Congestion Management Process

Central Connecticut Region

Prepared by:
Central Connecticut Regional Planning Agency

May 2012

I Acknowledgements

This Congestion Management Process report for the Central Connecticut region is prepared by the Central Connecticut Regional Planning Agency with guidance from the United States Department of Transportation Federal Highway Administration and Connecticut Department of Transportation. The opinions, interpretations, findings, and conclusions expressed in this publication are those of the Central Connecticut Regional Planning Agency and do not necessarily reflect the official views or policies of the United States Department of Transportation and/or the Connecticut Department of Transportation.

Agency Board

Representative	*Municipality*	*Position*
Bart Bovee	*Berlin*	
Dennis Kern	*Berlin*	*Vice Chair*
Rosie O'Brien Vojtek	*Bristol*	
Donald Padlo	*Bristol*	
John Pompei	*Bristol*	*Chair*
Peter McBrien	*Burlington*	
Paul Rachielles	*Burlington*	
Marie Lausch	*New Britain*	
Donald Naples	*New Britain*	*Secretary*
Steven P. Schiller	*New Britain*	
Jennifer Bartiss-Earley	*Plainville*	
James Cassidy	*Plainville*	
Carl Johnson	*Plymouth*	
Stephen Mindera	*Plymouth*	
John Barry	*Southington*	
Rudy Cabata	*Southington*	*Treasurer*
James Haigh	*Southington*	

Agency staff

Carl Stephani	*Executive Director*
Cheri Bouchard-Duquette	*Office Manager*
Francis R. Pickering	*Senior Planner*
Ethan Abeles	*Transportation Planner*
Timothy Malone	*Regional Planner*
Kristin Thomas	*Regional Planner*
Abigail St. Peter	*Assistant Planner*
Jason Zheng	*Assistant Planner*

CCRPA also acknowledges the work of interns Pat Gallagher and Greg Martin for their contributions to this report.

Contact information

Central Connecticut Regional Planning Agency
225 North Main St, Suite 304
Bristol, CT 06010-4993

Telephone/fax	(860) 589-7820
Internet	http://ccrpa.org

II Table of Contents

I Acknowledgements 2

II Table of Contents 4

III Figures 5

IV Executive summary 6

V Introduction and history 11

Purpose of the Congestion Management Process 11

History and background 11

VI Defining congestion 14

Congestion in context 14

Performance measures and data collection 16

Methodology for the Central Connection Region 19

VII The region 25

VIII Interstate Highways 29

Interstate 84 29

Interstate 691 29

IX Arterials (U.S. and State Routes) 30

U.S. Route 6 in Bristol and Plymouth 31

Connecticut Route 72 in Plainville and Bristol 39

Connecticut Route 10 and 299 around I-84 in Southington 48

X Discussion and conclusions 55

XI References 61

III *Figures*

Figure 1: Regional planning and the Congestion Management Process ... 13

Figure 2: Regional Vehicle Speeds (Raw data from GPS loggers).....27

Figure 3: Regional Congestion Points (Occurrences of Vehicle Speeds less than 10 MPH 28

Figure 4A: US-6 Raw Vehicle Speed 36

Figure 4B: US-6 Average Speed to Speed Limit Ratio 37

Figure 4C: US-6 Percentage of Time in Congestion 38

Figure 5A: CT-72 Raw Vehicle Speed 45

Figure 5B: CT-72 Average Speed to Speed Limit Ratio..... 46

Figure 5C: CT-72 Percentage of Time in Congestion 47

Figure 6A: CT-10 & CT-229 Raw Vehicle Speed 52

Figure 6B: CT-10 & CT-229 Average Speed to Speed Limit Ratio..... 53

Figure 6C: CT-10 & CT-229 Percentage of Time in Congestion..... 54

IV *Executive summary*

For many vehicle users, the day-to-day dread is congestion, the accompanying frustration, and the distress over lost productive time and leisure time. Historically, addressing congestion involved building bigger roads for faster vehicles. Currently, there is a greater effort to understand the role of congestion management in broader contexts such as safety, alternative modes of transportation, and surrounding land use. For example, some land-use strategies can encourage shorter non-automobile trips, and slow vehicle speeds are safer for pedestrian-oriented village centers and urban downtowns. While the past focus of congestion has been to improve vehicle flow, the present focus is more multidimensional and considers non-vehicle transportation options as well.

The congestion management process (CMP) is a federal requirement to assess regional congestion and coordinate with other regional planning documents such as the Long-Range Transportation Plan (LRTP) and Transportation Improvement Program (TIP). The Central Connecticut Regional Planning Agency (CCRPA), Capitol Region Council of Governments (CRCOG), and Midstate Regional Planning Agency (MRPA) collaboratively develop a CMP for the entire Greater Hartford transportation management area (TMA) that encompasses all three agencies. CCRPA is submitting a separate CMP report for the 2012 update. This report is intended to complement the work by CRCOG and MRPA.

The goal of this report is not to prescribe exact solutions to congestion, but to provide a general overview of current transportation performance and opportunities in the Central Connecticut region. The data collection process revolves around performance of vehicle mobility (such as vehicle speed), but the recommendations for addressing congestion revolve around methods to minimize traffic on existing roadways (rather than traditional solutions, such as widening roads, which can often induce additional traffic and actually worsen congestion). Such recommendations include improving road operations (traffic signal coordination, high connectivity road networks), encouraging less traffic-inducing land uses

(mixed-used and transit-oriented development), and promoting the viability of multiple modes of travel (transit, walking, bicycling).

This report assesses the transportation system for automobiles with three measures: (1) actual vehicle speed, (2) ratio of average speed to the speed limit, and (3) percentage of time in congestion (where vehicle speeds are less than 10 mph). Vehicle speed data is only valuable as a reference; speed data do not allow for a fair comparison of two or more roads because the context of each road is unique. The second measure relates vehicle speeds to the expected speed. In this manner, low speeds are not penalized if the road and surrounding area encourages slow vehicles. (This assumes that speed limit is the best representation of expected speed.) The third measure provides a time component and explains how often vehicles encounter slow speeds. The second and third measures provide context of the surrounding area to the measure of actual vehicle speed; doing so provides a better understanding of the complex relationship between speed, time, and congestion.

This report focuses on arterial roads (US-6, CT-10, CT-72, and CT-229) in the Central Connecticut region and finds that the region as a whole does not experience systemic congestion; problem areas are isolated to certain corridors and locations. These areas are at the junction of major routes (CT-72 with CT-229 in Bristol, CT-10 with I-84 in Southington) and/or have significant automobile-oriented development (along US-6 in Bristol, along CT-10 in Southington). Slower speeds are expected along these routes (due to traffic signals and volume of turning vehicles), but a critical part of the analysis is determining whether slow speeds are attributed to such factors or congestion.

The results of this CMP show that slow speeds are encountered at specific locations or along specific corridors, but vehicles only spend a relatively minimal portion of time traveling at slow speeds. This suggests that even though vehicle speeds are lower than the speed limit, the overall traffic stream is moving. These results indicate that some congestion is present, but it is not so pervasive as to cause substantial delay through-

out the whole corridor; vehicles are observed stopping or traveling at slow speeds only on small segments of the corridors.

In addressing congestion, many transportation agencies recommend considering alternative and low-cost approaches before costly road capacity expansions. These approaches are directly related to the broader context of each road – such as surrounding land use, transit options, et cetera. These elements are not directly related to automobiles, but they can ultimately reduce vehicle usage and congestion. This CMP discusses the current state of these elements and potential strategies to improve them. Some of these strategies are already taking shape in the region, either at the implementation or planning stages.

Land use and development in the region is generally automobile-oriented with low-density residential and commercial strip development. Continuing this development pattern will increase traffic and exacerbate congestion on existing roads. Potential land-use strategies that can develop the tax base for the towns without generating significant additional traffic include mixed-use and transit-oriented development. Currently, a development project in downtown Bristol is planning for a walkable neighborhood with a broad dense mixture of business space and housing choices. This new development will also be served by the upcoming bus rapid transit (BRT) system that will link Bristol, New Britain, and Hartford. This system will encourage further transit-oriented development throughout the region.

Viable travel choices are currently predominantly limited to automobiles. Access to a vehicle is often a requirement to access services, goods, jobs, and recreation. Existing transit service does not adequately serve the population. Walking and bicycling are often unsafe on the arterial roads due to the lack and/or poor conditions of sidewalks and bike lanes. Furthermore, non-automobile travelers must use these busy arterials because of low connectivity among local streets. Projects to expand mode choices include the BRT system (which includes a walking/biking path), the Farmington Canal Heritage Trail (a dedicated pedestrian and bicycling facility), Safe Routes to Schools projects, and several downtown

streetscape projects. Improving the connectivity of the local street network is also a goal of the region's LRTP.

The lack of connectivity leads to an overreliance on the arterials roads, even for short local trips. There are several major arterials throughout the region, but the supporting network of local streets is not well-connected. Channeling all vehicles to the arterials increases the potential for congestion and poses a safety concern for pedestrians and bicyclists. If local streets were well-connected, local traffic and non-automobile traffic may find a safer and more convenient alternate route. The LRTP recommends improving the road network connectivity to enhance road operations.

Existing road operations can also be improved through access management plans of development along arterials and better coordination of traffic controls. The numerous driveways, curb cuts, traffic signals, and large volumes of turning traffic obstruct through traffic on the arterials. Consolidating the number of driveways would benefit both businesses and travelers by increasing the number of spaces and reducing the number of conflict points. Traffic signals should also be verified that they provide a continuous green wave (where the traffic signals turn green in progression).

These strategies are often supportive of one another. For example, a denser mixed-used development encourages walking and bicycling, and has a better ridership base to support transit.

In addition to reducing congestion, these alternative strategies offer numerous additional personal, environmental, and economic benefits to communities and society as a whole. Supporting alternative modes of travel can promote a more active lifestyle (and associated health benefits) and serve a wider range of people (those who cannot drive). Less vehicle usage (because alternative modes are viable) can save households money and reduce greenhouse gas emissions. Fewer roads (and impervious surfaces) improves water quality and reduces flooding potential. Compact development, which also requires less road infrastructure, can help municipalities save money on maintenance and service provision (fire and police protection, schools and school buses, water and sewer, et

cetera). The traditional method of capacity expansion (e.g., road widening) can entail significant property acquisition, often significantly altering the character of places to the detriment of local communities. However, the contemporary approach to congestion can enhance communities in both a physical and financial sense.

V Introduction and history

This Congestion Management Process (CMP) report for the Central Connecticut Regional Planning Agency (CCRPA) encompasses the municipalities of Berlin, Bristol, Burlington, New Britain, Plainville, Plymouth, and Southington. Major roads serving the region include Interstate 84 (I-84), U.S. Route 6 (US-6), and Connecticut Routes 9, 10, 15, 72, and 229 (CT-9, CT-10, et cetera.)

Purpose of the Congestion Management Process

The CMP is a continuous planning activity that monitors congestion and is intended to inform the region's work. As shown in Figure 1, the CMP is coordinated with documents such as the regional long-range transportation plan (LRTP) and the transportation improvement program (TIP). The LRTP outlines broad transportation goals for the next three decades, and the TIP lists all federally-funded surface transportation projects scheduled to occur in the next four years. The CMP is a broad overview of the region which can help identify the places that are most congested and in need of further detailed examination.

History and background

Since 2004, Central Connecticut Regional Planning Agency (CCRPA) has worked with the Capitol Region Council of Governments (CRCOG) and the Midstate Regional Planning Agency (MRPA) to monitor congestion throughout the region. The towns represented by these three agencies constitute the Greater Hartford transportation management area (TMA). CCRPA and MRPA assisted in collecting data, while CRCOG analyzed the data and prepared the 2005 Congestion Monitoring Report.[1] As part of the monitoring process, CCRPA continued to collect congestion data for CRCOG's upcoming 2012 Congestion Monitoring Report. Unfortunately,

[1] CRCOG, CCRPA, MRPA. *Transportation Monitoring & Management Report for Metropolitan Hartford Area: 2005*
http://www.crcog.org/publications/transportation.html

staff turnover at CCRPA and equipment malfunction (for data collected in 2007-2008) impeded the collaborative effort with CRCOG and MRPA. Due to these circumstances, Central Connecticut will not be included in CRCOG's 2012 report. CCRPA has collected new data (2011) with new equipment for this report.

This CMP, with data collected in 2011, complements the 2012 Congestion Monitoring Report by CRCOG and MRPA. This report will not be directly comparable to past reports due to new methods of data collection and analysis.

From the federal perspective, congestion monitoring originated as the congestion management system (CMS) under the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 and continued under the succeeding transportation funding bill, the Transportation Equity Act for the 21st Century (TEA-21) of 1998. The CMS would later be known as the Congestion Management Process (CMP) under the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) of 2005. Although SAFETEA-LU expired in 2009, the United States Congress has continued to fund transportation programs by extending SAFETEA-LU until a new transportation funding bill is authorized.

