South Western Region Travel Time Monitoring Program

Congestion Management Process

Spring 2007 Report

Prepared by:
South Western Regional Planning Agency
888 Washington Boulevard
Stamford, CT 06901
Telephone: (203) 316-5190
Facsimile: (203) 316-4995
www.swrpa.org

Table of Contents

Introduction	2
Objectives	2
Background	2
Method	5
Evaluation	6
Appendix	12

List of Figures and Maps

Map 1	Traffic Volume and Volume-to-Capacity Ratio by Route Segment, 2005	3
Map 2	Traffic Volume and Volume-to-Capacity Ratio by Route Segment, 2025	4
Map 3	Travel Time: I-95 Southbound AM (Peak)	8
Map 4	Travel Time: I-95 Northbound AM	9
Map 5	Travel Time: I-95 Southbound PM	10
Map 6	Travel Time: I-95 Northbound PM (Peak)	11
Table 1	Travel Time: I-95 Summary Results	7

Acknowledgement of Funding Sources

This document was prepared in cooperation with the U.S. Department of Transportation, Federal Highway Administration and the Connecticut Department of Transportation. The opinions, findings, and conclusions expressed in this publication are those of the author and do not necessarily reflect the official views or policies of the South Western Regional Planning Agency, Connecticut Department of Transportation or the U.S. Department of Transportation.

Introduction:
The spring 2007 South Western Region Travel Time Monitoring Program established a framework for evaluating the region's transportation system and identifying deficiencies in the roadway and transit network. The Travel Time Monitoring Program is intended to become an important part of the Congestion Management Process (CMP) of the South Western Regional Planning Agency (SWRPA) and South Western Region Metropolitan Planning Organization (SWRMPO). The CMP serves as a tool for evaluating the effectiveness of transportation improvements projects previously implemented in the region. The CMP also serves as a tool to identify deficiencies within the system and, in turn, to develop priorities for the Long Range Regional Transportation Plan.

The monitoring program implemented by the SWRPA was modeled after similar programs undertaken by other regional planning organizations in Connecticut and throughout the nation. SWRPA greatly appreciates the technical assistance and resources provided by the Capitol Region Council of Governments and the Council of Governments of the Central Naugatuck Valley.

Objectives:
The objective of the Travel Time Monitoring Program is to obtain quantitative data measuring travel time and delay along the roadway and transit network in South Western Connecticut. Data is obtained using a global position system (GPS) device placed in a probe vehicle. SWRPA uses the data generated from this program to improve its understanding of congestion along major roadways and transit routes. Data products from this program support SWRPA's transportation planning program and CMP and help SWRPA recommend improvements that enhance and improve the reliability of the transportation system. While this pilot effort focused only on Interstate 95, future monitoring will cover the region's other major roadways including the Merritt Parkway (CT-15), US 1, and US 7 as well as important transit routes.

Data collected as part of this program will be supplemented with data made available in the Connecticut Department of Transportation's (ConnDOT) annual Congestion Screening and Monitoring (CSM) report. ConnDOT's annual CSM report presents data and forecasts on traffic volume and delay for all state highways.

Background:
Data on traffic conditions are fundamental components of transportation planning analysis. Travel time, or the time required to traverse a route between two points, is a basic measure in transportation. Travel time is a concept that is in regular use among a wide variety of audiences, from transportation professionals to elected officials to business persons to the traveling public.

'Congestion' has been defined as "the level at which transportation system performance is no longer acceptable due to traffic interference."[1] More simply, congestion means that there are more vehicles using a segment of roadway than it was designed for, resulting in slower speeds and delays.

