approximate start and end times of the congestion, and the relative severity of the problem. These notes are also appended to the LOS tables.
3. A matching archive of highlight aerial photographs is built showing typical congested conditions at each bottleneck (Congestion Highlights Slide Show). Highlight photos for each site are cross-referenced to the bottlenecks listed above.
4. All databases were integrated into a web-based retrieval environment, for access through the Congestion Highlights Slide Show. Tools were produced so web users can produce: 1) a customized exportable table of LOS ratings; 2) customized LOS tables showing side-by-side ratings from all surveyed years for any surveyed highway link; or 3) summary bar charts showing how many lane-mile-hours were operating at each LOS value for each surveyed year, customized by specified highway, all surveyed highways in a county, or system-wide.

Note regarding proper interpretation of LOS and surrogate LOS ratings

Normally, each LOS rating is based on four flyovers of a particular highway link during a given hour, from four different days, minus data affected by confirmed or suspected incidents. Due to the variable nature of traffic flow, fluctuations are evident in the ratings that do not represent actual change. In order to properly conclude that mobility has changed significantly, users must look for broad patterns confirmed by adjacent cells. For example, for a three-hour morning period, LOS ratings of C-D-C one year would not be meaningfully different than D-D-C another year. However, if the later values were E-F-E, then a conclusion that traffic quality had degraded could be drawn.