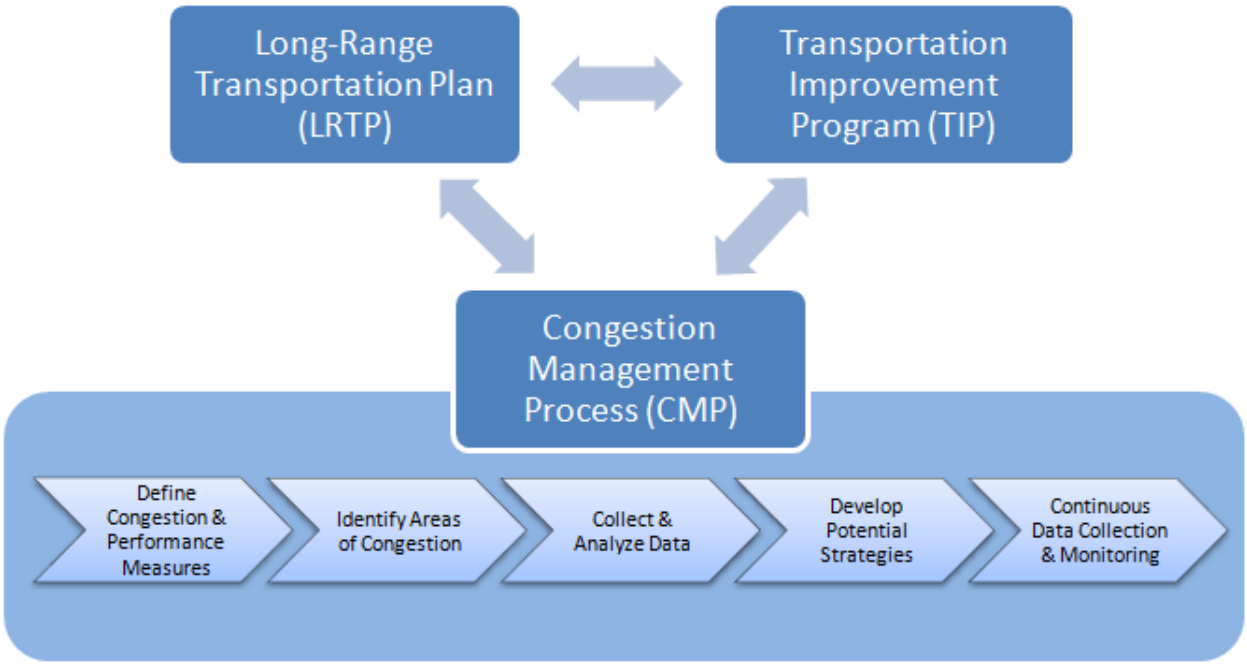
The goal of congestion monitoring evolved under each transportation bill. The CMS was interpreted as a stand-alone data analysis exercise, but the CMP represents an ongoing process to incorporate congestion-related issues into the metropolitan planning process. The most critical change is the growing understanding that addressing congestion is not limited to improving vehicle flow. The FHWA's *Congestion Management Process: A Guidebook* [2] emphasizes that addressing congestion must also consider the broader context of different places, accessibility and mobility, safety for all transportation users, and multimodalism (viability of different modes of transportation).

[2] US DOT FHWA. *Congestion Management Process: A Guidebook 2011* http://www.fhwa.dot.gov/planning/congestion_management_process/cmp_guidebook/

Federal regulations define a CMP as a "systematic process that provides information on transportation system performance and alternate strategies to alleviate congestion and enhance mobility of persons and goods." An effective CMP will include the following elements:

1. Define congestion and develop effective performance measures (Chapter II)
2. Identify congested corridors/locations (Chapter III)
3. Collect and analyze data (Chapters IV & V)
4. Develop potential alternative strategies to mitigate congestion (Chapter ZI)
5. Continuous data collection and monitoring of congestion (Ongoing & Future Work)

Figure 1: Regional planning and the Congestion Management Process



VI *Defining congestion*

Congestion in context

You can recognize congestion when you see congestion, but there is no simple definition of congestion. Congestion can be **systemic** (throughout the entire transportation network) or **localized** (to specific corridors and intersections). Congestion has elements that are both **spatial** (location along a corridor) and **temporal** (time of day or year). Congestion can be described as **recurring** (daily congestion due to volume, road network design, land use characteristics, et cetera) or **non-recurring** (result of accidents, weather, construction, et cetera).

There are numerous ways to characterize traffic congestion, but this report focuses on recurring congestion. Congestion is a perceived problem which varies between people and places. Vehicle speed, though commonly used, does not necessarily best represent congestion in all situations. Moving as many cars as fast as possible should not be the only goal of transportation systems. Considerable social, economic, and environmental costs may be attached to transportation projects.

Most definitions for congestion include language akin to "excess vehicles on the roadway which results in lower than normal speeds." The phrasing appears reasonable and understandable, but there is ambiguity in the words "*normal speeds*." ("Normal speed" is also referred to as "free-flow" speed.) Many factors such as the **type and design of roads** (e.g., limited-access freeway, signalized arterial, et cetera with straight sections, large curvatures, et cetera), the **broad continuum of places** (e.g., ranging from rural to urban), and the **needs and perspectives of different users** (e.g., through or local travelers) can influence what is considered normal speed.

In the case of freeways, due to their inherent nature, vehicle speeds are expected to be relatively consistent with no stop-and-go traffic. However, the normal speed can vary depending on context. Normal speed on a

rural freeway may be around 65 to 80 mph, but an urban freeway may experience lower speeds due to higher volumes, frequent highway ramps, and more merging vehicles. In the worst case for a freeway, design flaws and/or the high volume of merging vehicles can result in stopped traffic.

Understanding congestion for arterials is much more complicated. Factors such as intersections and development directly alongside arterials can slow traffic (traffic signals, access to and from development). In such cases, congestion and a normal speed can be difficult to define – when is stopping at a red light considered congestion? Are slower travel speeds more acceptable to local travelers, while through travelers would prefer faster speeds?

Traditionally, addressing congestion often involved building bigger roads. However, experience shows that "you cannot build your way out of congestion." Expanding roads can temporarily relieve congestion, but the lack of congestion frequently encourages additional development, more vehicles, and the return of congestion. Furthermore, adding capacity and road lanes is costly (both the initial capital and maintenance expenses) – especially when local, state, and federal government finances are precarious, as during the current economic uncertainty. In addition to monetary costs, road expansions can deteriorate environmental conditions which ultimately affect human health. For instance, roads and the accompanying development (often low-density sprawl) absorb entire ecosystems and prime agricultural soils; the increase in impervious surface can lead to more severe flooding, erosion, and water pollution.

At present, as noted by the FHWA's CMP Guidebook, many transportation agencies are addressing congestion with all other reasonable and appropriate strategies before resorting to roadway expansion due to the aforementioned costs and negative impacts. With the growing understanding of congestion, the preferred method to address congestion is to operate existing capacity more efficiently. Strategies include promoting other modes of transportation (besides single-occupancy vehicles), improving road operations (traffic signal upgrades, road connectivity,

transportation demand management, et cetera), and encouraging less auto-dependent land-use patterns.

While congestion is generally regarded as a problem, it may be desirable in some contexts. Slower traffic is safer for non-motorized travelers (such as pedestrians and bicyclists) and is more suitable for village/downtown settings. Some planners and city mayors, as discussed on Atlantic Cities[3] and the Project for Public Spaces[4], believe that congestion is an indicator of success; downtowns are congested because they are desirable and vibrant places that people want to visit. In the past, capacity expansions such as road widening were the prescribed solution for congestion everywhere, even for roads through the center of vibrant towns. This often led to the detriment of places where road widening significantly changed the character of a place, replacing pedestrian activity with wide roads for fast moving vehicles. There are numerous examples across the United States where extensive road construction has arguably done more harm than good for the social and economic fabric of cities. On the other hand, there are also examples where freeway removal has led to the revitalization of cities. This is not to say that congestion is inherently desirable or the cause of a successful downtown. Rather, it suggests that congestion management interventions must be planned so that they are sensitive to the local context. Congestion management techniques that are appropriate for freeways may not be appropriate for downtowns or neighborhood streets (and vice versa).

Performance measures and data collection

Part of the reason that the traditional approach to congestion focuses on vehicle speeds and capacity expansion is because of the measures selected to assess congestion. When the measures are speed and capacity, the solutions also focus on speed and capacity. Data for speed and capacity

---

[3] John Norquist. *The Case for Congestion*. 2011
http://www.theatlanticcities.com/neighborhoods/2011/12/case-congestion/717/#

[4] Gary Toth. *Level of Service and Travel Projections. The Wrong Tools for Planning Our Streets?* 2012
http://www.pps.org/blog/levels-of-service-and-travel-projections-the-wrong-tools-for-planning-our-streets/

happen to be the most readily available – especially for freeways due to the federal Highway Performance Monitoring System (HPMS) program, which is responsible for monitoring freeway usage.

Transportation agencies and municipal/regional planning organizations use a variety of measures to assess congestion, as shown in FHWA's CMP Guidebook, but non-automated data collection efforts are very labor intensive, time consuming, and costly. Such work includes installing traffic counters on roadways to assess volume; conducting turning movement counts at intersections to assess volume and delay; driving specific routes at specific times with GPS tracking devices to assess speed, travel times, and delay; and administering traveler surveys to assess origins, destinations, and preferred routes.

Data collection is labor intensive and costly, especially for arterial roads which do not benefit from the automated monitoring systems used for freeways. Many planning agencies are attempting to access traffic data from the network of GPS-enabled devices. Some of this data is already being made available online for other uses. (See i95travelinfo.net or maps.google.com with live traffic options enabled.)

Other studies that benefit the CMP help provide a broader context to the transportation system. Such studies include assessing transit conditions (e.g., overcrowding, on-time performance); land use characteristics (e.g., ratio between jobs and housing); the viability of alternative travel modes (e.g., condition of sidewalks and bicycle facilities); accessibility to goods and services (e.g., number of amenities accessible to residential neighborhoods within a defined distance of travel time by different modes of travel). These studies could help explain the cause of congestion. For example, perhaps congestion is a significant problem because other travel modes are unavailable. These studies also reinforce the idea that congestion management should focus on a broader context. For example, some critics of congestion evaluation argue that congestion is a biased metric and accessibility is a more important measure. The purpose of congestion monitoring is to determine people's ability to access jobs, goods, and

services. However, a sole focus on congestion only accounts for the population with vehicle access.

Where possible, the CMP should make use of alternative sources of existing data and/or share data with other transportation agencies. For example, the state departments of transportation often have freeway data for speed and capacity. Other potential sources of traffic data are the companies that manage GPS devices and GPS-enabled cellular phones. For example, Google monitors and archives traffic conditions in real time throughout the country via Android smart phones. This GPS data is currently unavailable to CCRPA and other regional planning agencies, but may become a source of invaluable data in the future. In Connecticut, the State Department of Transportation (ConnDOT) shares freeway-related data – as notably reported in CRCOG's CMP.

CRCOG's congestion report primarily focuses on private vehicles, freeways, and arterial roads using a combination of data provided by ConnDOT and manually collected data. Freeway conditions are continuously monitored electronically by ConnDOT's Regional Traffic Management System (RTMS) using a system of video cameras and traffic flow monitors. Arterial roads are assessed by driving the routes with GPS devices which record time, location, and speed. CRCOG's CMP includes three measures:

Speed

Average speed is calculated for vehicles on the overall corridor. CRCOG considers speed a poor measure because speed is affected by road type and design. Therefore, speed is not directly comparable across all the routes. Freeways and arterials can expect clear differences in speeds, but even the arterials show great variation. Some arterials mimic freeways with dividing medians and sparse access points, while other arterials are located through town centers.

Delay

Hours-of-delay is the total time of all vehicles spent traveling under a specific speed. For freeways, the threshold speed is 60 mph. This threshold speed is chosen because the Urban Mobility Report by the Texas Trans-

portation Institute, a nationally recognized publication of congestion, uses a threshold speed of 60 mph. For arterials, the threshold speed varies depending on several factors such as road geometry, traffic controls, and land use. Delay can be a misleading measure because the total amount of delay can depend on the total length of the corridor. A longer corridor can potentially have more delay due to a higher chance of stopping at a red traffic signal. (Furthermore, being stopped at a light is not necessarily congestion.)

Travel Time Index

This index is the ratio of average travel time during the peak hour versus the travel time during non-peak periods. The magnitude of the ratio greater than one indicates how much more the peak period is congested (longer travel time) than the daytime non-peak periods. For example, a ratio of 1.25 indicates that travel time is 25% longer in the peak period than the non-peak period. This is indicated as a strong measure because the relative nature of the travel time index allows for comparisons between different roads.

Congestion measures can dictate the tone of the CMP (whether it will focus on automobile speeds or other congestion-related factors). However, selection of the appropriate metrics can depend on the availability of data or other limitations of the agency responsible for the CMP.

Methodology for the Central Connection Region

This CMP focuses on arterial roads with data collection for passenger car performance and discussion for additional factors such as land-use patterns and alternative modes of travel. While the data collection efforts should focus on more than just automobiles, some of the broader measures of congestion are not applicable to the Central Connecticut region or are beyond the capabilities of CCRPA. For example, despite concern that transit is inaccessible or impractical to use in much of the region, a thorough review of transit is infeasible due to a lack of comprehensive data–the region's buses lack automatic vehicle location and passenger count devices.

To assess the performance of the region's transportation system for passenger cars, CCRPA collected data using GPS loggers in vehicles. These data were collected during peak and non-peak hours for several routes from March to June in 2011. Data collection efforts were coordinated with staff commutes and work-related trips. The GPS devices provide a continuous stream of travel data by recording a data point (position and vehicle speed) every second. The data were input into geographic information system (GIS) models for analysis and visualization.

Given the limitations of data collection and the nature of transportation in the region, this CMP assesses congestion with three measures of automobile speed. However, the strategies to address congestion involve looking at land use patterns, road networks, and alternative travel modes.

The three measures for assessing congestion in this CMP and potential limitations are discussed below:

Speed

As described throughout this report, speed is a poor measure of congestion for many reasons. However, the raw data (location and speed) are included for reference. These data are useful for visualizing all occurrences of low vehicle speeds which can portray a potential worst case scenario.