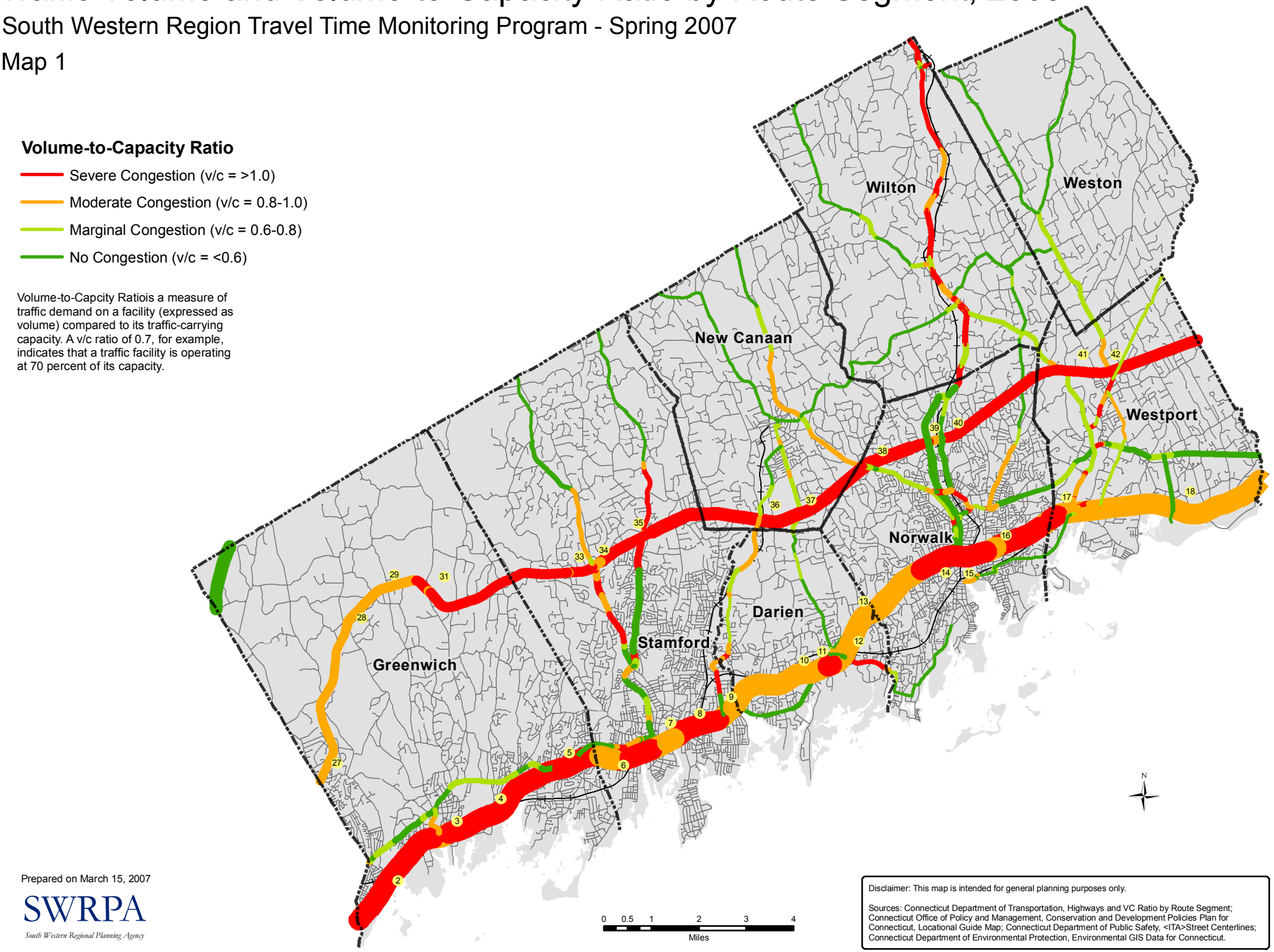
Traffic congestion is widely recognized as a preeminent quality of life issue in South Western Connecticut. Until implementation of the travel time monitoring program in 2007, SWRPA relied primarily on congestion data developed by ConnDOT for its annual CSM report. Through the Travel Time Monitoring Program, SWRPA will generate traffic data for I-95 and other major roadways in South Western Connecticut that will be accessible to and comprehensible by the traveling public.

[1] http://www.fhwa.dot.gov/resourcecenter/teams/planning/cms.cfm

Traffic Volume and Volume-to-Capacity Ratio by Route Segment, 2005

South Western Region Travel Time Monitoring Program - Spring 2007

Map 1



Prepared on March 15, 2007

SWRPA

South Western Regional Planning Agency

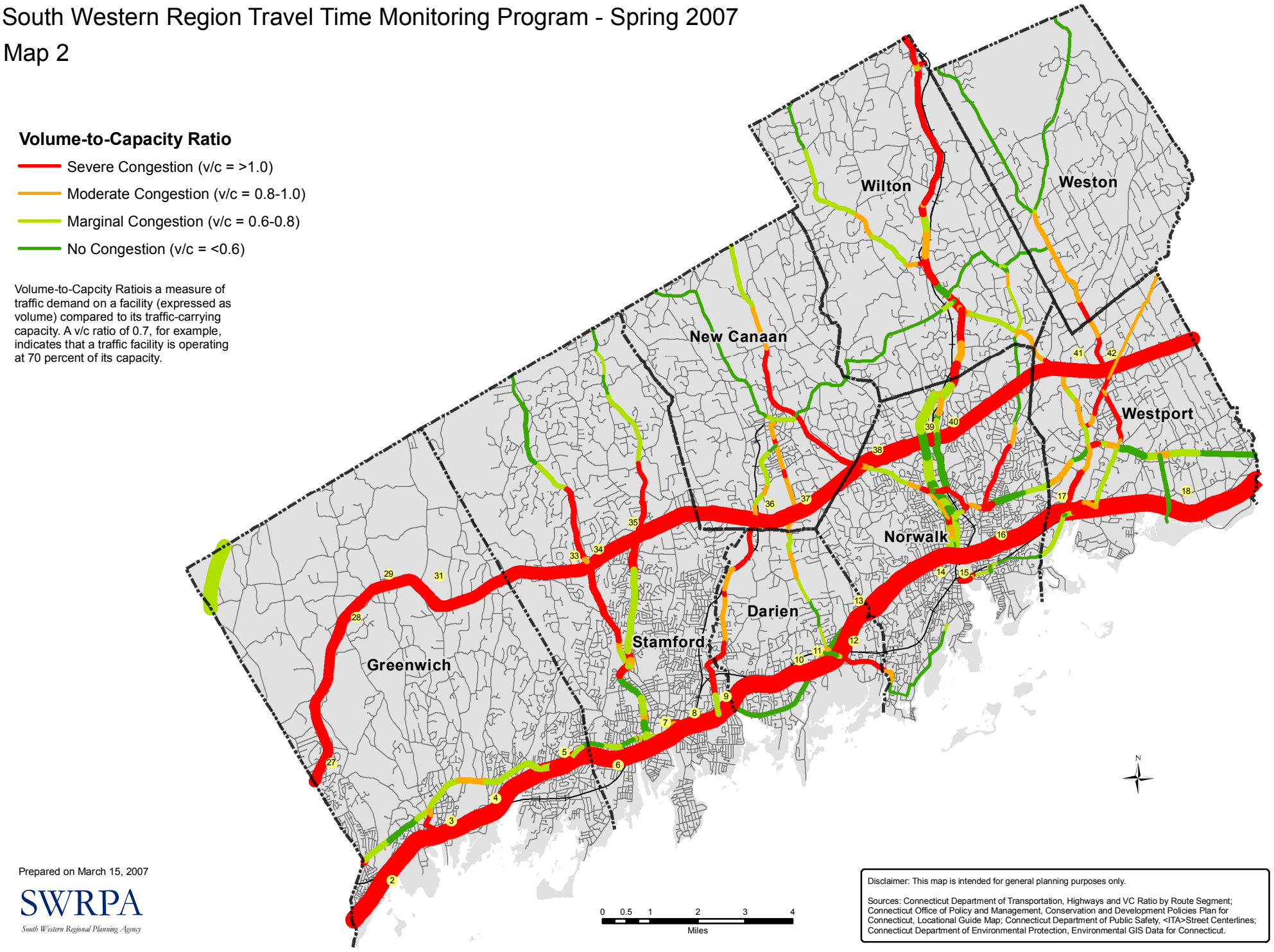
Disclaimer: This map is intended for general planning purposes only.

