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# **Speed Limit Compliance on Arterials & Collectors in the Chicago Region as of 2007**

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## Speed Limit Compliance on Arterials & Collectors in the Chicago Region as of 2007

### 1. Executive Summary

Traffic speed is important because it affects highway safety, crash severity, property damage, injury and fatality levels, as well as regional congestion and mobility. This report focuses on two speed-based data items contained in the Illinois Department of Transportation (IDOT) Traffic Count Database as potential speed limit compliance performance measures for arterial and collector functional class (FC) roadways in the seven-county Chicago region. The report includes map exhibits showing geographic distribution of traffic count locations, and summary observations by speed limit class.

The **85<sup>th</sup> percentile speed** is defined in the *Institute of Transportation Engineers (ITE) Speed Zoning Guidelines* as the speed at or below which 85% of the sample of free-flowing vehicles are traveling. This measure reflects driver behavior with low volume traffic levels, when essentially unaffected by congestion or traffic control devices. The 85<sup>th</sup> percentile speed was considered to be in compliance with the posted speed limit if the reported value was at or below the posted speed limit plus 5 miles per hour (mph).

The **pace speed** is defined in the *ITE Speed Zoning Guidelines* as the ten mile per hour (mph) band containing the largest number of observed vehicles. This measure reflects driver behavior under all traffic conditions. Typically, upwards of 70% of daily traffic travels within this ten mph speed band, and the midpoint of the pace speed approximates the average speed of the roadway. The **pace speed midpoint** was considered to be in compliance with the posted speed limit if the value was at or below the posted speed limit.

Primary observations of this report are summarized below:

Performance Measure	Principal Arterial (FC 30)	Minor Arterial (FC 70)	Collector (FC 80)
<b>85<sup>th</sup> Percentile Speed</b> at or below the posted speed limit + 5 mph	36%	32%	39%
<b>Pace Speed Midpoint</b> at or below the posted speed limit	53%	53%	67%
<b>Geographic Sample*</b>	Regional	Cook County	Cook County

\* Sample dataset - subject to error.

For both performance measures, and at all three functional class levels, it was observed that speed limit compliance tended to improve as the posted speed limit increased. Observations in this report were based on a sample dataset from 2006 and 2007, and are subject to error. During the review, numerous data gaps were observed, and data for many county routes was not included. A regionally representative dataset and data review is recommended for future analysis.

## 2. Introduction

This report provides two measures of speed limit compliance for arterial and collector roadways in the Chicago region. Traffic speed is important because it affects safety, crash severity, property damage, injury and fatality levels, as well as regional congestion and mobility. According to the *2008 Conditions and Performance Report to Congress (1)*, speed has been identified as a factor in 31% of fatal crashes in 2006, with damage cost that exceeded \$40 billion in 2000.

In this report, the measurement of speed limit compliance was limited to comparison to the posted speed limit. There was no available data to consider driving too fast for conditions. In both cases, the negative impacts of higher speeds can include safety (crash incidence), crash severity, traffic noise; and at speeds over 50 miles per hour, reduced fuel economy and increased vehicular emissions. As cited in the Federal Highway Administration (FHWA) report, *Speed Concepts: Informational Guide (2)*, there is “clear and convincing evidence that crash severity increases with individual vehicle speed.”

Agencies typically consider a range of factors, as shown in Exhibit 1, to establish posted speed limits; and it should be noted that different approaches with similar circumstances may sometimes lead to different speed limits. Although there is not just one specific methodology to establish posted speed limits, any such difference should be relatively minor since the 85th percentile speed is a dominant factor.

Exhibit 1: Primary Factors Used to Establish Posted Speed Limits

Factor	Percent Time Used	
	By State Agencies	By Local Agencies
<b>85<sup>th</sup> Percentile Speed</b>	100	86
Roadside Development	85	77
Accident Experience	79	81
<b>10 mph Pace Speed</b>	67	34
Roadway Geometrics	67	57
Average Test Run Speed	52	34
Pedestrian Volumes	40	50

Source: Speed Concepts: Informational Guide, (FHWA, September 2009, page 26)

This review focused on the two “primary factors used to establish speed limits” that are reported within the IDOT traffic count database: 85<sup>th</sup> percentile speed and the pace speed, also known as the 10 mph pace speed.

The **85<sup>th</sup> percentile speed** is defined in the *Institute of Transportation Engineers (ITE) Speed Zoning Guidelines (3)*, as the speed at or below which 85% of the sample of free flowing vehicles are traveling.