Methodology & Limitations

Raw data are collected with GPS loggers. Staff drove specific routes during their commutes (to and from work) and work-related trips. This includes travel at all times of day (peak and non-peak). The data (from all loggers and all trips) were aggregated together and imported into GIS software. The GPS loggers likely recorded higher vehicle speeds when encountering lower traffic volumes and more traffic signals in the green phase. Lower vehicle speeds are likely recorded when encountering more traffic and/or traffic signals in the red phase.

Due to the technical nature of data presentation in the GIS software, the points of data overlap – with the data points for the lowest vehicle speeds overlaid on the other data points. In a sense, this helps portray

the worst case scenario because the software highlights the data points with the lowest vehicle speeds. Since the data from all trips are aggregated together, the hypothetical worst case scenario is composed of the lowest speeds from all the trips. In reality, separate trips may have recorded low speeds on different segments of road. Although pieced together from different trips, the scenario is plausible because congestion is not entirely predictable or constant on a daily basis.

In the following chapters, the speed data are presented in five categories: 0 to 10 mph (red), 11 to 20 mph (orange), 21 to 30 (yellow), 31 to 40 (light green), and anything greater (dark green). This CMP attempts to stray from the idea that high speeds are always positive and low speeds are always negative (because speed must account for context). Rather than praise roads with high speeds, this report focuses on roads with low speeds (which can either be the result of congestion or context) where vehicle speeds are less than 10 mph (red).

Raw speed data is useful for reference, but the legal posted speed limit varies between roads. Therefore, vehicle speed data does not allow for a fair comparison between roads.

Average Speed to Speed Limit Ratio

This measure compares average vehicle speeds with the speed limit. This methodology assumes that the posted speed limit is the normal speed (what speed is expected). Ultimately, this measure attempts to relate vehicle speed with the context of the road. For example, this measure does not penalize low vehicle speeds in a pedestrian-oriented downtown area if the posted speed limit is also low. Ratios around 1.0 are preferable – greater than 1.0 indicates vehicle speeds above the speed limit; less than 1.0 can indicate congestion.

Normal speed *is a complex concept that can be difficult to define. It is the expected speed of the roadway. The value varies between roads of different design standards and contexts. For the purpose of this CMP, the posted speed limit is used as the normal speed, and these two terms are often used interchangeably throughout this report.*

Methodology & Limitations

Within the GIS software, the average value of the raw speed data is calculated for road segments of predefined lengths. The street network GIS file used in this analysis is developed and maintained by the State's Department of Emergency Management & Homeland Security (DEHMS). The calculated average speed is then compared to the posted speed limit as recorded in the DEHMS file. CCRPA staff verified and revised these speed limits, but some discrepancies between the recorded posted speed limit and the actual speed limit remain possible.

Normal speed can depend on many factors (especially on active arterial roads with significant development), but this analysis depends on the assumption that the posted speed limit accurately portrays the normal speed with respect to the context of the road. Otherwise, a ratio greater than one can also indicate the posted speed limit is too low or a ratio less than one means the posted speed limit is too high. This is a complex issue, but CCRPA found no other standardized alternative methods to determine normal speed on the many roads throughout the region.

In the following chapters, the ratios are presented in five categories: average speed is 0 to 0.25 of the speed limit (red), 0.26 to 0.50 (orange), 0.51 to 0.75 (yellow), 0.76 to 1.00 (green), 1.01 to 1.25 (dark green), and anything greater (black). Assuming that the speed limit is the best available representation of normal speed and that the speed limit has been accurately set for roads in the region, vehicle speeds close to the speed limit are preferred. The CMP can highlight cases of speeding, but the congestion aspect focuses on where the average speed limit is below the speed limit by more than half (red and orange).

Traveling above the legal posted speed limit is not recommended. However, CCRPA staff found that existing traffic speeds often exceeded the posted speed limit. (During data collection, CCRPA staff with the GPS loggers drove the routes while attempting to mimic existing traffic patterns but maintain safe following distances from other vehicles.) A possible explanation for these excessive speeds is that some roads are overdesigned for their posted speed limit. For example, a straight-away free-

way section with clear line-of-sight and wide shoulders makes drivers more comfortable driving at higher speeds (and ignoring the posted speed limit). Another example, a low volume local neighborhood street could also experience high vehicle speeds if the road is designed for high speeds (e.g., characteristics such as wide shoulders, wide turning radii).

This measure shows vehicle speeds with regard to context and is comparable between roads in the region, but neither this measure nor the first measure provide indication of delay and lost time.

Percentage of Time in Congestion (Vehicle Speed Less than 10 mph)

This measure reflects the time component of congestion. Contrasting with the raw vehicle speed data that shows the worst case scenario, this measure can represent how often the worst case scenario occurs.

This measure assesses delay as a percentage rather than the actual total delay in units of time. Travel time is relative to the length of the roads and normal speeds. Therefore, representing delay as a percentage allows for a fair comparison between the many roads in the region.

Methodology & Limitations

The time between each data point presented in the GIS software is an equal period of time, one second. To determine percentage of time in congestion, for each road segment, the number of data points with vehicle speeds less than 10 mph is compared to the total number of data points.

A limitation to this methodology is that vehicles traveling under 10 mph can be the result of congestion, traffic signals, a combination of both, and/or other factors. A critical part of this analysis is determining when slow vehicles are the result of congestion or other factors.

In the following chapters, the percentage of time spent in traffic is presented in three categories: vehicles are traveling under 10 mph between 0% to 25% of the time (green), 26% to 50% (yellow), 51% to 75% (orange), and 76% to 100% (red). This CMP focuses on where vehicles are spending more than half their time traveling under 10 mph (red and orange).

In the next chapters, these measures will be described in greater detail alongside the data.

Before proceeding, note that the overall process has limitations as well. This report represents CCRPA's best effort to quantify congestion in the region, but financial constraints and staff capabilities (e.g., staff cannot physically monitor all roads at all times) mean that gaps in coverage do exist. One notable constraint is that the data does not contain a proportional amount of directional travel. For example, the GPS devices recorded more staff morning commutes on arterials towards the city of Bristol than away from the city. To alleviate this issue, CCRPA could contact other regional planning agencies, such as CRCOG, that may have commutes towards Hartford to collect and share data. CCRPA will also continue to attempt to access the extensive traffic data belonging to companies that manage GPS-enabled devices. Until such data is available, manual collection of data is inefficient due to labor intensity and cost.

VII *The region*

Congestion in the Central Connecticut region is not systemic, but more localized to specific corridors and locations. The freeways (Interstate 84 and Connecticut Routes 9) experience relatively low congestion within the boundaries of the region. Congestion problems are primarily perceived along the region's arterials (such as US-6, CT-10, CT-15, CT-72, and CT-229) – especially the arterials with high concentrations of auto-oriented commercial development (strip malls); signalized intersections; and off/on ramps joining the freeways. The arterials function as feeder routes to freeways, primary routes through the region, and general business/shopping districts.

The raw data collected for the Central Connecticut region, expressed in vehicle speed at specific locations in one second intervals, are shown in Figures 2 and 3. The first figure presents all the collected data. Data points where vehicle speeds are high (for example, where a traffic signal is green while driving through) may be overlaid by the data points where vehicle speeds are low (for example, a traffic signal turns red). Therefore, the speed data presents the worst case scenario for vehicles where speeds are low (for example, stopped at every traffic signal behind numerous cars). The second figure only shows the slowest points (speed less than 10 mph). Slow vehicle speeds can be the result of congestion, traffic signals, a combination of both, and/or other factors.

In Figure 3, a concentration of slow points at one location may represent a vehicle at a traffic signal, but a series of slow points could potentially indicate congestion. A series of slow points can represent a long queue of cars waiting behind another car attempting to make a turning movement or a queue of cars at a traffic signal and can point to cases where a vehicle sits through more than one cycle of phases at a traffic light. (In layman's terms, this means the car is at a red light, the light turns green, but there are so many cars that the light turns red again before the car can get through the intersection.) Determining when slow speeds are attributed to congestion or other factors is a critical piece of this report.

These figures help CCRPA select US-6, CT-10, CT-72, and CT-229 for further review in this CMP. Slow speed may pose a problem for long-distance through travelers, but slow vehicle speeds can be acceptable and appropriate for many of the busy shopping streets and pedestrian-oriented places in the region. The measures revolve around vehicle speed and time, but discussion regarding other factors such as transit options and land use are also included.

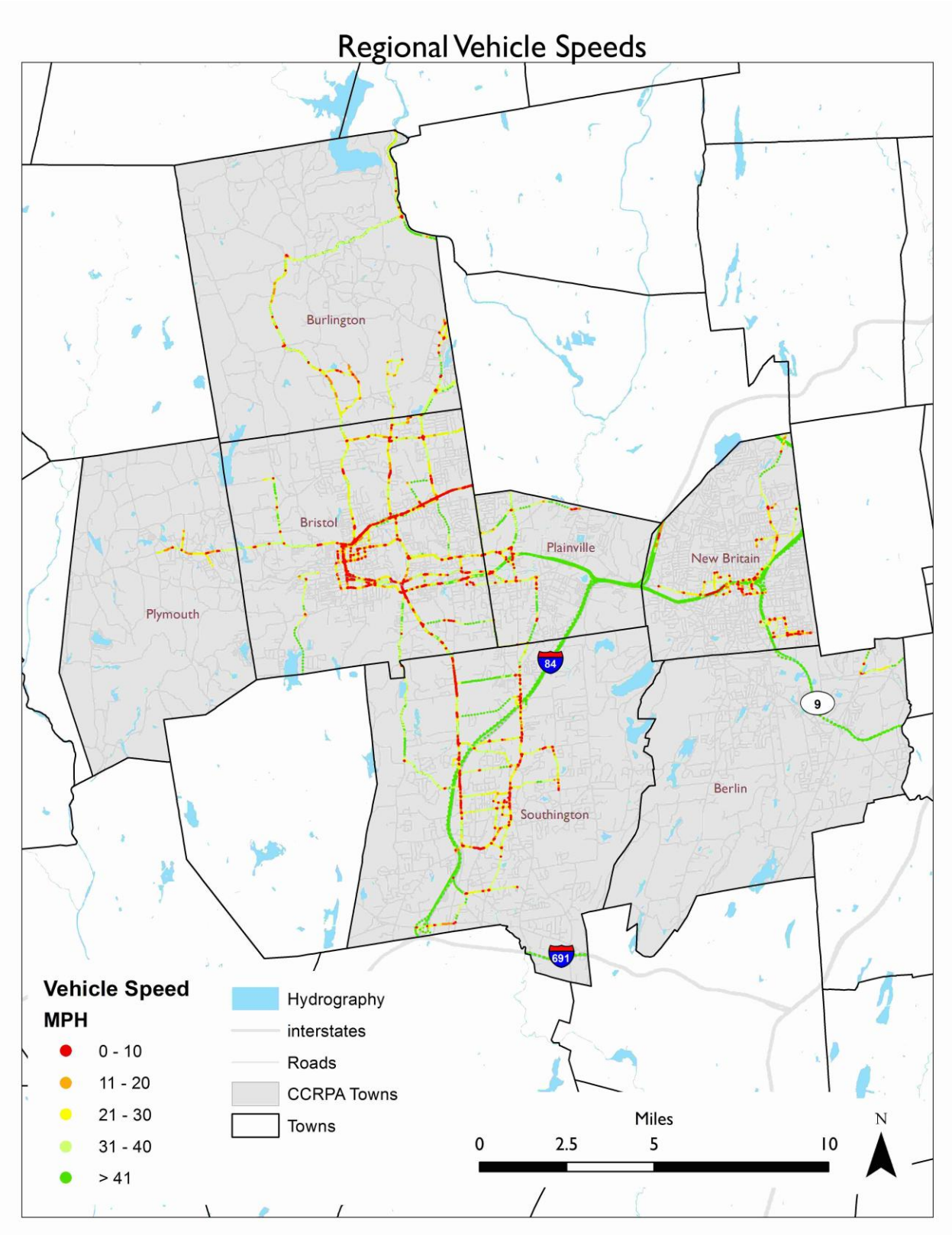


Figure 2: Regional Vehicle Speeds (Raw data from GPS loggers)