Sources: Connecticut Department of Transportation, Highways and VC Ratio by Route Segment; Connecticut Office of Policy and Management, Conservation and Development Policies Plan for Connecticut, Locational Guide Map; Connecticut Department of Public Safety, <ITA>Street Centerlines; Connecticut Department of Environmental Protection, Environmental GIS Data for Connecticut.

Traffic Volume and Volume-to-Capacity Ratio by Route Segment, 2025

South Western Region Travel Time Monitoring Program - Spring 2007

Map 2



Prepared on March 15, 2007

SWRPA
South Western Regional Planning Agency

Disclaimer: This map is intended for general planning purposes only.

Sources: Connecticut Department of Transportation, Highways and VC Ratio by Route Segment; Connecticut Office of Policy and Management, Conservation and Development Policies Plan for Connecticut, Locational Guide Map; Connecticut Department of Public Safety, <ITA>Street Centerlines; Connecticut Department of Environmental Protection, Environmental GIS Data for Connecticut.

According to ConnDOT's 2006 CSM report, I-95 is the region's most heavily traveled expressway. Daily vehicle miles traveled (VMT) on I-95 in the South Western Region are over 3,000,000 and segments of the road have average daily traffic (ADT) figures in excess of 150,000 vehicles. By 2025, ConnDOT's travel model forecasts ADTs on I-95 in excess of 210,000 vehicles in Greenwich, and 190,000 vehicles Stamford and Norwalk. Traffic volumes of the magnitude projected would result in volume-to-capacity (V/C) ratios greater than 1.5, which is indicative of an extremely congested roadway. Already in 2005, 74% of the expressway segments in the South Western Region were approaching or over capacity.

Method

With the advent of GPS technologies and GIS applications, detailed travel time data can be easily gathered and analyzed. Probe vehicles equipped with inexpensive, off-the-shelf GPS technology can obtain detailed datasets of time, distance, and speed. Simple analysis using GIS software on a standard PC allows these datasets to be studied and presented in a format which is both sophisticated and easily comprehensible.

Data was collected on Tuesdays, Wednesdays, and Thursdays. Mondays and Fridays were avoided because traffic on those days is impacted by weekend travel. Data collection began on May 15, 2007 and continued until June 29, 2007. Spring and fall are generally considered the best months to conduct traffic monitoring. During the winter months, inclement weather can impact both the volume and speed of traffic. During the summer months, primary and secondary schools are not in session and many households take vacation, which decreases the volume of traffic on the highways.

Data was collected during both the morning and evening peak hour periods. Based on hourly traffic count data from ConnDOT's continuous count stations, the morning peak was identified as 6.30 am to 9.30 am with the core peak from 7:00 am to 9:00 am. The evening peak was identified as from 3.30 pm to 7.00 pm with the core peak from 4:00 pm to 6:00 pm. High traffic volume during the peak periods is largely attributed to trips between home and work.

Other travel time studies, such as the study conducted by the Central Naugatuck Valley Region, took into account outside factors that may affect the traffic congestion in the region. These factors include: incidents, inclement weather, construction work zones, special events, and poor signal timing. SWRPA's pilot monitoring program was focused only on recurring congestion. Data was not collected during periods of inclement weather. Data collected while there was an incident on the highway was omitted from the final analysis.