According to the FHWA *Speed Concepts Informal Guide (4)*:

*“The 85th percentile speed is used extensively in the field of traffic engineering and safety. Since the majority of drivers are considered reasonable and should be accommodated, some numerical definition for this segment of the driver population is needed. Over time, the 85th percentile driver (or speed) has been used to characterize reasonable and prudent behavior.*

The *Manual for Uniform Traffic Control Devices* (MUTCD) (5) frequently references the 85<sup>th</sup> percentile speed as an important factor in establishing speed limits, and recommends that *“When a speed limit within a speed zone is posted, it should be within 5 mph of the 85th-percentile speed of free-flowing traffic.”* However, it is also very appropriate that high levels of importance can also be assigned to factors such as roadside development, accident experience, roadway geometrics, and pedestrian volumes. As a result, it is quite common for posted speed limits to be set below the 85<sup>th</sup> percentile speed.

For the purposes of this review, the 85<sup>th</sup> percentile speed was considered to be in compliance with the posted speed limit if the reported value was at or below the posted speed limit plus 5 miles per hour. This performance measure reflects driver behavior under free flow condition with low traffic volume and when unaffected by congestion or traffic control devices.

The **pace speed** is defined in the *ITE Speed Zoning Guidelines* (6), as the ten mile per hour band containing the largest number of observed vehicles. For the purposes of this review, the pace speed midpoint was compared to the posted speed limit. Typically upwards of 70% of daily traffic falls within this 10 mph speed band, and the midpoint of the pace speed approximates the average traffic speed of the roadway. For example, in the case of a pace speed of 40 - 50 mph, midpoint of 45mph was compared to the posted speed limit. The pace speed midpoint was considered to be in compliance with the posted speed limit if the value was at or below the posted speed limit. This performance measure reflects driver behavior under all conditions.

### **3. Data Sources**

The Illinois Department of Transportation (IDOT) Traffic Count Database was utilized as a primary resource for this review. The dataset used in this analysis contained data that IDOT collected during the time period 2006 and 2007; and this dataset had been pre-processed by CMAP staff for use in a previous traffic study. CMAP staff also referenced posted speed limit data from the IDOT 2008 Illinois Roadway Information System (IRIS) database, which included average daily traffic (ADT) and posted speed limit data from the same time period. We understand that the original traffic count locations were not specially selected to represent anything other than IDOT’s needs for traffic information. The traffic

count locations were primarily on the IDOT system (state and federal marked routes); and data for numerous county routes was not included. As with any such dynamic database, there was some unusable (missing or mismatched) data that resulted in data gaps even for state routes. While staff attempted to extract obviously mismatched data, more review would be required to improve data quality for location-specific reliability. As a result of all these issues, representative coverage of the region or any county or sub-area should not be assumed. The observations and analysis in this report should therefore be considered as based on sample data and subject to error.

This CMAP review focused on traffic speed data based on IDOT functional classifications (FC) for principal arterials (FC 30), minor arterials-urban (FC 70) and for collectors-urban (FC 80). For future reference, Exhibit 2 was included to show names and codes for the IDOT functional classification system compared to the corresponding FHWA Highway Performance Management System (HPMS) classification system. The IDOT Traffic Count Database did include traffic count locations for principal arterial in all 7 counties, however for the minor arterials and collector level classifications, upwards of 90% of traffic count locations were geographically within Cook County.

Exhibit 2: Functional Classification Codes for IRIS and HPMS

IRIS Code	Functional Classification	HPMS Codes	
		Rural	Urban
10	Interstate	01	11
20	Freeway / Expressway		12
<b>30</b>	<b>Other Principal Arterials</b>	<b>02</b>	<b>14</b>
40	Minor Arterials (Non-Urban)	06	
50	Major Collector (Non-Urban)	07	
55	Minor Collector (Non-Urban)	08	
60	Local Road or Street (Non-Urban)	09	
<b>70</b>	<b>Minor Arterial (Urban)</b>		<b>16</b>
<b>80</b>	<b>Collector (Urban)</b>		<b>17</b>
90	Local Road or Street		19

Sources: IRIS manual (7), and HPMS field manual (8)

#### 4. 85<sup>th</sup> Percentile Speed Criteria

For the purposes of this review, the 85<sup>th</sup> percentile speed was considered to be in compliance with the posted speed limit if the reported value was at or below the posted speed limit plus 5 miles per hour (mph). As shown in Exhibit 3, 36% of principal arterial (FC 30) traffic count locations in the region were shown to be at/below the posted speed limit plus 5 mph. In other words, based on the 85<sup>th</sup> percentile speed criteria, 36% of principal arterial (FC 30) traffic count locations were compliant with the posted speed limit plus 5 mph.