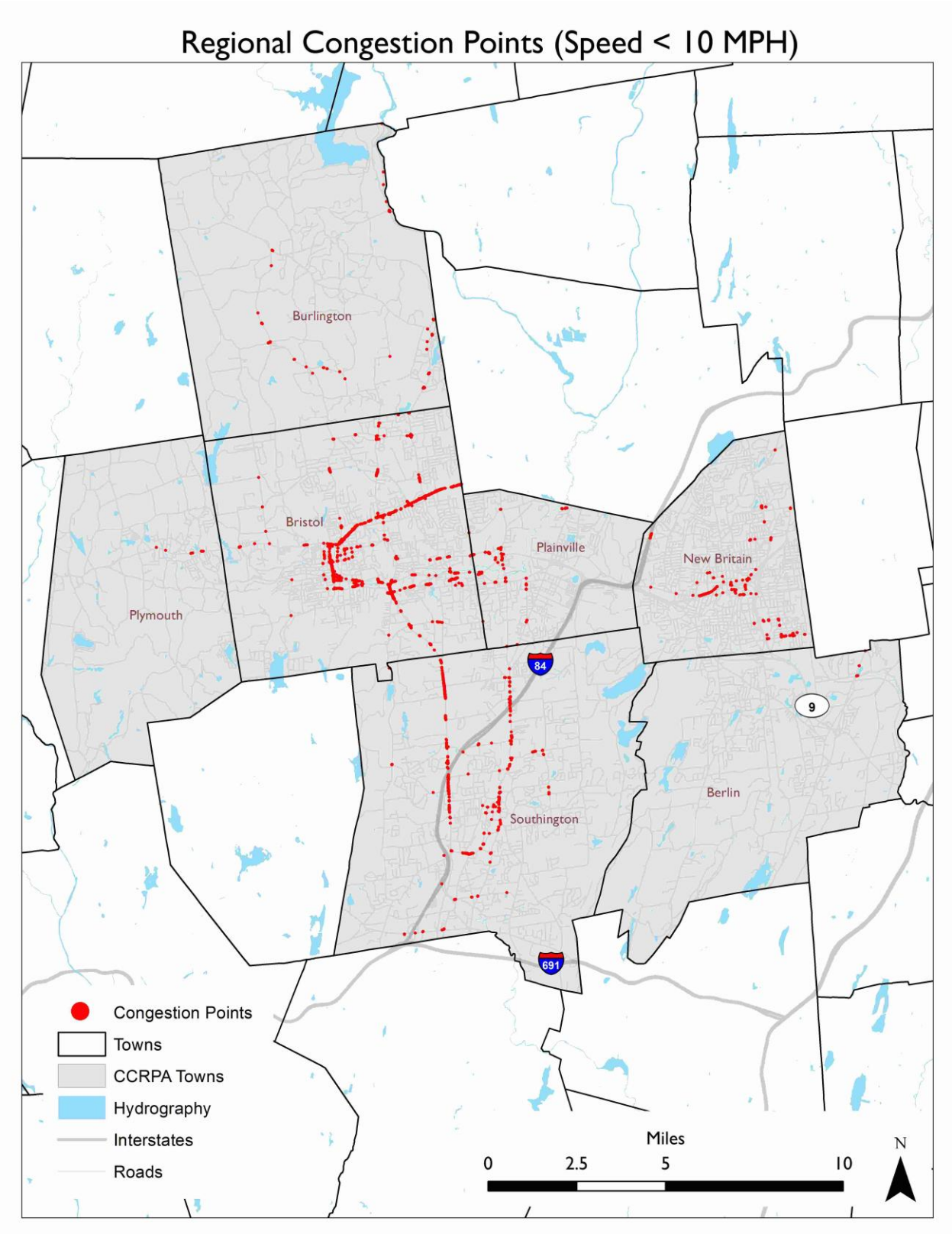


Figure 3: Regional Congestion Points (Occurrences of Vehicle Speeds less than 10 MPH

VIII *Interstate Highways*

Two interstate highways are present in the Central Connecticut region.

Interstate 84

This portion of I-84 is approximately 12 miles and crosses the towns of Southington, Plainville, and New Britain. The average daily traffic (ADT) is around 80,000 cars per day. The next major cities are Waterbury, to the west, and Hartford, to the east.

Interstate 691

This portion of I-691 is approximately 3 miles long and is in the southern end of Southington. The ADT is around 40,000 to 60,000 cars per day. This auxiliary freeway (three-digit subset of the interstate highway system) connects with I-84 in Southington and I-91 to the east.

The source of these traffic volume data is the 2010 ConnDOT Traffic Log.[5]

Traffic patterns on I-84 are significantly different between Central Connecticut and the surrounding area. In Central Connecticut, the ADT is in the range of 80,000 cars per day on the six-lane sections (three lanes per direction). Where I-84 meets with CT-72 in New Britain, the ADT is approximately 125,000 cars per day (ten lanes total). In contrast, other portions of I-84 through Hartford experience 90,000 to 130,000 cars per day on the six-lane sections and over 160,000 cars per day on some sections with more than six lanes. Commute patterns in the morning are primarily eastbound from Central Connecticut towards Hartford; the afternoon traffic is westbound away from Hartford. To a lesser extent, there are commuters towards and from the Waterbury direction as well.

[5] ConnDOT. *2010 Traffic Volumes State Maintained Highway Network (Traffic Log)*. http://www.ct.gov/dot/cwp/view.asp?a=3532&q=330402

I-691 is two lanes in each direction and carries an ADT of 40,000 to 60,000 cars on the Southington section. The busiest section of I-691, located in Meriden, sees between 70,000 to 80,000 cars per day.

I-84 and I-691 in the region are not known for congestion problems, but this section is reserved for future use. Any congestion on the access ramps (between I-84 and arterial roads) are assessed in the next chapter.

IX *Arterials (U.S. and State Routes)*

Numerous arterials cross Central Connecticut. This report includes:

1. US-6 in Bristol and Plymouth
2. CT-10 in Plainville and Southington
3. CT-72 in Bristol, Plainville, and New Britain
4. CT-229 in Bristol and Southington

The following three measures represent different aspects of congestion. Together, they help explain the relationship between vehicle speed and congestion.

Raw vehicle speed *data present the worst case scenario. Data points with lower vehicle speeds overlay and cover data points with higher vehicle speeds. A cluster of low speeds can indicate stops at a traffic signal, while a series of low speeds can indicate potential congestion. The consistency of vehicle speeds can indicate vehicle flow (low speeds suggest stop-and-go traffic). The focus is on speeds less than 10 mph.*

Average speed to speed limit ratio *compares actual vehicle speeds with expected normal speeds. Although not necessarily ideal, speed limit is used as the representation of normal speed. The focus is on ratios less than 0.50 (where average speed is more than half below the speed limit).*

Time spent in congestion (percent of time vehicle speed less than 10 mph) *shows how often vehicles are driving slowly (which could be the result of congestion or traffic signals). This complements the other measures by*

providing a time component. The focus is on vehicles spending more than half the time traveling under 10 mph.

U.S. Route 6 in Bristol and Plymouth

US-6 is a major east-west route through Bristol and Plymouth. To the east, US-6 merges with I-84 in Farmington and through to Hartford; to the west are Thomaston and Route 8. Many commuters and freight trucks (for destinations beyond Bristol and Plymouth) use Route 6, but development along the route also attracts substantial local traffic. The ADT ranges from 25,000 cars per day at the Farmington town line; to 18,000 near North Main St in Bristol; and to 11,000 in Terryville in Plymouth.

Note that data collection for the CMP is limited by staff hours. Weekend peak hour conditions are unmonitored in this report. As a primary commercial area, Route 6 weekend traffic can exceed weekday commuter traffic (based on anecdotal evidence). The same can potentially be true for the other arterials in this CMP.

Figure 4A – Raw Vehicle Speed

From this presentation, in the worst case scenario, there is the potential for slow traffic extending from the Farmington town line to North Main Street in Bristol (continuous stream of red data points indicating low vehicle speeds). Vehicle speeds are higher west of North Main Street towards Terryville in Plymouth. Until reaching the village center of Terryville, vehicle speeds and flow are consistent with slowing clustered only around traffic lights.

Figure 4B – Average Speed to Speed Limit Ratio

The results of this measure are similar to the raw speed data. Average vehicle speeds are below the speed limit mostly around the portion of Route 6 from the Farmington line to North Main Street in Bristol. The area between Terryville and North Main has average speeds at or above the speed limit.

Figure 4C – Time Spent in Congestion

This figure suggests that, most of the time, vehicles are generally moving. The areas that vehicles spend the most time at a standstill are near major intersections such as US-6 with Stafford Ave, Brook St, Route 229 (King St), Route 69 (Burlington Ave), North Main St, Clark Ave, Riverside Ave (Route 72).

These three measures show that there is potential for congestion, but traffic is generally moving. The raw speed data shows, in the worst case scenario, a large portion of US-6 can experience slow vehicle speeds. On the same stretch of road, average vehicle speeds are below the speed limit (our representation of normal speed). Despite these negative outlooks, the small percentage of time that vehicles spend below 10 mph suggests that traffic is constantly moving. Therefore, vehicles are traveling slowly (below the speed limit) but consistently (little stop-and-go traffic).

A possible explanation for these vehicle patterns are the number of traffic signals related to intersecting routes and major shopping centers. Route 6 is the primary east-west route and intersects with numerous north-south routes such as US-69 and US-229. US-6 is also one of the primary shopping corridors in the region with numerous big box stores, strip malls, and small businesses along the entire route. These factors contribute to the high volume of vehicles on US-6, the need for numerous traffic signals, and a large number of vehicles that must turn in and out of the road. These factors compound to result in low vehicle speeds. The segment of US-6 with the lowest vehicle speeds (Farmington line to North Main St) is the same segment of road with the highest proportion of traffic signals and businesses. The segment of Route 6 with higher speeds (North Main St to Terryville) has relatively much fewer traffic signals and development.

The following section further describes the surrounding land use and road networks, as well as transit options.

Additional Considerations & Factors Related to Congestion

Alternative Modes of Travel

Transit options are limited to local bus service run by CT TRANSIT, the Bristol Local (BL) Line, which operates on weekdays from 7 am to 6 pm. This line runs between Tunxis Community College in Farmington along Route 6 and North Main St to downtown Bristol at McDonald's. The short length of the route (travel to destinations beyond Tunxis or downtown Bristol require a transfer), limited hours of operation, and confusing schedule may limit the utility of the route to potential riders on the corridor.

Bicycling and pedestrian amenities are also limited. There are no bike lanes, and only an inconsistent shoulder (usually narrow but sometimes wide in places) exists on the street. Sidewalks exist for the sections with development but do not exist consistently on both sides of the road. In some cases, the sidewalk ends and users must cross the street midblock (with no crosswalk or signals) to continue using the sidewalk. Where pedestrian crossing buttons do exist, they are often not linked to a dedicated pedestrian signal and phase but, instead, trigger a green light for adjacent commercial driveways. This design may actually increase the likelihood of conflicts between pedestrians and vehicles, as it forces pedestrians to cross in the path of turning vehicles, which are less likely to see or be seen and whose drivers may not expect to encounter pedestrians. In addition, even when sidewalks are present, they rarely connect to the facility they front—pedestrians generally must cross large parking lots, including busy access drives to get to the facility. Both bicyclists and pedestrians face potentially intimidating or unsafe conditions due to high traffic volumes and numerous curb cuts. In the densest areas, non-drivers must cross a driveway every fifty feet. These factors likely inhibit area residents from walking or biking to destinations on or across Route 6.

Land Use

Development along and adjacent to the corridor is mostly characterized by low density residential, small businesses, and large shopping centers. However, US-6 crosses through the village center of Terryville as well as

the northern side of Bristol's downtown. The latter is in the process of redeveloping in a traditional pedestrian-friendly mixed-use manner. Aside from these town centers, the low density patterns of development and strip malls reflect typical automobile-oriented development. For the majority of destinations, access to goods and services also require access to automobiles.

Operations and Road Networks

Traffic operations refer to the management of traffic flow, which is largely regulated by traffic signals along US-6. To provide optimal flow and minimize delay along the corridor, these signals should be verified that they ensure a continual green wave for vehicles. (In layman's terms, this means that the traffic signals should be coordinated so that they turn green in progression as vehicles travel along the route.) From experience driving the routes, these traffic signals are not always well-coordinated.

Note that, although the intent of improving traffic operations is to reduce delay at signals, another potential result is that signal coordination can lead to higher vehicle speeds. By nature, higher vehicles speeds reduce delay but can also lead to more dangerous road conditions (for other vehicles and especially for non-motorized road users). In some contexts, traffic signals are actually used as a deterrent to high speeds. To limit this effect, signal coordination should be verified in tandem with a review of physical road characteristics (e.g., roadway width impact on speed, line of sight due to horizontal and vertical curvature, traffic calming measures, et cetera). Previous chapters discussed the relationship between road design and vehicle speeds. Signal coordination should be sought to reduce delay at signals but not to encourage vehicle speeds.

Many curb cuts along US-6 should be considered for consolidation or elimination. Some large shopping centers have one curb cut for entrance/exit, but there are numerous smaller groups of businesses with individual driveways. Consolidating these driveways can benefit both the businesses and overall traffic. Businesses benefit because fewer driveways mean more land can be used for parking. Overall traffic benefits be-

cause a reduction in the number of curb cuts will reduce the number the number of conflict points with turning vehicles.

The road network of surrounding streets resembles a loose grid with culs-de-sac. Since no roads run completely parallel with US-6, all east-west traffic collects onto US-6. Any major incidents or closure of the route leaves travelers with few alternatives. The closest arterials that parallel US-6 are either one to two miles to the north or south. Most traffic must take Route 6, even for a short distance. This incomplete street network contributes to the high volume of cars and number of turning vehicles that slow traffic on the main arterial. A more well-connected network could relieve traffic from Route 6 by offering alternative low-volume routes which may be preferable to local travelers (which would also provide safer conditions for pedestrians and bicyclists).