Data was collected using a probe vehicle equipped with a GPS device. SWRPA staff programmed the GPS device to log the location of the vehicle every two seconds. The probe vehicle driver was instructed to accurately represent the flow of traffic. To do so, the driver was instructed to ride in the middle (travel) lane while maintaining the speed limit or the appropriate speed of traffic. Offensive or aggressive driving, 'fighting' traffic, and riding in the fast lane were discouraged.

In order to relate the GPS data to existing highway data, a series of control points were plotted along I-95 between Greenwich and Westport using a GIS. Control points were placed so as to match the highway segment mile points in the ConnDOT annual CSM report. Generally, these mile points are located at entrances, exits, and under- and over-passes along the expressway. A total of sixty-five control points were plotted. From these sixty-five control points, thirty-nine line segments were generated. The lines segments are used to display the speed data between two control points.

After each data gathering 'run', the GPS device is brought back to the SWRPA office and the log (a text file) is downloaded onto a computer for analysis. Each log point recorded by the GPS device includes three key pieces of the data: latitude, longitude, and time. It is necessary to do some slight modifications to the log file (spaces in the header row are removed) so that it can be read by ESRI ArcGIS software. Utilizing GIS software, the log file is then loaded into ArcMap and plotted on a map based on the recorded latitude and longitude. This log data is then 'spatially joined' to the control points, thereby associating each control point with the attribute data of the nearest log point. The control points and associated log data are then saved as a shapefile and labeled with the date, direction, and time of day (e.g. 070529_95_N_AM for the I-95 Northbound AM run on May 29, 2007). The resulting data is then output as a table and loaded into a separate spreadsheet, which calculates the speed and time per highway segment. Speed is determined by dividing the length of the segment by the time required to travel between the two end points. In some instances where good GPS data is not available or a satisfactory spatial join is not achieved, the data is reasonably adjusted based on data from the next closest control point. This process is repeated for each travel time run in each direction. Finally, the individual run data for each period and direction (AM southbound, AM northbound, etc.) is aggregated and averaged. The averaged data is then brought back into a GIS for presentation.

Evaluation:

That there are delays on I-95 during the peak travel hours should not be a surprise to anyone, especially commuters who rely on the road everyday. However, the delays on I-95 are not as omnipresent as it might seem. Based on the data generated for this report, it is clear that certain segments of expressway seem to produce more delays during peak commuting times. Notable among these delay prone segments are the approaches to the Stamford central business district (Exits 4-9), the interchange with US 7 in Norwalk (Exit 15), and the interchange with the Sherwood Island Connector in Westport (Exit 18).

AM Southbound (Peak)
Staff collected data from nine runs along I-95 southbound in the morning peak. For the entire 22.38 mile corridor from the Fairfield – Westport town line to the New York State line, the average speed was 31 MPH and the average travel time was 44:02 minutes. The slowest morning southbound run took 1:05 hours and averaged 21 MPH. The slowest stretches include the segment from Exit 16 to Exit 14 in Norwalk and the segment through the Stamford central business district (Exits 4-9). South of Stamford to the New York state line, average travel speeds increased substantially.

AM Northbound
Staff collected data from seven runs along I-95 northbound in the morning peak. For the entire 22.38 mile corridor from the New York State line to the Fairfield – Westport town line, in contrast to the slow speeds in the southbound direction, the average speed was 51 MPH and the average travel time was 27:01 minutes. The slowest segments are found from the New York state line through Greenwich to the Stamford central business district (Exit 7).

PM Southbound
Staff collected data from two runs along I-95 southbound in the evening peak. For the entire 22.38 mile corridor from the Fairfield – Westport town line to the New York State line, the average speed was 52 MPH and the average travel time was 25:50 minutes. The slowest segments are found just south of the Stamford central business district (Exit 7) and south of the Exit 4 in Greenwich.

PM Northbound (Peak)
Staff collected data from four runs along I-95 northbound in the evening peak. For the entire 22.38 mile corridor from the New York State line to the Fairfield – Westport town line, the average speed was 28

MPH and the average travel time was 48:26 minutes. The slowest evening northbound run on I-95 took 1:07 hours and averaged 20 MPH. The slowest segments on I-95 northbound in the evening peak are found from the Stamford central business district (Exit 7) north through Darien and Norwalk (Exit 16).