Exhibit 3: 85<sup>th</sup> Percentile Speed Compared to Speed Limit + 5 mph\*

Principal Arterials (FC 30)			Principal Arterials (FC30)		
County Geography	85 <sup>th</sup> Percentile Within Speed Limit +5 m.p.h.	85 <sup>th</sup> Percentile Exceeds Speed Limit +5 m.p.h.	Speed Limit	85 <sup>th</sup> Percentile Within Speed Limit +5 m.p.h.	85 <sup>th</sup> Percentile Exceeds Speed Limit +5 m.p.h.
Cook	36%	64%	25	n.a.	n.a.
DuPage	32%	68%	30	23%	77%
Kane/Kendall	25%	75%	35	29%	71%
Lake	37%	63%	40	30%	70%
McHenry	52%	48%	45	34%	66%
Will	30%	70%	50	45%	55%
All Counties	36%	64%	55	52%	48%
			All Speeds	36%	64%

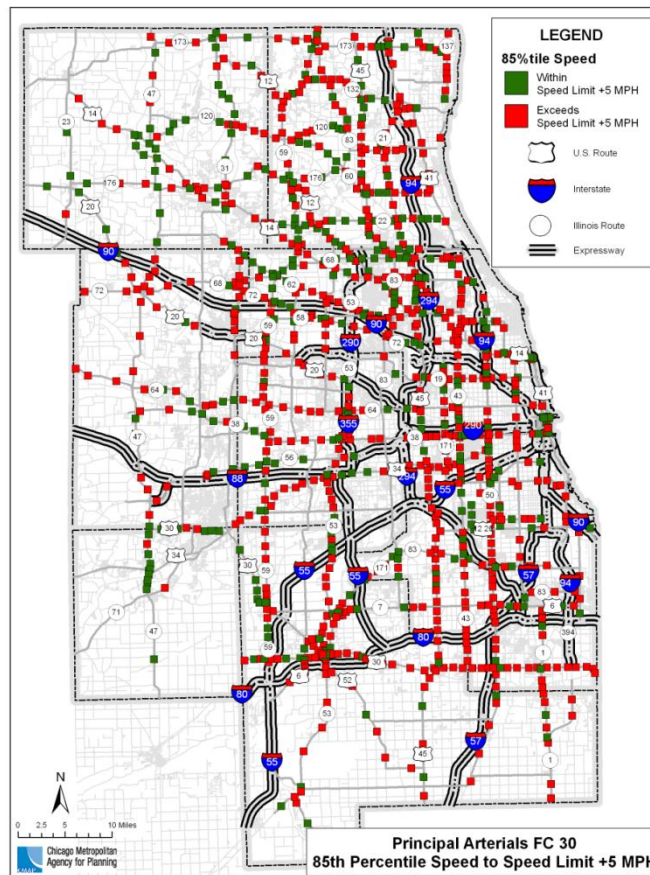
Notes: Cook County heavily influenced the regional value, since 44% of the 1,103 traffic count locations were within Cook County. Kane & Kendall combined due to small sample sizes.

Note: n.a. denotes not available due to small sample size.

\*Sample data-subject to error

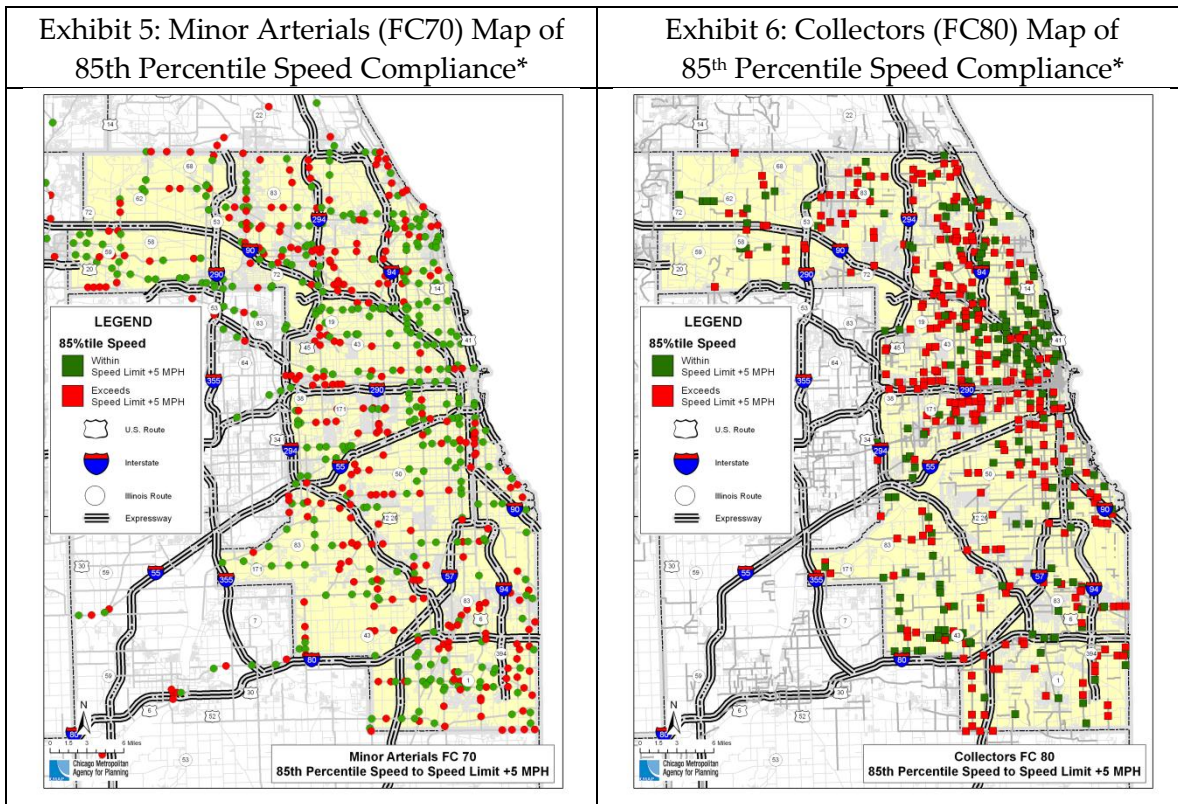
Based on county geography, six of the seven counties showed speed limit compliance for principal arterials ranging from 25% to 37%, except for McHenry at over 50%. Based on speed limit classes, speed limit compliance tended to improve as the posted speed limit increased, from a low of 23% at 30 mph up to 52% at 55 mph.