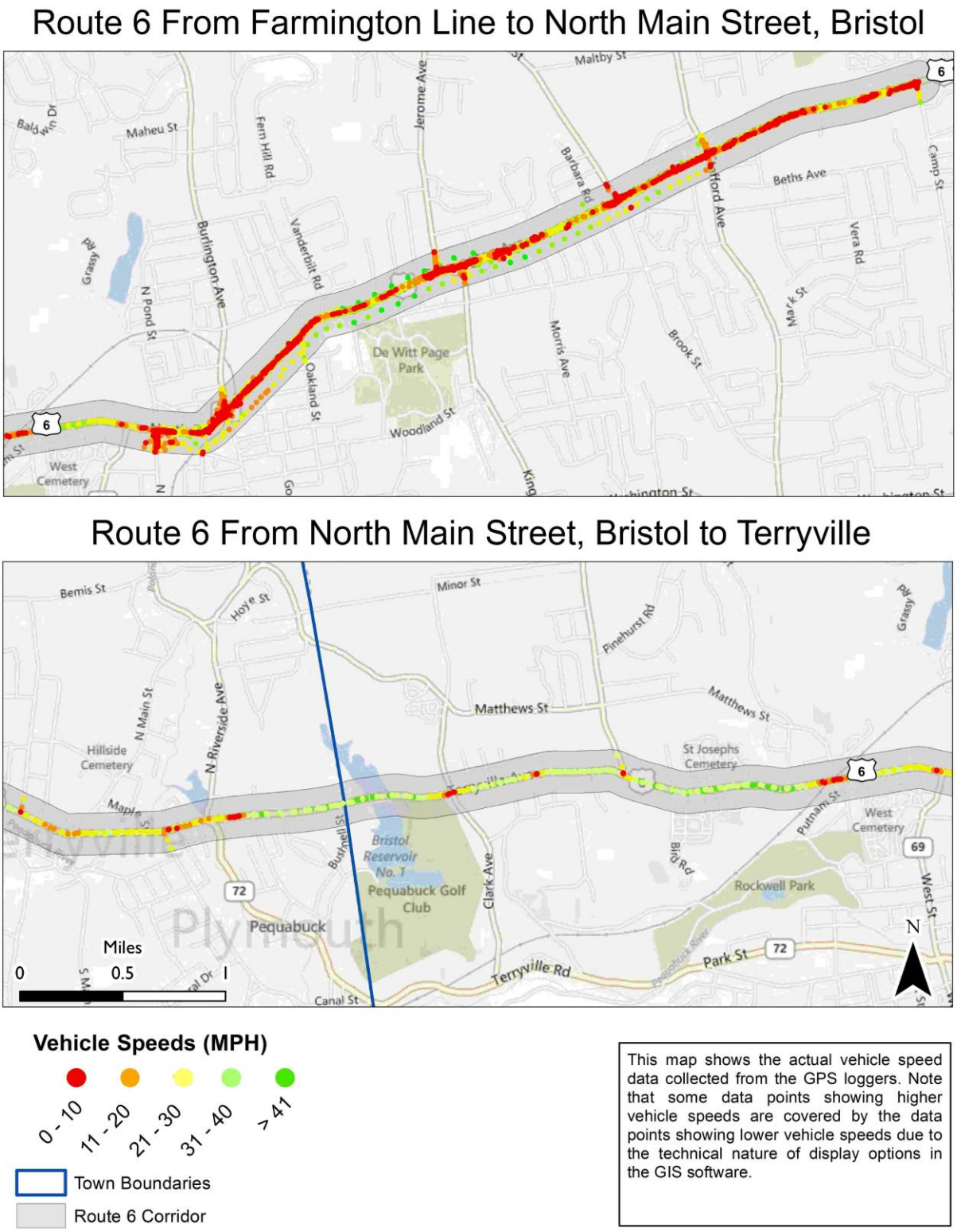
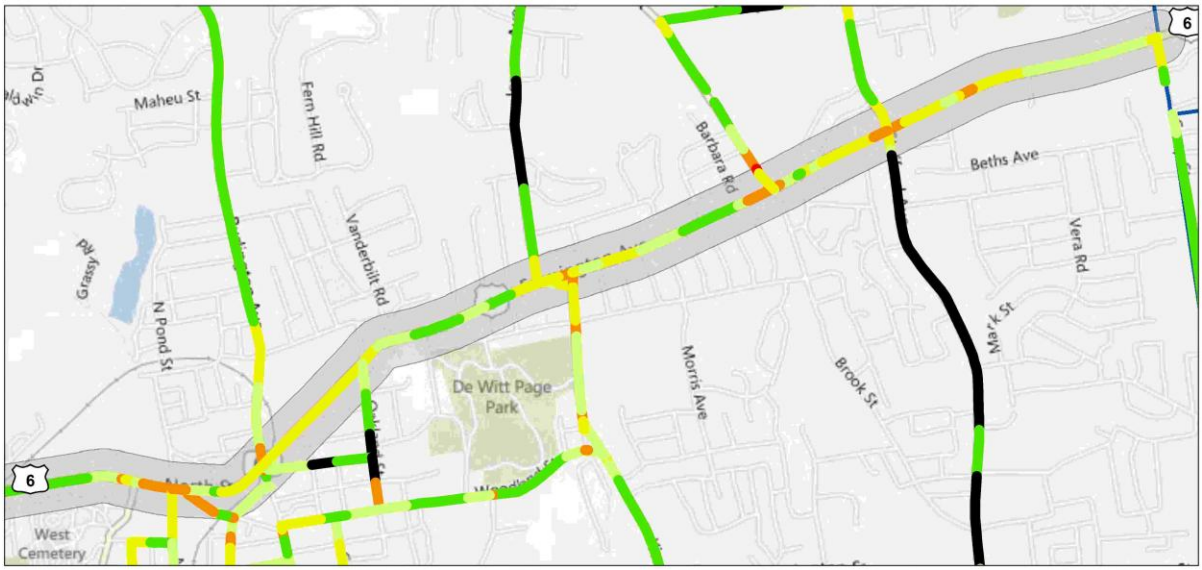
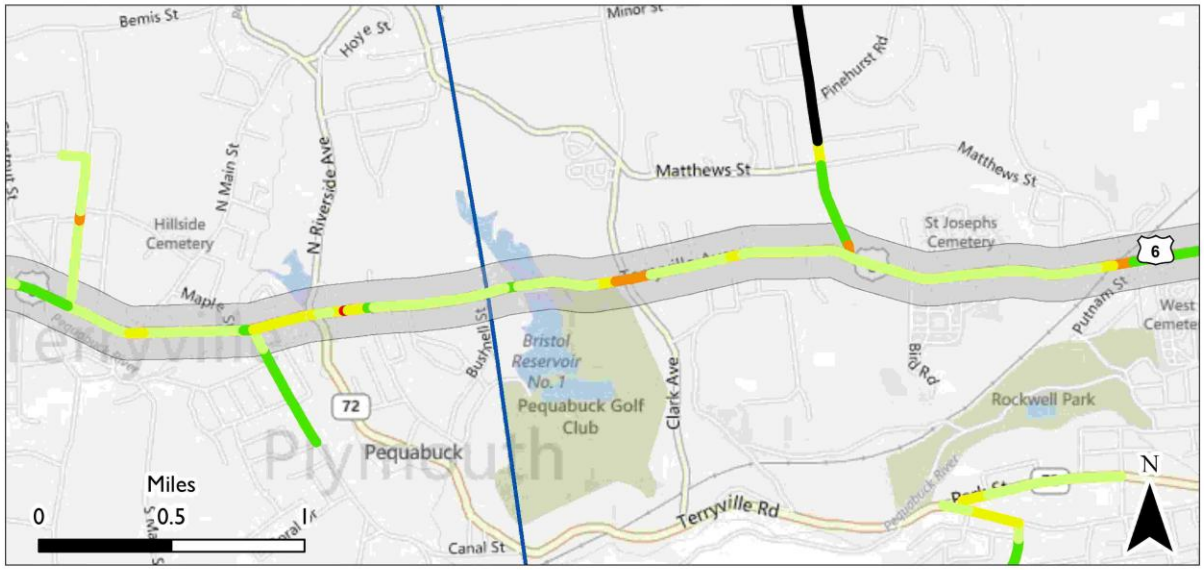


Figure 4A: US-6 Raw Vehicle Speed

Route 6 From Farmington Line to North Main Street, Bristol



Route 6 From North Main Street, Bristol to Terryville



Vehicle Speed to Speed Limit Ratio

0.00 - 0.25
0.26 - 0.50
0.51 - 0.75
0.76 - 1.00
1.01 - 1.25
> 1.25

Route 6 Corridor

Town Boundaries

This map shows the ratio between the average vehicle speed and the expected normal speed. This methodology assumes the posted speed limit is the best available representation of normal speed.

Figure 4B: US-6 Average Speed to Speed Limit Ratio

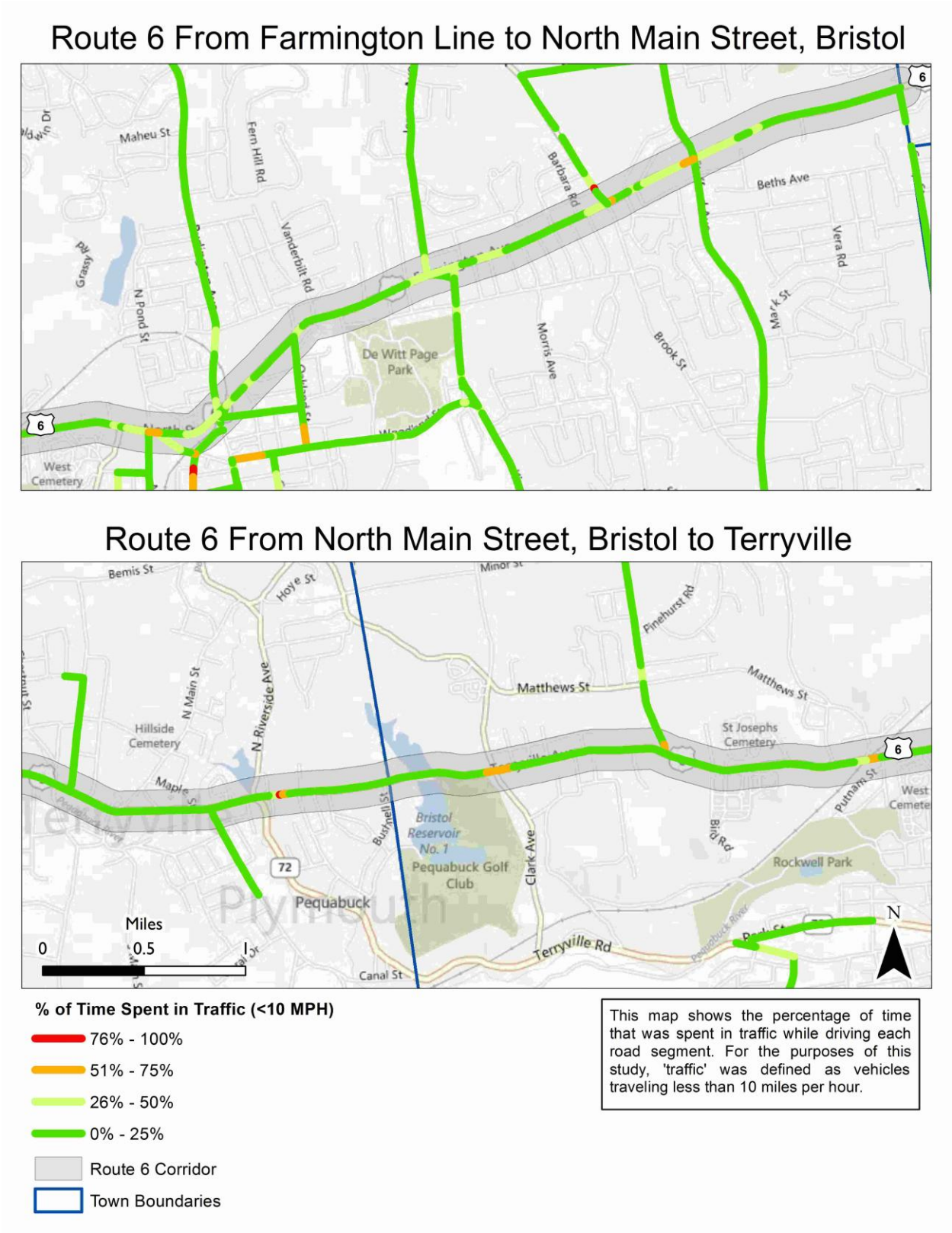


Figure 4C: US-6 Percentage of Time in Congestion

Connecticut Route 72 in Plainville and Bristol

CT-72 is another major east-west route in the region. CT-72 is a limited-access freeway in Bristol, New Britain and Plainville; in Bristol the road changes from a divided highway to an urban street which continues through Plymouth. The ADT is approximately 30,000 in New Britain; between 15,000 to 20,000 in Bristol and Plainville; around 10,000 near downtown Bristol; and fewer than 5,000 in Plymouth. This CMP focuses on CT-72 in Bristol because this portion has the dual responsibility of accommodating a high volume of through traffic while also functioning as an important street for businesses and local needs.

In 2011, a new section of CT-72 was completed in Bristol. The original CT-72 crossed through the village center of Forestville in Bristol. The new CT-72 is parallel to the old route but with twice as many lanes. Part of the new route is a new road, a divided highway with no developable frontage; the other part is a widening of an existing road, Pine Street, which has several small businesses and homes.

Figure 5A – Raw Vehicle Speed

High speeds are seen along the freeway portion of CT-72 in Plainville until reaching the traffic signal at the intersection with CT-372. Vehicle flow is consistent, only with stops near traffic signals, on both the old and new Route 72. The divided section of the new route experiences higher, often freeway, speeds despite a posted 40 mph speed limit and several signal-controlled intersections. The widened section of Pine Street, in contrast, experiences lower vehicle speeds. A particularly troublesome area appears to be the intersection between CT-229 with the new and old CT-72 – with slow vehicle speeds spanning across a handful of closely located signalized intersections.

Figure 5B – Average Speed to Speed Limit Ratio

Generally, vehicle speeds are within the range of normal speeds and only dropping to below half of normal speed around intersections (on both the new and old CT-72) which is expected. This figure also shows problems for the intersection of CT-229 and CT-72. Average speed for north-

south traffic through the intersection is below 50% of normal speed. On the other hand, east-west traffic is around 50% to 75% of normal speed.

Figure 5C – Time Spent in Congestion

For the majority of the corridor, vehicle flow is consistent and showing little time not moving. The old CT-72 still experiences delays at the intersection with Central St in Forestville. The most notable area of concern, again, is the intersection of CT-229 and CT-72.

The new Route 72 is a prime example of how traffic signals and development tend to slow traffic but not necessarily cause congestion (similar to Route 6). Ignoring the impact of traffic signals, the newly constructed divided section (with no developable frontage) has consistent flow at high vehicle speeds; the widened Pine Street section (with several businesses and residences) has consistent flow at low speeds. The consistent flow (although at different speeds), coupled with indication of low percentage of time under 10 mph, suggests minimal, if any, congestion.