Table 1. Travel Time- I-95 Summary Results

AM/PM	Direction	Peak	# Runs	Mean Travel Time	Min. Travel Time	Max. Travel Time	Mean Speed	Max. Speed	Min. Speed
AM	N	No	7	0:27:01	0:23:06	0:41:04	50	58	33
PM	S	Yes	9	0:44:02	0:33:36	1:05:04	31	40	21
AM	N	Yes	4	0:48:02	0:40:12	1:07:48	28	33	20
PM	S	No	2	0:25:50	0:22:08	0:29:32	52	61	45

Total length of corridor: 22.38 miles

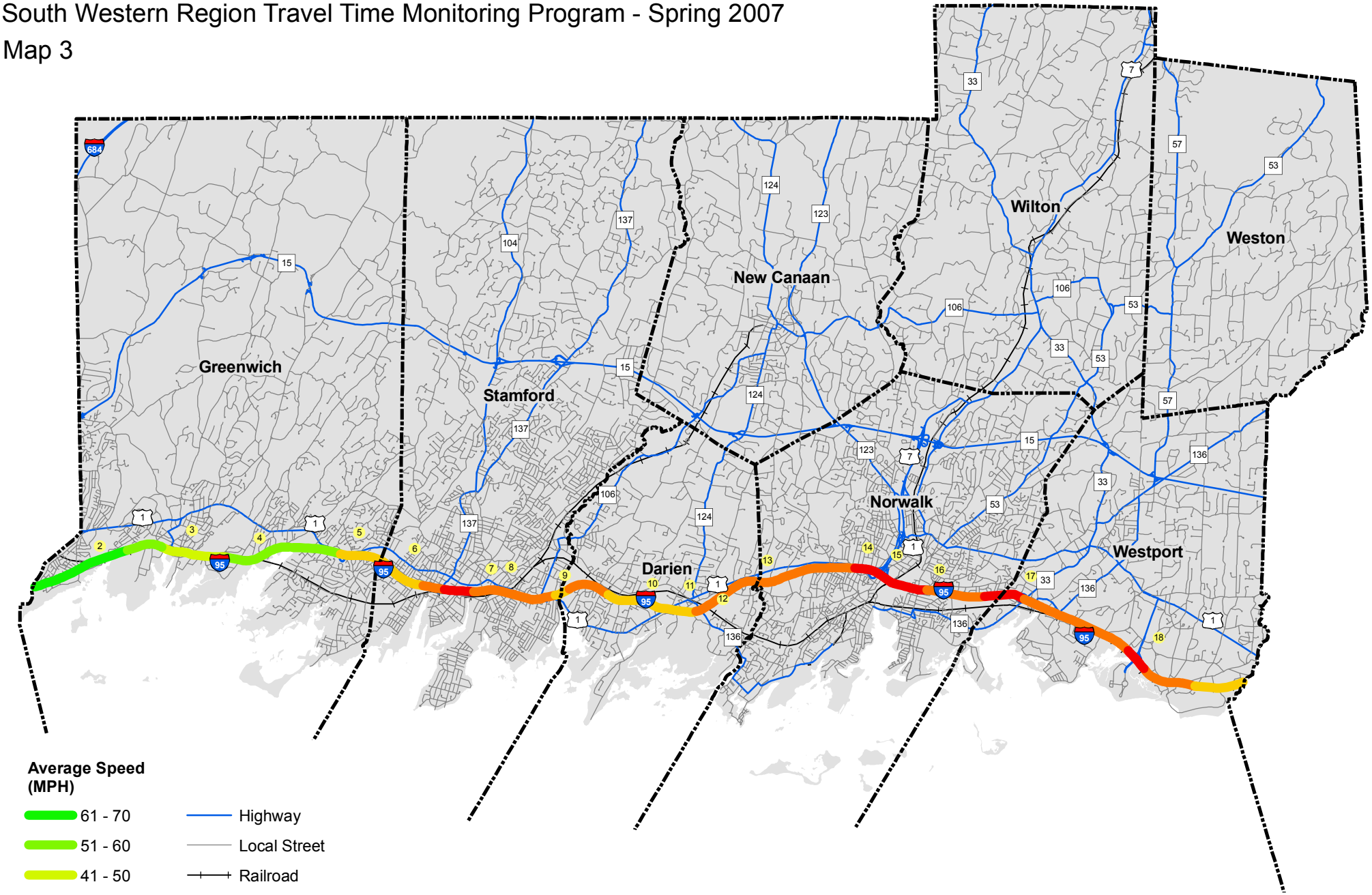
Source: South Western Region Travel Time Monitoring Program - Spring 2007

The four maps on the following pages present the averaged speed data both northbound and southbound in the morning and evening peak:

Travel Speed: I-95 Southbound AM (Peak)

South Western Region Travel Time Monitoring Program - Spring 2007

Map 3



Disclaimer: This map is intended for general planning purposes only.

Sources: Connecticut Department of Transportation, Highways; Connecticut Department of Environmental Protection, Environmental GIS Data for Connecticut.