Exhibit 4: Principal Arterials (FC 30) Map of 85<sup>th</sup> Percentile Speed Compliance\*



\* Sample data-subject to error

However, as shown in Exhibit 4, the regional map shows clear data gaps with the geographic distribution of 1,061 traffic count locations on principal arterials from the IDOT traffic count location database that was used in this review. Data gaps are evident for both IDOT and county routes such as McHenry County (IL 173, IL 23, IL 62), Kane County (Randall/Orchard Road, Fabyn Parkway), DuPage County (County Farm Rd, Army Trail Rd, Naper Blvd. and 75<sup>th</sup> St.), and Will County (Weber Rd, Crete-Monee, US 6). Cook County gaps include major routes North Avenue (IL 64) and 95<sup>th</sup> St (US 12/20). Lake Shore Drive is monitored with the expressway loop detector system, even though it is classified as FC 30.



\* Sample data-subject to error

The geographic distributions of data gaps at the minor arterial (FC 70) and collector (FC 80) levels have similar issues, as shown in Exhibits 5 and 6. The mapping of usable data for minor arterial (FC 70) traffic count locations indicated numerous gaps, although there is a relatively even coverage of Cook County. For collector (FC 80) traffic count locations, useable traffic count locations were concentrated within the City of Chicago north of I-55.

A summary of all three functional classes is shown in Exhibit 7. Since county level data was only available at the principal arterial (FC 30) level, the data is only shown by speed limit class. Even though the minor arterial and collector functional class data sets were only relevant for Cook County, compliance trends

were similar to the principal arterial level. Overall speed compliance for the minor arterials (FC 70) was 32%, and for collectors (FC 80) was 39%.

Exhibit 7: 85<sup>th</sup> Percentile Compliance by Speed Limit & Functional Class\*

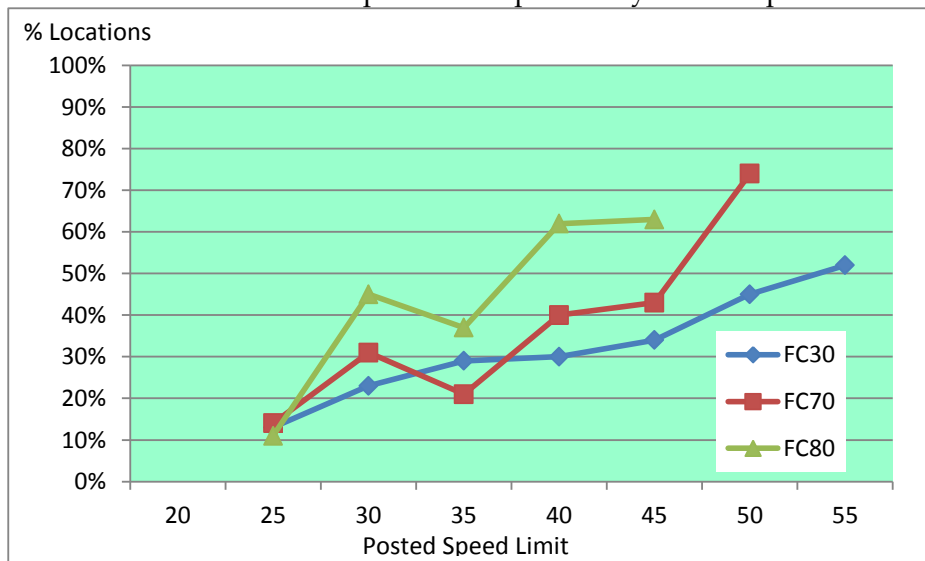
Speed Limit	Principal Arterial (FC30)		Minor Arterial (FC70)		Collector (FC80)	
	85 <sup>th</sup> Percentile Within Speed Limit + 5 m.p.h.	85 <sup>th</sup> Percentile Exceeds Speed Limit + 5 m.p.h.	85 <sup>th</sup> Percentile Within Speed Limit + 5 m.p.h.	85 <sup>th</sup> Percentile Exceeds Speed Limit + 5 m.p.h.	85 <sup>th</sup> Percentile Within Speed Limit + 5 m.p.h.	85 <sup>th</sup> Percentile Exceeds Speed Limit + 5 m.p.h.
25	n.a.	n.a.	14%	86%	11%	89%
30	24%	76%	31%	69%	45%	55%
35	29%	71%	21%	79%	37%	63%
40	30%	70%	40%	60%	62%	38%
45	34%	66%	43%	57%	63%	37%
50	45%	55%	74%	26%	n.a.	n.a.
55	52%	48%	n.a.	n.a.	n.a.	n.a.
All Speeds	34%	66%	32%	68%	39%	61%