The off-ramp from CT-72 westbound to CT-177 in Plainville is of potential concern. Even with two right-turn lanes and permitted right-turn on red, there is a long queue of vehicles at this signal during peak hours. This queue can back up onto CT-72, resulting in one lane of moving traffic and one lane of stopped traffic on CT-72. This may pose a safety concern as CT-72 is narrow at this location (minimal shoulders and no breakdown lane) and vehicles routinely exceed the 50 mph posted speed limit.

The opening of the new section of CT-72 has significantly altered traffic patterns along the corridor, with the greatest impact in Forestville. The old Route 72 in Forestville formed an offset intersection with Central St and was designed with a confusing traffic island to primarily facilitate east-west traffic. However, there is underlying north-south traffic that must take a circuitous route to get around the traffic island. Now that the new Route 72 carriers the majority of east-west traffic, a possibility is that the old intersection could be further studied to ensure the design and signal operation are still appropriate for the new traffic pattern.

A need to serve high volumes of traffic in all directions could also explain why the CT-229/CT-72 intersection measures so poorly among all three congestion metrics. This area consists of several signalized intersections that accommodate vehicles moving in all directions. These two routes are coordinated for a green wave independently of each other and potentially come in to conflict when they meet. Another possible explanation for the poor performance of this area is because CT-229 and CT-72 overlap between Riverside Ave and Mountain Rd–thus one section of road must carry the combined volume from two high-volume arterials. Alleviating this problem, as part of the new CT-72 construction, a new bridge was built that directly connects the eastern portion with the western portion, thereby passing the previous overlap that CT-72 had with CT-229. This bridge was not open during the time of this study's data collection, and it has yet to be determined whether this bridge has solved the issues in this area. (Anecdotal evidence suggests that it has not.)

West of CT-229, CT-72 has another difficult intersection with Downs St, Memorial Boulevard, and Blakeslee St. This intersection, with five approaches, can be confusing to those unfamiliar with the area. Traveling westbound, there is no clear indication of which travel lane corresponds to which street. Those seeking to continue on CT-72 or Blakeslee St (for Bristol Hospital) have one travel lane, with another lane for Memorial Boulevard. Many vehicles mistaken the lane for Memorial Boulevard for CT-72 and can cause conflicts at this intersection. There is often a long queue for CT-72 and Blakeslee, and Memorial Boulevard can function as an alternative route to CT-72. However, Memorial Boulevard only allows non-commercial vehicles.

Memorial Boulevard is a route through the center of Memorial Boulevard Park that is often used as an alternative to CT-72 by passenger cars. Many of these cars have the tendency to drive above the posted speed limit of 30 mph on this road. These high speeds are in conflict with pedestrians, bicyclists, and park users. Although the intent of Memorial Boulevard is to function as a calm drive through the park, the design of the road (divided road, good visibility, no curvature) encourages high travel speeds.

Additional Considerations & Factors Related to Congestion

Alternative Modes of Travel

Transit options along this corridor include local bus service by CT TRANSIT, the Plainville-Bristol (PB) line, as well as express commuter bus to downtown Hartford. The PB line operates weekdays from 6 am to 5 pm and runs between New Britain's downtown and Bristol's downtown along the old CT-72. Transfers are possible from New Britain to many regional destinations such as the Central Connecticut State University, University of Connecticut Medical Center, Westfarms Mall, Berlin Turnpike, Hartford, Meriden, and Middletown. However, transfers are often poorly coordinated, frequently entailing outdoor waits of one hour or more; current service from Bristol to downtown Hartford can take 90 minutes (compared to 25 minutes by car). Coupled with the early end of service (buses cease service before the evening commute), these travel times likely make bus service impractical for many residents and workers in the region. An express commuter bus operated by CT TRANSIT is also available from a park and ride lot located off CT-229 in Bristol for morning, midday, and afternoon rides to downtown Hartford.

The planned New Britain-Hartford Busway may address some of the shortcomings of the region's transit systems. The current draft service plan includes a seven-day-a-week shuttle from downtown Bristol to Hartford. On this service, travel times between Bristol and Hartford are expected to decrease to 50 minutes, frequency of service to increase to 12 minute headways at peak (and 20-30 minutes off peak), and the daily hours of operation are expanded.

Pedestrian and bicycling amenities are not ideal. The old CT-72 is designated as a State Bike Corridor in the *Connecticut Statewide Bicycle and Pedestrian Transportation Plan*[6] but lacks sidewalks and shoulders in some locations. The new CT-72 has no bike lanes and narrow shoulders; sidewalks only exist on the Pine St portion. Pedestrians and bicyclists still use the route even when lacking sidewalks, crosswalks at busy intersections,

---

[6] ConnDOT. *2009 Connecticut Statewide Bicycle and Pedestrian Transportation Plan*. http://www.ct.gov/dot/cwp/view.asp?a=1390&q=259656

and sufficient shoulder widths. These conditions, along with high volume and speed of vehicles, are dangerous for both pedestrians and cyclists.

Land Use

Development in this area consists of low density residential with some small businesses, a shopping center, and some industrial uses. Access to most goods and services require automobile access. However, CT-72 crosses the southern portion of Bristol's downtown (not shown in the figures) which is currently in the process of redeveloping in a walkable mixed-use style.

CT-72 no longer crosses directly through Forestville center (the current CT-72 is one block south of the former route), and the reduction in vehicle traffic has been applauded by some residents. The relocation of Route 72 onto Pine Street may raise pressure for development on that section. To accommodate commercial uses while minimizing an increase in traffic and potential congestion, the City of Bristol has proposed access management regulations. As part of the new construction, the State of Connecticut has also converted some of the streets to culs-de-sac.

Operations and Road Networks

Similar to Route 6, intersection traffic controls play a large role in regulating traffic flow along this corridor. The new bridge for CT-72 added a traffic signal to the system and does not appear to be well-synchronized with other signals. The intersection of CT-72 and CT-229 should be examined because some observations suggest the signal has increased delay. Additional intersections that should be examined include the confusing intersections in Forestville and at Memorial Boulevard.

There are some considerations for roundabouts in this corridor. Roundabouts act in the same capacity as signal coordination, with the similar result of reducing delay. However, while signal coordination can lead to increased vehicle speeds, roundabouts inherently reduce vehicle speeds.

The surrounding road network resembles a loose grid that allows for several alternative routes. There are several north-south routes (e.g., CT-229, Stafford Ave and Central Ave, and CT-177.) and east-west routes (e.g.,

old CT-72, new CT-72, Memorial Boulevard, and South St.) The most heavily traveled routes are CT-229 and CT-72, but locals often make use of alternate routes to avoid traffic.