Prepared on July 17, 2007

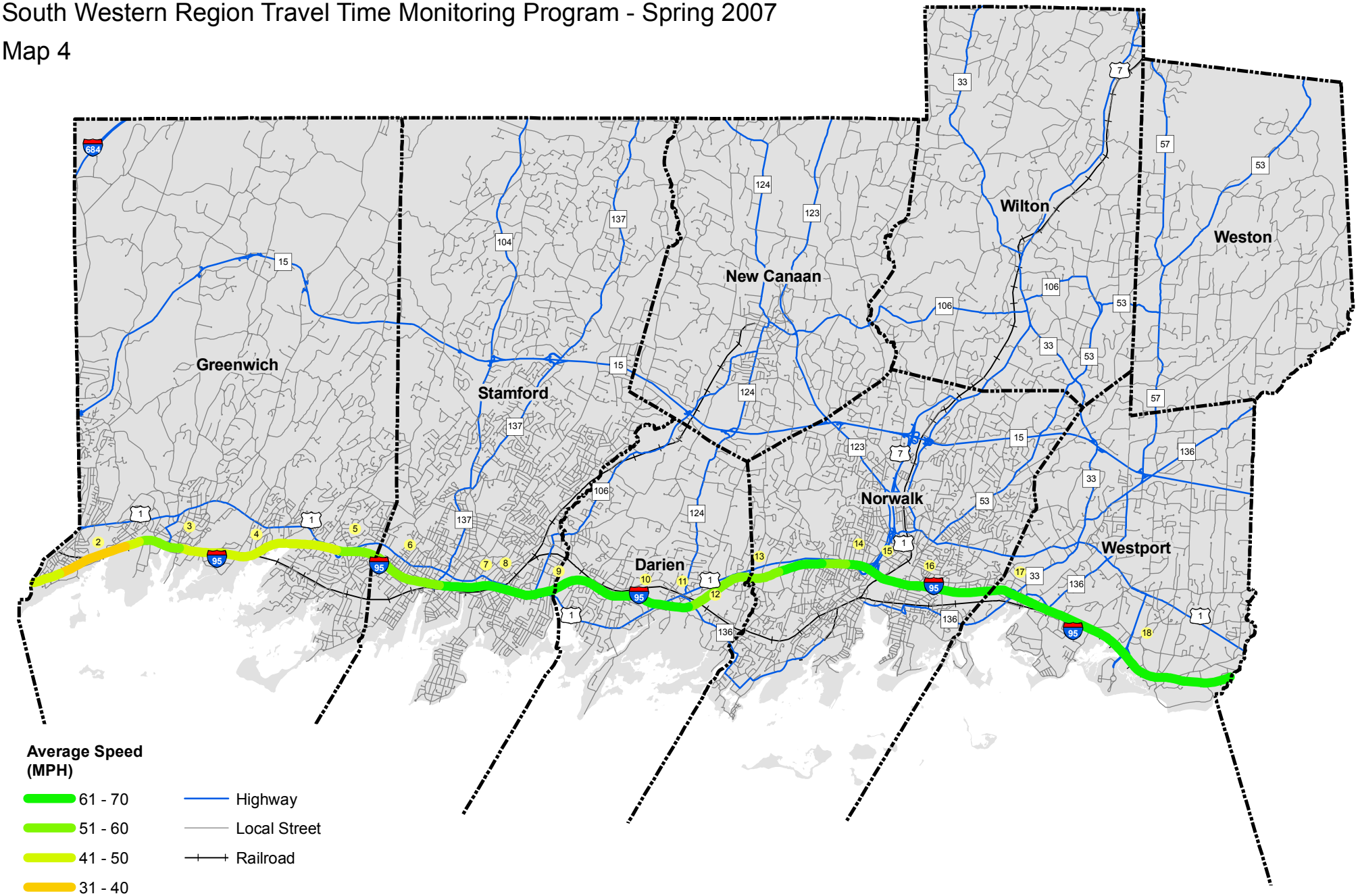
SWRPA

South Western Regional Planning Agency

Travel Speed: I-95 Northbound AM

South Western Region Travel Time Monitoring Program - Spring 2007

Map 4



Disclaimer: This map is intended for general planning purposes only.

Sources: Connecticut Department of Transportation, Highways; Connecticut Department of Environmental Protection, Environmental GIS Data for Connecticut.