Note: n.a. denotes not available due to small sample size.

\* Sample data-subject to error

Also, as shown in Exhibit 8, as the posted speed limit increased, compliance to the posted speed limit tended to improve for all three functional classes.

Exhibit 8: 85<sup>th</sup> Percentile Speed - Compliance by Posted Speed Limit\*



\* Sample data-subject to error

Additional maps are included in Appendix A: 85<sup>th</sup> Percentile Speed Limit Compliance for Principal Arterials - County Maps. The county level maps show the individual principal arterial (FC 30) traffic count locations with compliance status based on the criteria for the 85<sup>th</sup> percentile speed, and the speed limits that were utilized in this analysis. The dataset reviewed for this report should be considered sample data due to numerous data gaps, and the significant county routes that were not included. A more regionally representative dataset and additional quality control is recommended for future analysis.

## 5. Pace Speed Criteria

For the purposes of this review, the pace speed midpoint was considered to be in compliance with the posted speed limit if the reported value was at or below the posted speed limit. As shown in Exhibit 9, 53% of principal arterial (FC 30) traffic count locations in the region were shown to be at or below the posted speed limit. In other words, based on the pace speed midpoint criteria, 53% of principal arterial (FC 30) traffic count locations in the region were compliant with the posted speed limit.

Exhibit 9: Pace Speed Midpoint Compared to Speed Limit\*

Principal Arterials (FC 30)			Principal Arterials (FC 30)		
County	Pace Speed Midpoint Within Speed Limit	Pace Speed Midpoint Exceeds Speed Limit	Speed Limit	Pace Speed Midpoint Within Speed Limit	Pace Speed Midpoint Exceeds Speed Limit
Cook	53%	47%	25	n.a.	n.a.
DuPage	71%	29%	30	44%	56%
Kane/Kendall	26%	74%	35	49%	51%
Lake	46%	54%	40	43%	57%
McHenry	68%	32%	45	58%	42%
Will	56%	44%	50	60%	40%
Will	56%	44%	55	69%	31%
All Counties	53%	47%	All Speeds	53%	47%

Note: Cook County heavily influenced the regional value, since 43% of the 960 traffic count locations were within Cook County. Kane & Kendall combined due to small sample sizes.

Note: n.a. denotes not available due to small sample size.