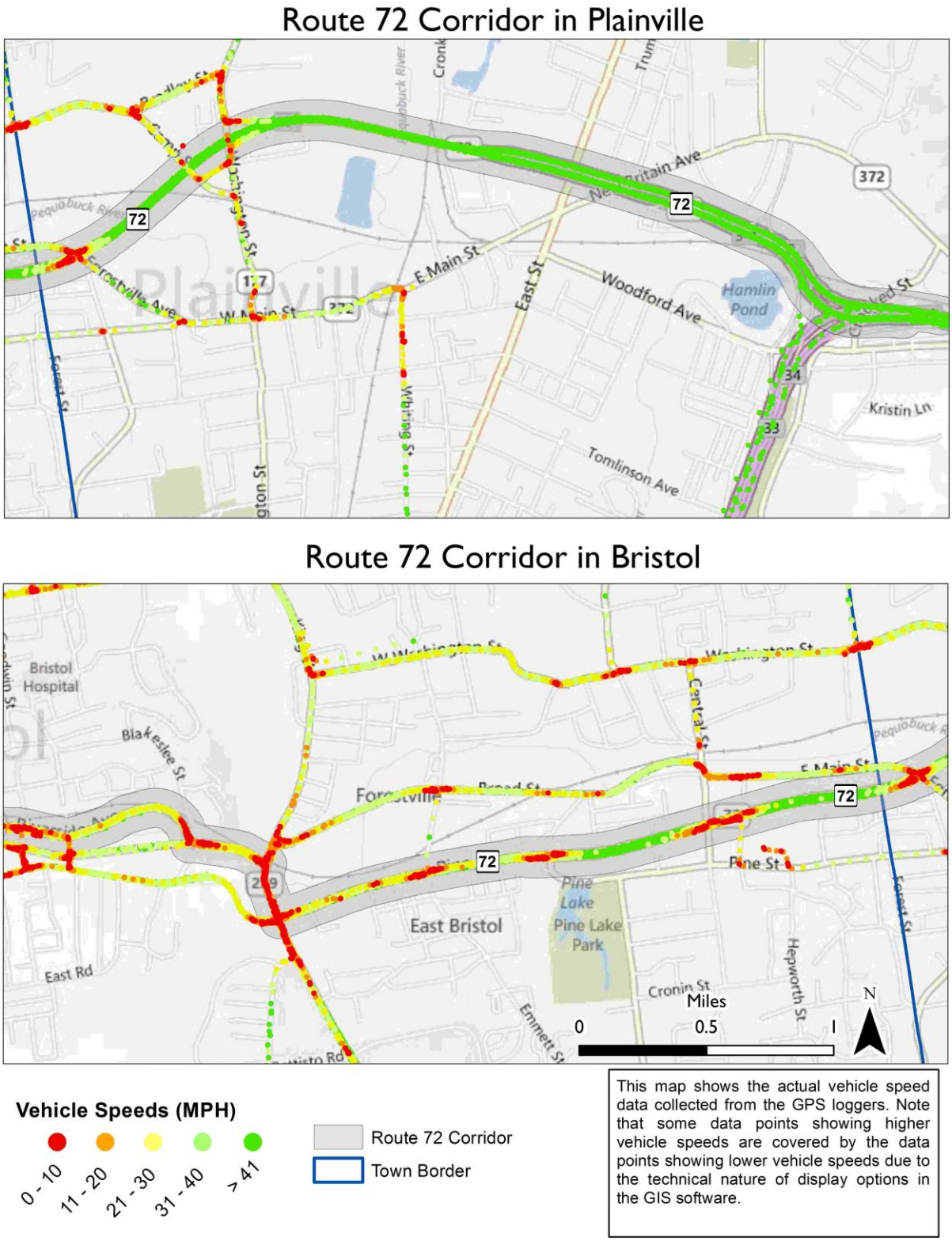


Figure 5A: CT-72 Raw Vehicle Speed

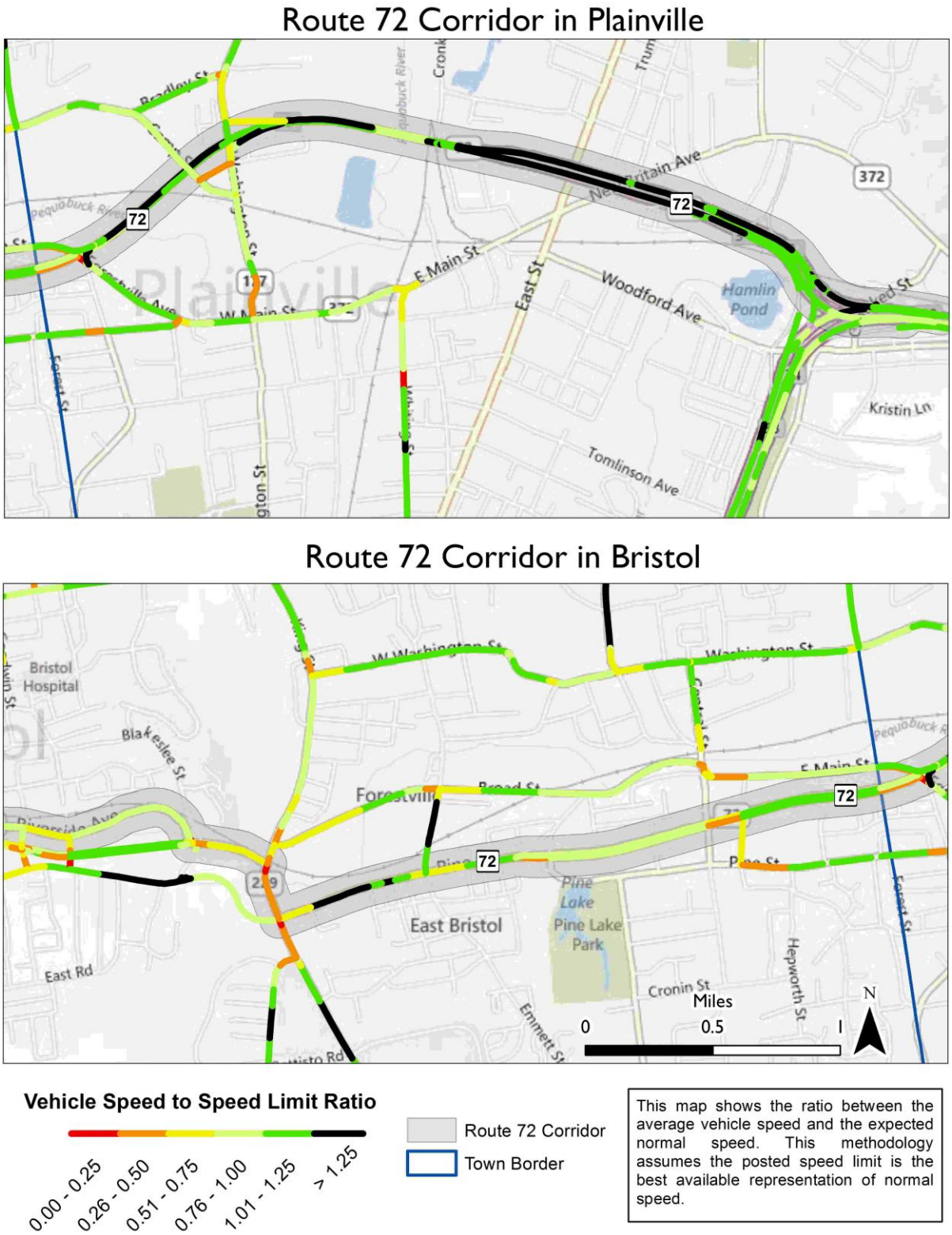


Figure 5B: CT-72 Average Speed to Speed Limit Ratio

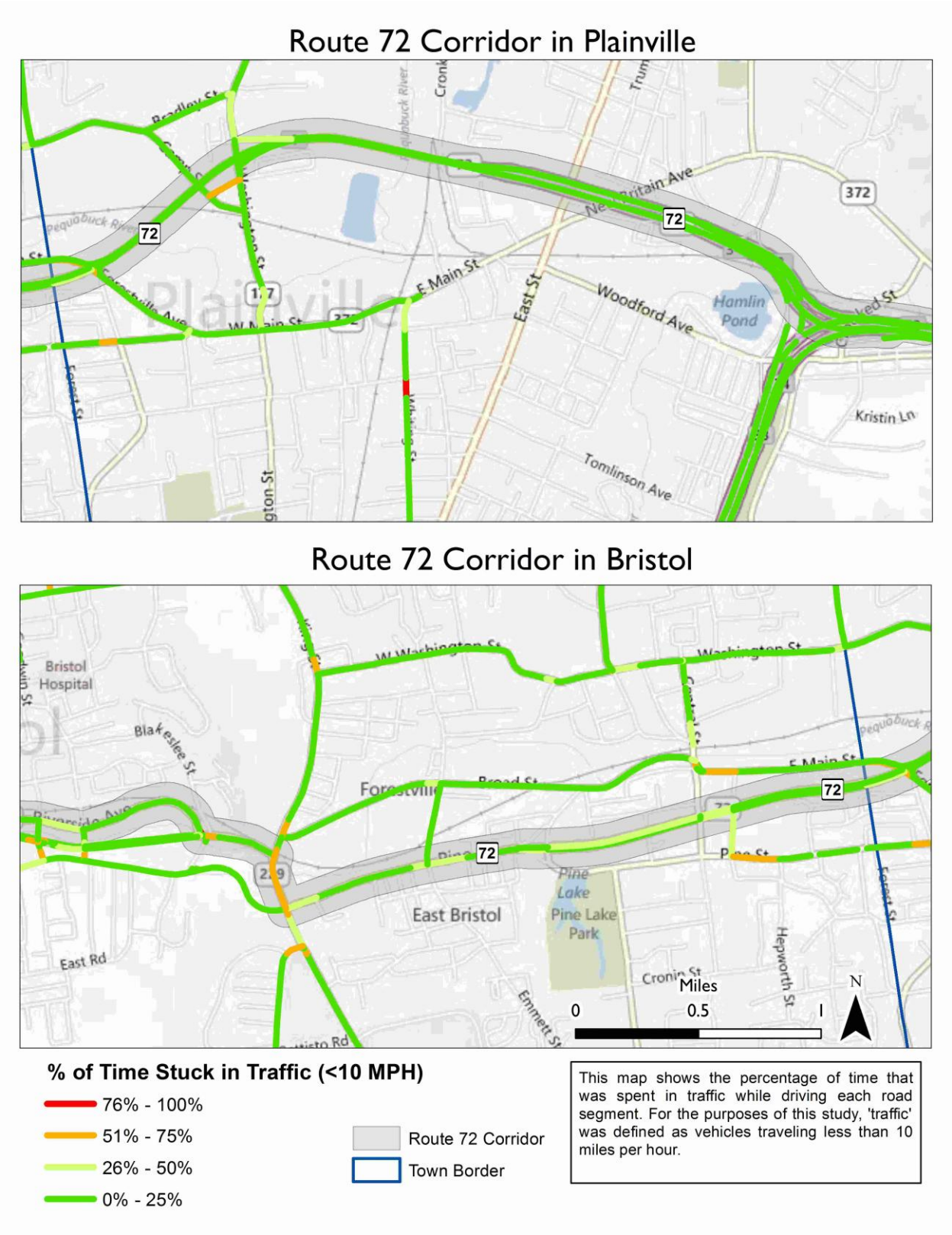


Figure 5C: CT-72 Percentage of Time in Congestion

Connecticut Route 10 and 299 around I-84 in Southington

CT-10 and CT-229 are two parallel north-south routes between Bristol, Plainville, and Southington. Both routes cross I-84 in Southington which connects west to Waterbury and east to Hartford. There is significant commercial and industrial development along the routes. The headquarters for ESPN, the largest private employer in the region, are located on Route 229 in Bristol. Route 10 has several big box stores, shopping plazas, industrial plants, and numerous other small businesses. The ADT for CT-229 is around 20,000 cars per day while ADT for CT-10 varies between 15,000 and 30,000.

Figure 6A – Raw Vehicle Speed

Showing similar patterns to the other corridors in the region, the areas with sparse development show higher vehicle speeds. Low vehicle speeds are observed near major intersections and areas of development. These locations are CT-229 near the Bristol town line (ESPN nearby), where CT-229 and CT-10 meet with I-84, and downtown Southington.

Figure 6B – Average Speed to Speed Limit Ratio

Most road segments show that vehicles are traveling within an acceptable range of normal speeds with an exception for CT-10 near I-84 and side roads in downtown Southington. Many of the roads between CT-229 and CT-10 have a posted speed limit of 25 mph, but most vehicles are traveling 30-35 mph on these roads.

Figure 6C – Time Spent in Congestion

Showing similar results, vehicles spent the most time in traffic on CT-10 near I-84 and downtown Southington. The majority of travel along CT-229 and CT-10 experiences little time spent traveling at speeds below 10 mph.

CT-229 is relatively well performing – with only the raw speed data showing potential for long queues and congestion. The intersection at W Queen St is signal controlled with ESPN headquarters to the north and an entrance to a large industrial park to the west. The intersection at I-84 consists of several traffic signals as well as entrances to shopping centers and office parks.

CT-10 experiences lower average speeds and more time in congestion due to significantly greater levels of auto-oriented development. A particular point of heavy traffic is at I-84. Furthermore, the immediate area to the north and south of the access ramps to I-84 include several large shopping centers and industrial businesses. Vehicle speeds are lower in downtown Southington, but slower speeds are not necessarily problematic here and expected due to pedestrian and on-street parking activity. Furthermore, Southington has recently completed streetscape improvements to the downtown area that include sidewalk bulb-outs and textured crosswalks (further encouraging lower vehicle speeds while making the area more hospitable to pedestrians).

Based on our collected data, traffic conditions are not particularly worrisome for these routes (except at a few key locations). However, there are substantial tracts of developable land and future growth could exacerbate any existing problems. Following existing patterns of low-density residential development and commercial/industrial parks will result in greater automobile usage on these roads. Aside from the traditional downtown area of Southington, access to services and goods will only be possible by private automobiles – as no transit service is available in Southington.

Additional Considerations & Factors Related to Congestion

Alternative Modes of Travel

The only transit option is an express commuter service by CT TRANSIT to downtown Hartford via I-84 accessible by a Park and Ride lot in Plantsville, Southington (not shown in the figures).

Like the other arterial corridors, CT-10 and CT-229 do not have ideal pedestrian and bicycling amenities (lack of bike lanes and poor sidewalk conditions), but Southington benefits from the Farmington Canal Heritage Trail (FCHT). The FCHT is a dedicated pedestrian and bicycling facility which runs along an unused rail right-of-way that runs parallel to CT-10. The FCHT currently connects New Haven, CT to Cheshire, CT and Farmington, CT to Massachusetts. The FCHT is incomplete and efforts are underway to connect the Southington portion with Cheshire. (Completion

of the Plainville portion, which will connect Southington and Farmington, is being held up by right-of-way issues.) Extensions are also planned to connect the trail with major employment areas in the region, such as the ESPN campus. The FCHT is the only viable option for non-motorized travel in Southington and is the only means to reach downtown Southington without an automobile. The FCHT has been regarded with great success, local support, and even as an economic draw for the city. Studies show that some segments of the trail attract over 500,000 visits each year which includes recreationists, tourists, and commuters.

Land Use

Like the other corridors in this CMP, land use generally consists of low density residential, shopping centers, and industrial uses. There are also large tracts of farmland and developable land. Within the past few decades, development pressure has resulted in the loss of farmland to typical automobile-oriented, sprawl patterns of development. The southern end of CT-10 is downtown Southington (and eventually Plantsville center which is not shown in the figures). These town centers are walkable and inviting for non-automobile users, but other destinations throughout the majority of Southington require access to automobiles.

Operations and Road Networks

As with other routes of significant development, traffic in this corridor is regulated with series of traffic signals that are often closely spaced together. The design of the I-84 access ramps on CT-10 and CT-229 require two or three traffic signals. Adjacent to these high-volume intersections are signalized entrances and exits to office parks and commercial strip development. These signals should be verified to ensure they are properly coordinated.

There are a large number of business driveways and curb cuts along CT-10 resulting in conflict points that can slow vehicle speeds as well as pose a safety hazard for pedestrians, bicyclists, and other vehicles. Most development consists of large shopping centers which concentrate into one driveway, but smaller businesses could consider a shared driveway as well.

Roads are sparse along this corridor, with the majority of roads as culs-de-sac that do not contribute to a grid network. CT-10 and CT-229 function as the primary north-south routes with several east-west connections between the two routes. A lack of continuous east-west routes through Southington channels vehicles onto Routes 10 and 229 (at least for a short distance until the next east-west route is available). Vehicles that must temporarily use CT-10 and CT-229 impede traffic by adding to the overall volume of vehicles and the need to make turns.