Prepared on July 17, 2007

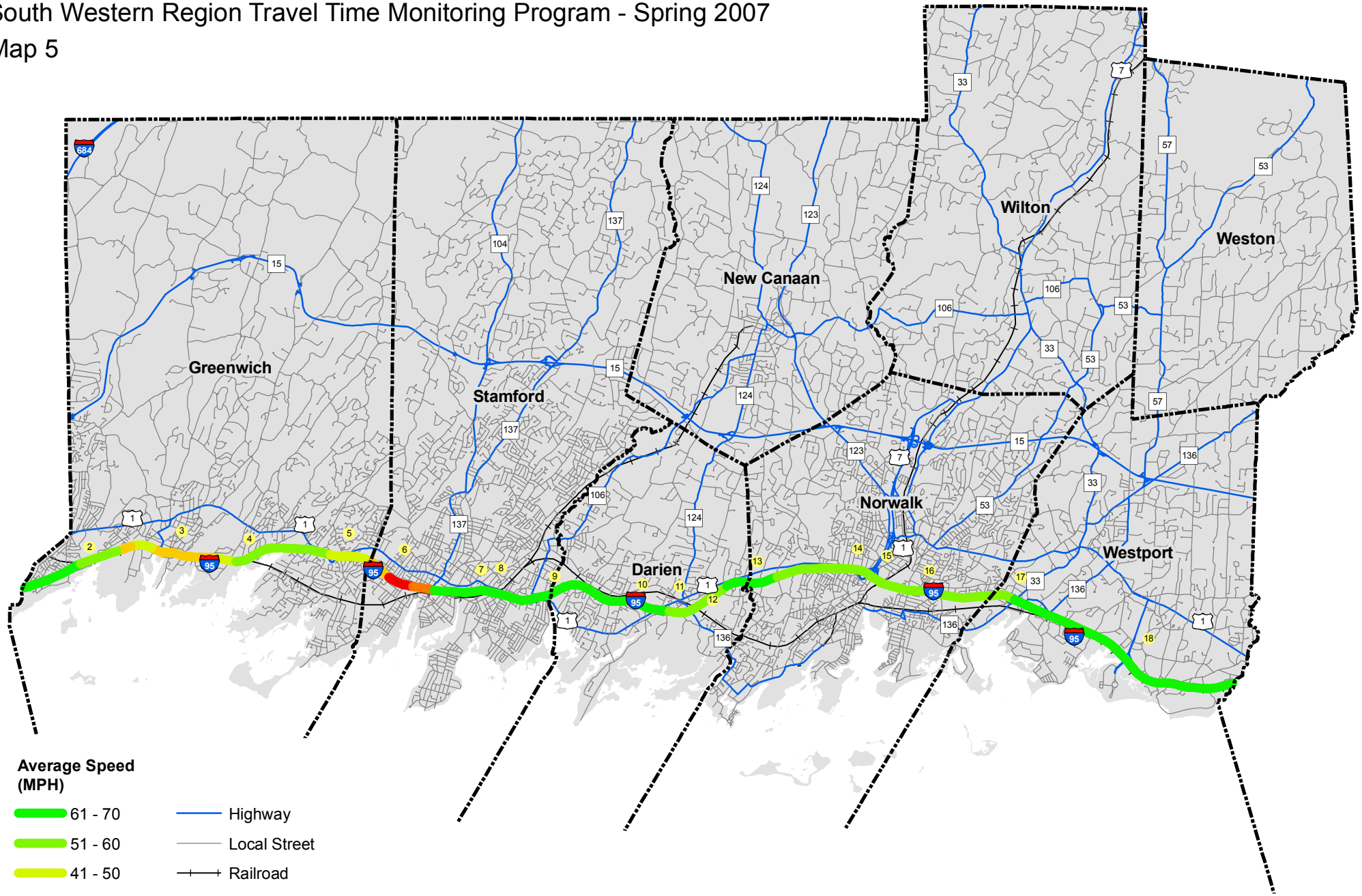
SWRPA

South Western Regional Planning Agency

Travel Speed: I-95 Southbound PM

South Western Region Travel Time Monitoring Program - Spring 2007

Map 5



Disclaimer: This map is intended for general planning purposes only.

Sources: Connecticut Department of Transportation, Highways; Connecticut Department of Environmental Protection, Environmental GIS Data for Connecticut.