\* Sample data-subject to error

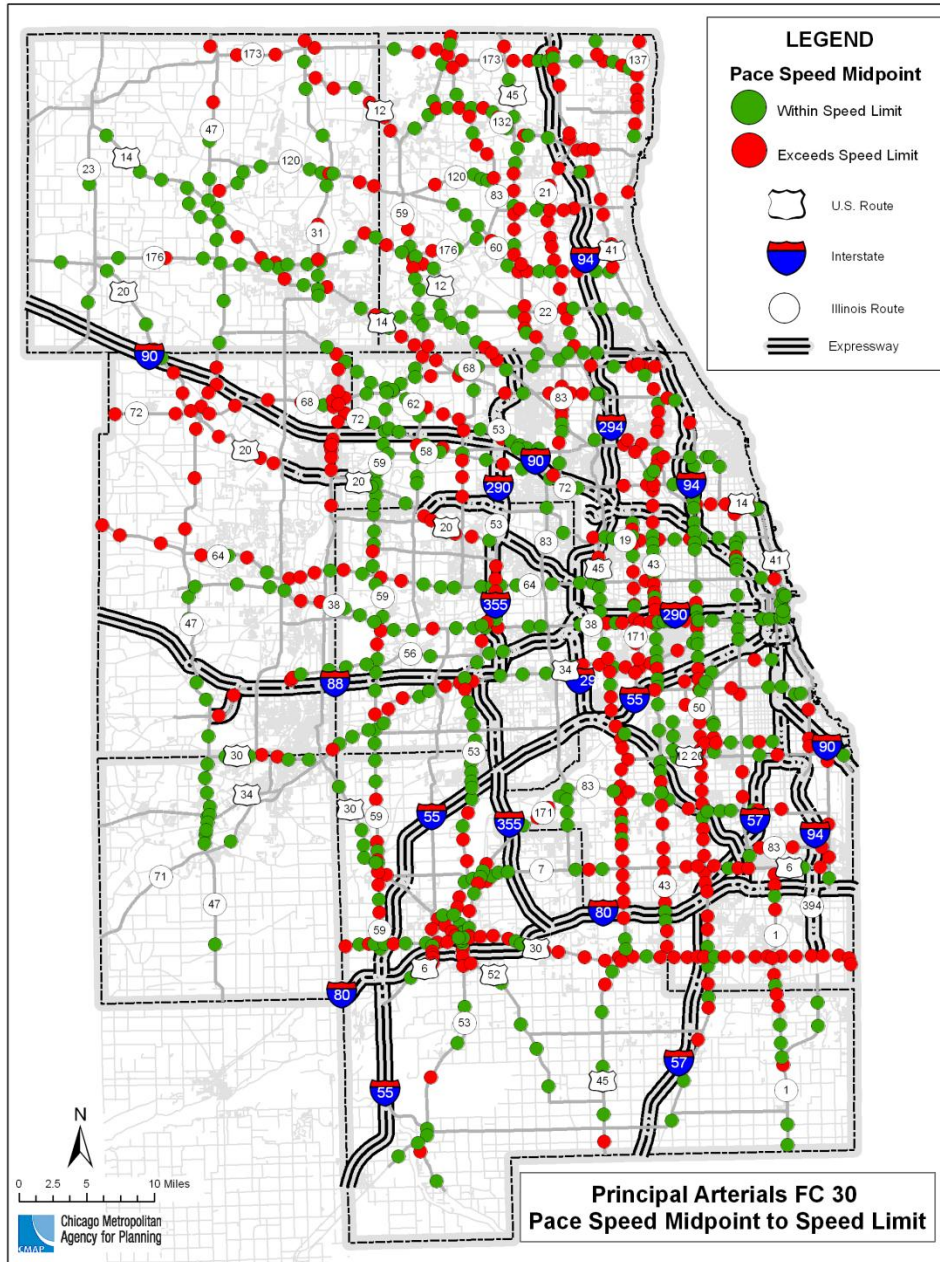
Based on county geography, six of the seven counties showed pace speed midpoint speed limit compliance ranging from 53% to 71%. The extreme pace speed midpoint values included a low of 26% compliance in Kane and Kendall Counties. This extreme variation indicates that a more detailed data quality review is needed before this analysis may be considered representative based on county geography. Also, as shown in Exhibit 9, based on speed limit classes, overall speed limit compliance tends to improve as the posted speed limit increases.

As shown in Exhibit 10, the regional map shows data gaps and the geographic distribution of 960 traffic count locations on principal arterials (FC30). While the IDOT traffic count dataset that was used in this review included both 85<sup>th</sup> percentile and pace speed data, not all locations included both data items. In the final analysis, there were fewer usable traffic counts for the pace speed midpoint criteria review. While there were additional and expanded gaps for the pace speed midpoint data, essentially the overall route coverage was similar to the 85<sup>th</sup> percentile speed data regarding IDOT and county routes such as McHenry County (IL 173, IL 23, Il 62), Kane County (Randall/Orchard Road, Fabyan Parkway), DuPage County ( County Farm Rd, Army Trail Rd, Naper Blvd. and 75<sup>th</sup> St.), and Will County (Weber Rd, Crete-Monee, US 6). Cook County gaps



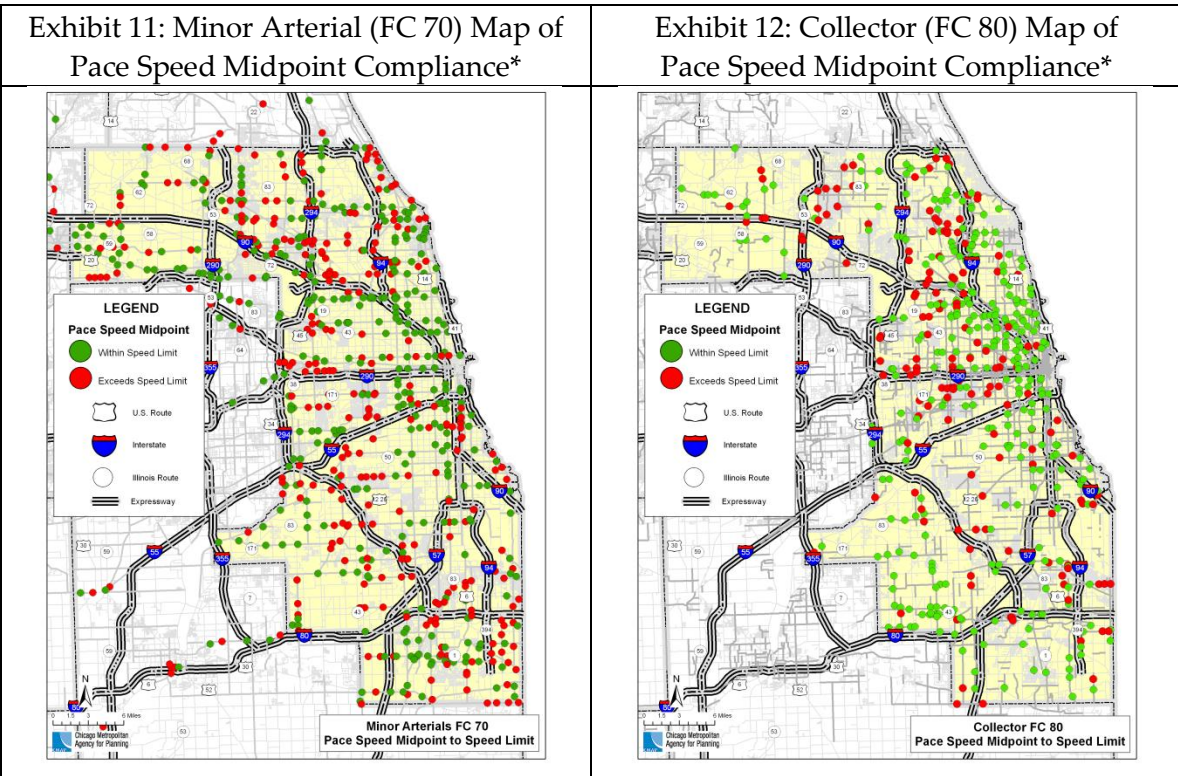
included major routes including North Avenue (IL 64) and 95<sup>th</sup> St (US 12/20). Lake Shore Drive is monitored with the expressway loop detector system, even though it is classified as FC 30.

Exhibit 10: Principal Arterial (FC 30) Map of Pace Speed Midpoint Compliance\*



\* Sample data-subject to error

The geographic distributions of data gaps at the minor arterial (FC 70) and collector (FC 80) levels have similar issues. As shown in Exhibits 11 and 12, the mapping of usable data for minor arterial (FC 70) traffic count locations indicated numerous gaps, although there is a relatively even coverage of Cook County. For collectors (FC 80) traffic count locations useable traffic count locations were concentrated within the City of Chicago north of I-55.



\* Sample data-subject to error

A summary of all three functional classes is shown in Exhibit 13. Since county level data was only available at the principal arterial (FC 30) level, the data is only shown by speed limit class. Although the minor arterial and collector functional class data sets were only relevant for Cook County, compliance trends were similar to the principal arterial level. Overall speed compliance for the minor arterials (FC 70) was 53%, and for collectors (FC 80) was 67%.

**Exhibit 13: Pace Speed Midpoint Compliance by Speed Limit & Functional Class\***

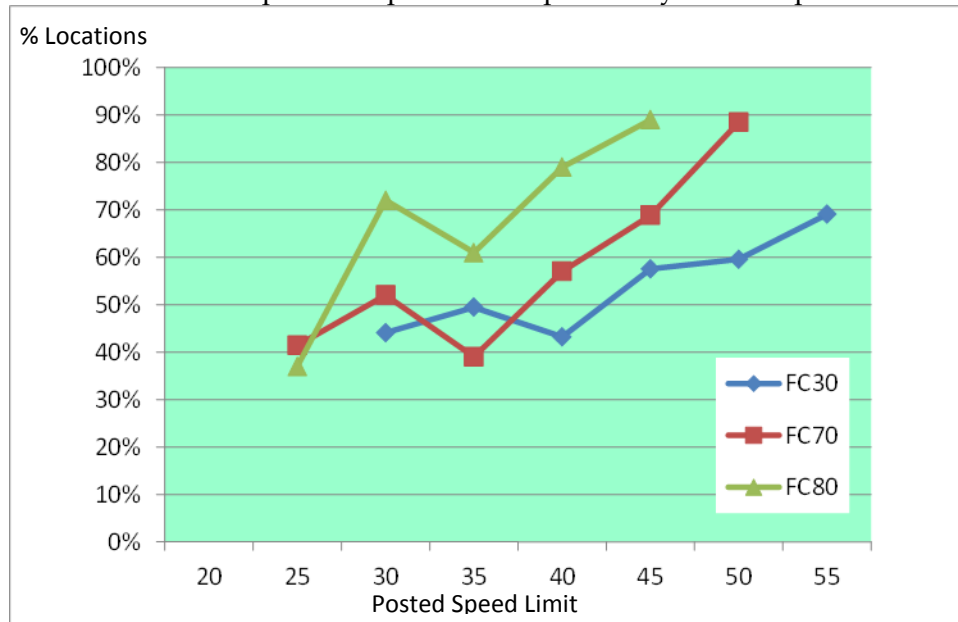
Speed Limit	Principal Arterial (FC30)		Minor Arterial (FC70)		Collector (FC80)	
	Pace Speed Midpoint Within Speed Limit	Pace Speed Midpoint Exceeds Speed Limit	Pace Speed Midpoint Within Speed Limit	Pace Speed Midpoint Exceeds Speed Limit	Pace Speed Midpoint Within Speed Limit	Pace Speed Midpoint Exceeds Speed Limit
25	n.a.	n.a.	41%	59%	37%	63%
30	44%	56%	52%	48%	72%	28%
35	49%	51%	39%	61%	61%	39%
40	43%	57%	57%	43%	79%	21%
45	58%	42%	69%	31%	89%	11%
50	60%	40%	88%	12%	n.a.	n.a.
55	69%	31%	n.a.	n.a.	n.a.	n.a.
All Speeds	53%	47%	53%	47%	67%	33%