Prepared on July 17, 2007

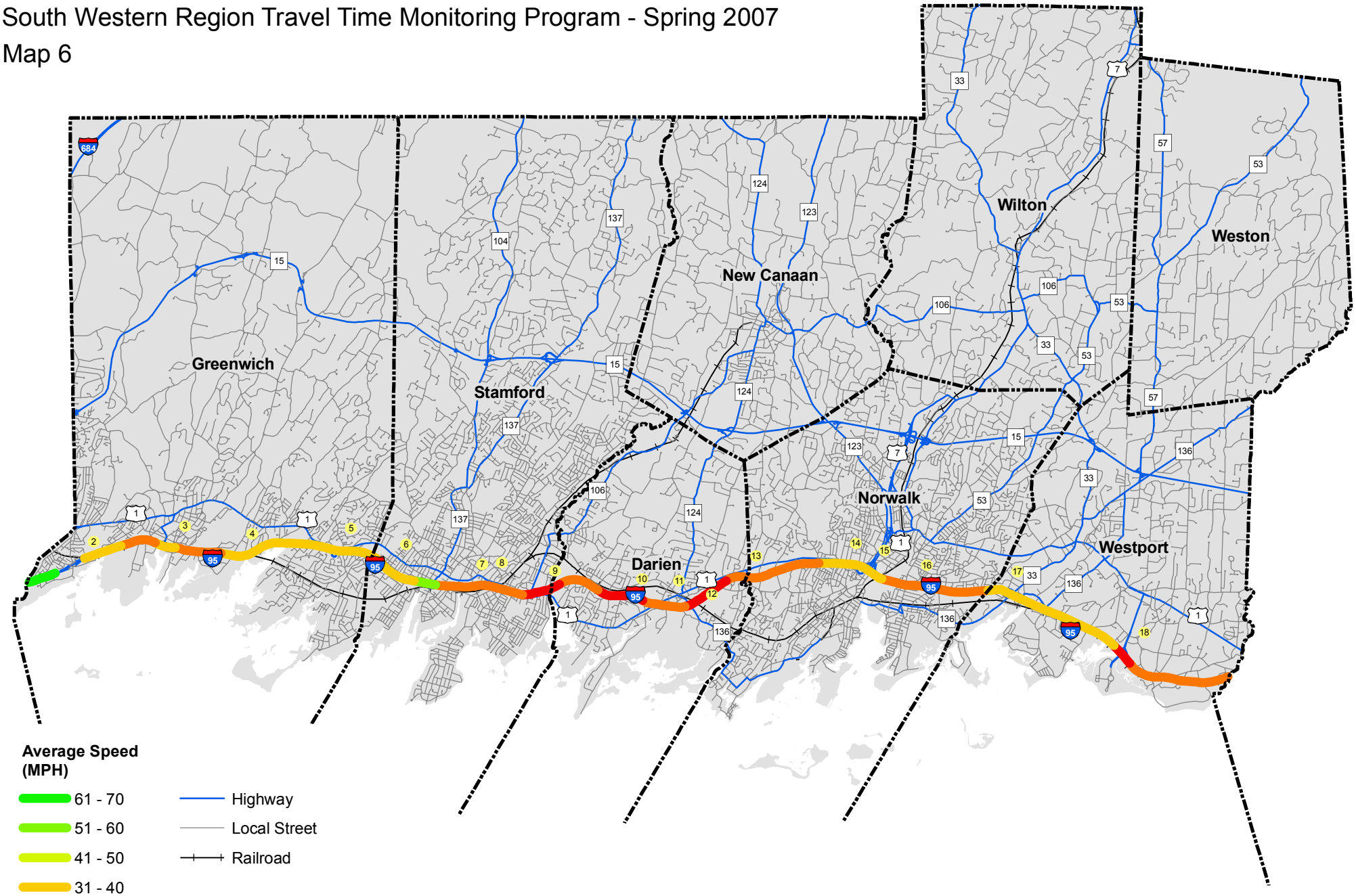
SWRPA

South Western Regional Planning Agency

Travel Speed: I-95 Northbound PM (Peak)

South Western Region Travel Time Monitoring Program - Spring 2007

Map 6



Disclaimer: This map is intended for general planning purposes only.

Sources: Connecticut Department of Transportation, Highways; Connecticut Department of Environmental Protection, Environmental GIS Data for Connecticut.

Prepared on July 17, 2007

SWRPA

South Western Regional Planning Agency

Appendix:

Equipment:
Delorme Earthmate Blue Logger; Bluetooth wireless GPS receiver (2)
Kensington Bluetooth USB adaptor

Data collection & Processing:

A GPS receiver logged the position of the probe vehicle every 2 seconds. The attribute data associated with the logged point includes the date, time, latitude, longitude, and speed. The data from a run is output from the GPS device as a comma delineated text file, an example of which is displayed below:

Date, Time_GMT, Latitude, Longitude, Elevation, Heading, Speed, GPS_Status, Log_Type
05/29/2007, 11:33:54, 41.129857, -73.298775, -86.458, 218.72, 37.97, 3, 1
05/29/2007, 11:33:56, 41.129633, -73.299048, -82.935, 219.50, 37.03, 3, 1
05/29/2007, 11:33:58, 41.129421, -73.299322, -89.381, 219.95, 39.15, 3, 1
05/29/2007, 11:34:00, 41.129144, -73.299585, -83.601, 220.27, 42.19, 3, 1
05/29/2007, 11:34:02, 41.128878, -73.299880, -82.317, 223.89, 42.56, 3, 1
05/29/2007, 11:34:04, 41.128636, -73.300204, -81.215, 225.68, 43.12, 3, 1
05/29/2007, 11:34:06, 41.128386, -73.300556, -81.322, 227.22, 44.93, 3, 1
05/29/2007, 11:34:08, 41.128141, -73.300904, -83.796, 229.42, 45.55, 3, 1
05/29/2007, 11:34:10, 41.127902, -73.301289, -83.875, 230.90, 45.73, 3, 1
05/29/2007, 11:34:12, 41.127675, -73.301663, -78.926, 232.95, 44.68, 3, 1
05/29/2007, 11:34:14, 41.127462, -73.302053, -80.131, 234.94, 45.55, 3, 1
05/29/2007, 11:34:16, 41.127258, -73.302455, -79.887, 237.55, 45.17, 3, 1
05/29/2007, 11:34:18, 41.127057, -73.302868, -80.353, 239.43, 45.98, 3, 1
05/29/2007, 11:34:20, 41.126870, -73.303292, -77.212, 241.22, 45.55, 3, 1
05/29/2007, 11:34:22, 41.126697, -73.303725, -74.989, 243.26, 46.11, 3, 1
05/29/2007, 11:34:24, 41.126540, -73.304176, -74.394, 244.57, 46.48, 3, 1
05/29/2007, 11:34:26, 41.126383, -73.304628, -73.799, 246.31, 45.92, 3, 1
05/29/2007, 11:34:28, 41.126232, -73.305068, -70.335, 245.63, 45.55, 3, 1
05/29/2007, 11:34:30, 41.126081, -73.305520, -67.580, 246.47, 45.55, 3, 1
05/29/2007, 11:34:32, 41.125942, -73.305957, -64.323, 246.64, 43.37, 3, 1
05/29/2007, 11:34:34, 41.125813, -73.306375, -65.090, 246.76, 41.13, 3, 1
05/29/2007, 11:34:36, 41.125686, -73.306771, -62.279, 246.93, 38.96, 3, 1