Note: n.a. denotes not available due to small sample size

\* Sample data-subject to error

As shown in Exhibit 14, as the posted speed limit increased compliance to the posted speed limit tended to improve for all three functional classes.

Exhibit 14: Pace Speed Midpoint - Compliance by Posted Speed Limit\*



\* Sample data-subject to error

During the review it appeared that there were more issues with the Pace Speed Midpoint data. It would seem appropriate that some type of focused corridor review might be useful to identify additional instances of mismatched data.

Additional maps are included in Appendix B: Pace Speed Midpoint Speed Limit Compliance for Principal Arterials - County Maps. The county level maps show the individual principal arterial (FC 30) traffic count locations with compliance status based on the criteria for the pace speed midpoint, and the speed limits that were utilized in this analysis. The dataset reviewed for this report should be considered sample data due to numerous data gaps, and the significant county routes that were not included. A more regionally representative dataset and additional quality control is recommended for future analysis.

## 6. Overview

This review relied on information from the IDOT Traffic Count Database, and focused on two speed performance measures **85<sup>th</sup> percentile speed** and the **pace speed midpoint** for roadways at the principal arterial (FC 30), minor arterial (FC 70) and collector (FC 80) levels. The primary results of this report are summarized in Exhibit 15.

Exhibit 15: Speed Limit Compliance Comparison

Performance Measure	Principal Arterial (FC 30)	Minor Arterial (FC 70)	Collector (FC 80)
<b>85<sup>th</sup> Percentile Speed</b> at/or below the posted speed limit + 5 mph	36%	32%	39%
<b>Pace Speed Midpoint</b> at/or below the posted speed limit	53%	53%	67%
<b>Geographic Sample*</b>	Regional	Cook County	Cook County

\* Observations in this report were based on a sample dataset from 2006 and 2007, and are subject to error.

The **85<sup>th</sup> percentile speed** performance measure reflects driver behavior under free-flow conditions with low volume traffic levels when unaffected by congestion or traffic control devices. The 85<sup>th</sup> percentile speed was considered to be in compliance with the posted speed limit if the reported value was at or below the posted speed limit plus 5 miles per hour (mph). On the regional level speed limit compliance based on the 85<sup>th</sup> percentile criteria ranged from 32% to 39% across the three functional classes that were reviewed for this report, and speed limit compliance tended to improve as the posted speed limit increases.

The **pace speed midpoint** performance measure represents the ten mile per hour speed range that the largest percentage of vehicles travel in, under all driving conditions; and this measure reflects driver behavior under all conditions. The midpoint of the pace speed was considered to be in compliance with the posted speed limit if the value was at or below the posted speed limit. Frequently the pace speed contains upwards of 70% of observed vehicles, and the pace speed midpoint approximates the average speed of the roadway. Regional speed limit compliance based on the pace speed midpoint criteria ranged from 53% to 67% across the three functional classes reviewed in the study, and speed limit compliance tended to improve as the posted speed limit increases.

In order to generate reasonable regional and or county level observations, future application of either or both of these criteria would require an updated dataset from IDOT, and include some type of corridor-level review process for data quality control purposes and to establish a regionally representative sample.

## 7. References

1. *2008 Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance Report to Congress*, U.S. Department of Transportation, Washington, DC, 2009, pg. 5-9. Available for download at , <http://www.fhwa.dot.gov/policy/2008cpr/pdfs.htm>



2. *Speed Concepts: Information Guide*, Federal Highway Administration, Report FHWA-SA-10-001, Washington, DC, September 2009, pg. 8. Available for download at: [http://safety.fhwa.dot.gov/speedmgt/ref\\_mats/fhwasa10001/fhwasa10001.pdf](http://safety.fhwa.dot.gov/speedmgt/ref_mats/fhwasa10001/fhwasa10001.pdf)
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8. *Highway Performance Management System (HPMS) Field Manual*, Federal Highway Administration, U.S. Department of Transportation, Washington, DC, 2005, pp. IV-12 and 13. HPMS functional classification names and codes are available at: <http://www.fhwa.dot.gov/ohim/hpmsmanl/pdf/chap4.pdf> . The HPMS manual is available at: <http://www.fhwa.dot.gov/ohim/hpmsmanl/hpms.cfm>