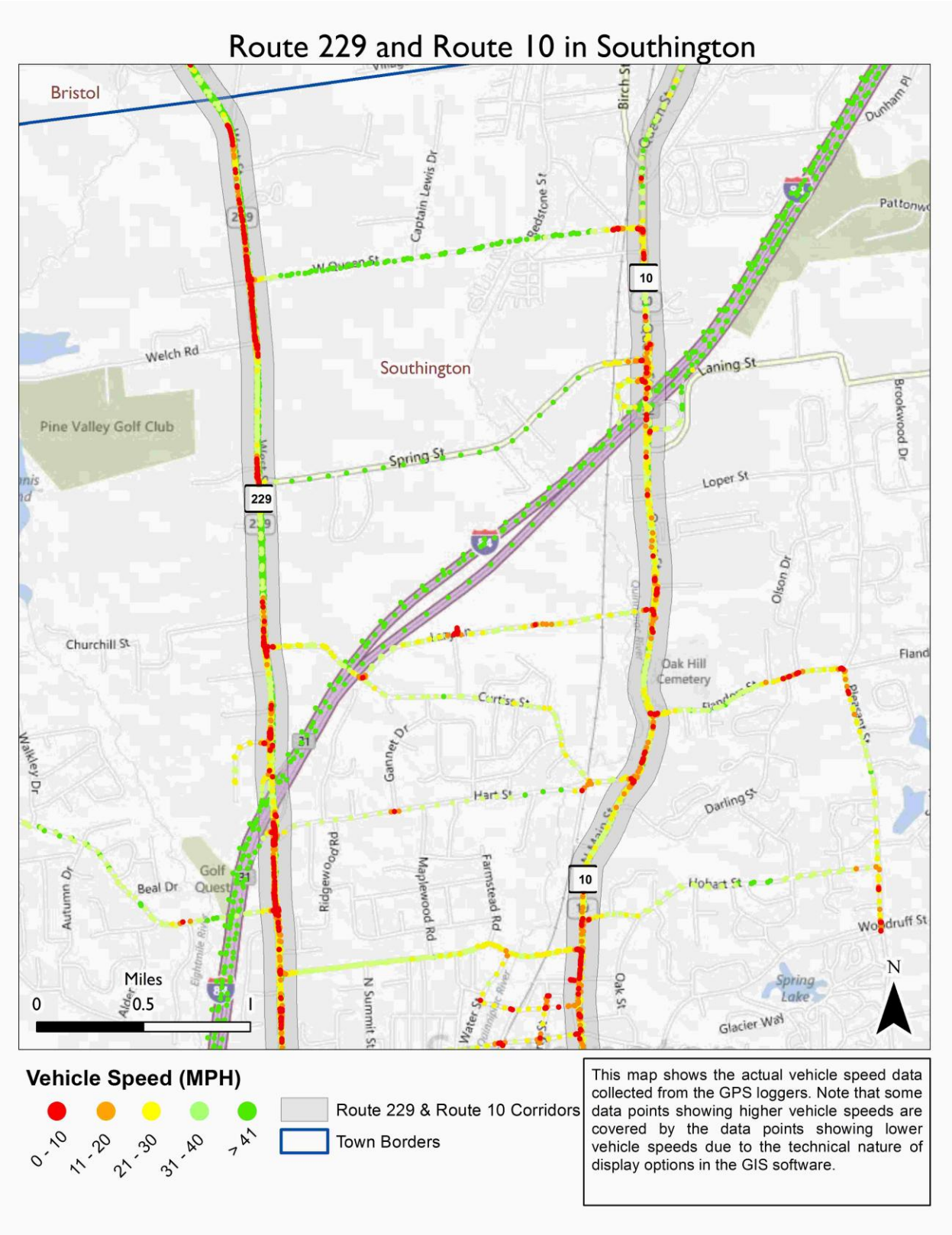


Figure 6A: CT-10 & CT-229 Raw Vehicle Speed

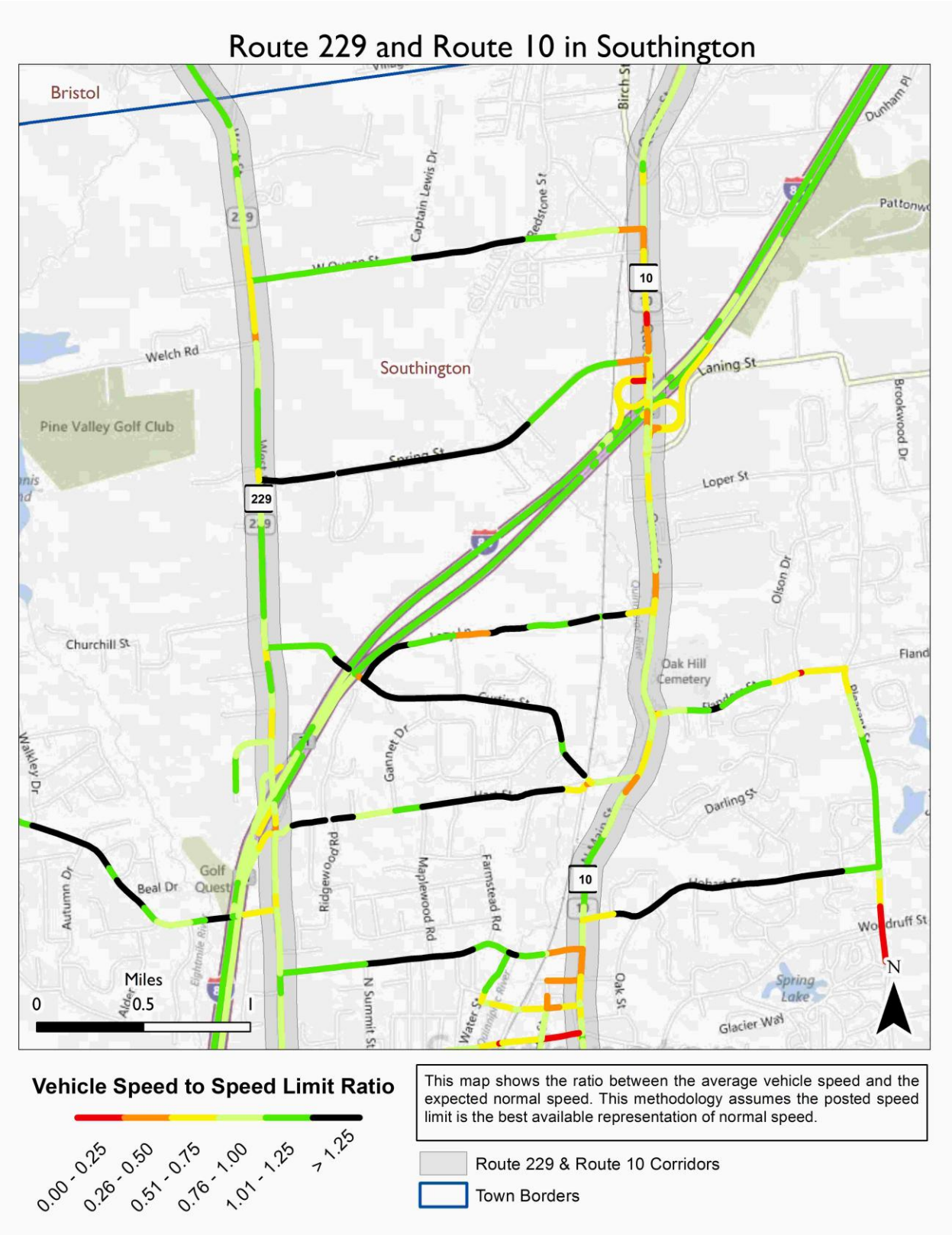
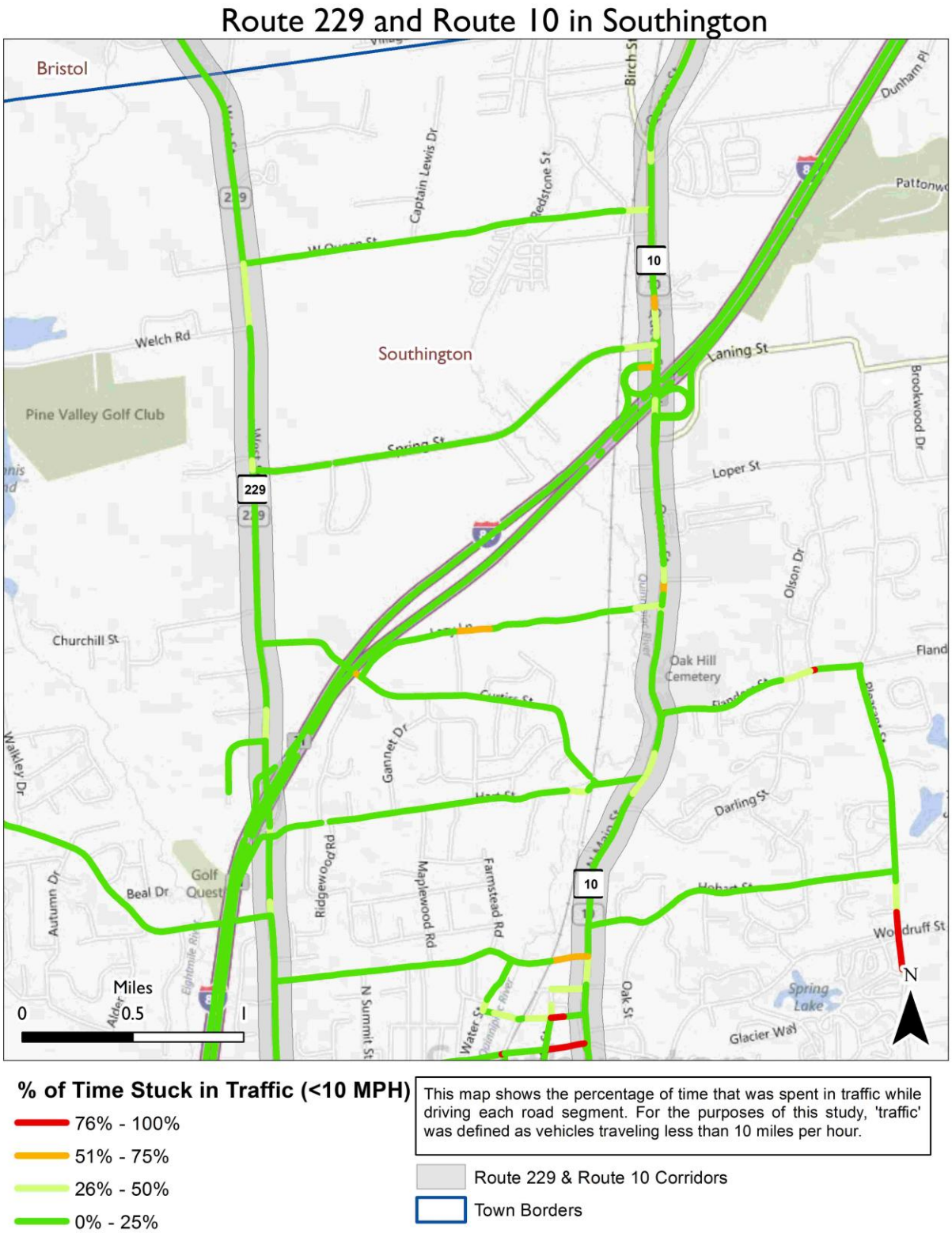


Figure 6B: CT-10 & CT-229 Average Speed to Speed Limit Ratio



% of Time Stuck in Traffic (<10 MPH)

- 76% - 100%
- 51% - 75%
- 26% - 50%
- 0% - 25%

This map shows the percentage of time that was spent in traffic while driving each road segment. For the purposes of this study, 'traffic' was defined as vehicles traveling less than 10 miles per hour.

- Route 229 & Route 10 Corridors
- Town Borders

Figure 6C: CT-10 & CT-229 Percentage of Time in Congestion

X Discussion and conclusions

The goal of this work is to provide an overview of the region's main transportation corridors, not to prescribe exact solutions. This report identifies potential strategies and locations where more detailed studies may be beneficial. The data focuses on automobiles, but understanding transportation and potential congestion problems requires a broader perspective of the surrounding context of places. Addressing congestion should consider the influence of land use, road networks, and alternative modes of travel.

This CMP focuses on the arterial routes (US-6, CT-10, CT-72, and CT-229) and three measures of congestion (raw vehicle speed, average speed to speed limit ratio, and percentage of time spent in congestion). Raw vehicle speed data provide a reference but are not comparable across the corridors because each road is unique with inherent differences in development patterns and road design. The latter two measures are relative in nature, being a ratio and a percentage, and therefore allow a more fair comparison between the roads in the region.

The data for raw vehicle speed for the region's three main corridors shown in Figures 4A, 5A, and 6A reveal a pattern of low vehicle speeds around areas with a relatively higher density of traffic signals and development. These areas are along Route 6 in Bristol and Route 10 in Southington. The intersections of major roads (CT-229 and CT-72 in Bristol; CT-10 and I-84 in Southington) also experience low vehicle speeds due to longer signal phases at traffic signals that must handle the confluence of large volumes of turning vehicles. These intersections also depend on the coordination of several traffic signals at closely spaced intervals.

The ratio of average speed to speed limit shown in Figures 4B, 5B, and 6B appear to also be related to signals and development. The roads most likely to experience average speeds less than half of the posted speed limit are around Route 6 in Bristol, Route 10 in Southington, the intersec-

tion of Route 229 and Route 72 in Bristol, and the intersection of Route 10 and Interstate 84 in Southington.

The percentage of time spent in congestion (vehicle speed less than 10 mph) shown in Figures 4C, 5C, and 6C portray how often or how much time vehicles spend waiting in congestion or at a traffic signal. Again, the areas of greatest concern are the same ones identified by the other two measures. However, time spent in traffic is often less than half the time. There are a few occurrences where traffic is moving slowly 50-75% of the time, but rarely does time spent in traffic reach above 76% of the time.

These three measures appear to identify four potential areas of concern. Although vehicle speeds are low and the average speed is often less than half the normal speed (for our purposes, the speed limit represents normal speed), vehicles are not spending a significant portion of time not moving. Determining what traffic is attributed to congestion and what traffic is expected due to signals and development is difficult, but these results suggest that congestion is not severe in the region. The traffic stream is generally moving, although sometimes at low speeds. There are very few instances where vehicles spend more than half their time not moving or moving slowly. The results suggest that some congestion is potentially present but not widespread to great extent throughout the region.

A side note, this CMP does not develop travel performance generalizations for each corridor as a whole (such as the average speed or total travel time along the entire route). Although some travel in the region is long distance, metrics for the full length of the route are impractical due to many factors. A majority of trips only utilize the arterial routes for short distances – whether because the end destination is on the arterial or because the lack of a well-connected street network forces vehicles onto the arterials. The context along each route also constantly changes – U.S. Route 6 crosses a village center, a drinking water reservoir, another downtown area, and strip mall development.

The latter two measures of this CMP are particularly valuable for understanding traffic concerns because the relationship between speed and

congestion is complex (especially for arterial roads); it is not as simple to say higher vehicle speeds are always better; the context of place must be considered. The raw vehicle speed data does not indicate whether the speeds are ideal for the road and surrounding land use. The speed limit ratio attempts to compare actual speeds with the expected and appropriate speed. For the purposes of this work, the speed limit is the best available representation of expected speed. This ratio accounts for context because low vehicle speeds are not penalized if the posted speed limit is also low (e.g., lower speeds and lower speed limits in a village or town center). The third measure assesses time. Which is another factor closely related to speed and congestion. This measure, shown as a percentage, presents where and how often vehicles are traveling slowly. The combination of these measures shows that, in some contexts, low vehicle speeds do not always lead to more time spent in congestion.

This CMP reflects the changing approach to transportation planning, from designing for faster vehicle speeds to designing for places. Focusing on vehicle speeds often encourages building freeways and widening roads that did increase vehicle speed, but often deteriorated the local communities along the routes (and actually increased traffic). Presently, many transportation agencies embrace concepts such as complete streets, green streets, livable streets, et cetera. There are many names, but these concepts essentially amount to similar goals – to build roads with respect to the context of place, to offer a balanced transportation system that is more safe and viable for all users (not just motorized vehicles).

Many transportation agencies recommend considering strategies to address congestion with capacity expansion (e.g., roadway expansions) as a final option. These alternatives are related to the broader context of each road. Although these alternatives are not directly related to automobiles, they can ultimately reduce vehicle usage. Examples of potential strategies in the region include:

Encouraging non-automobile oriented development patterns

Current development largely consists of low-density residential, strip malls, office parks, et cetera. Homes, jobs, and services are spread out in a manner where access requires automobile use. Mixed-use or transit-oriented development can reduce vehicle dependency and traffic levels while improving accessibility. This is a region-wide strategy but can leverage the most benefit by focusing around other transportation investments such as the Farmington Canal Heritage Trail (FCHT)–a dedicated pedestrian and bicycling facility in Southington and Plainville–and the upcoming bus rapid transit (BRT) system that will connect Bristol, New Britain, and Hartford.

Proposing access management strategies for existing development along the busiest corridors – such as Route 6 in Bristol and Route 10 in Southington. Many businesses should consider sharing parking lots and driveways. Reducing the number of curb cuts by combining parking lots reduces the number of conflict points between vehicles on the main roads, turning vehicles, pedestrians, and bicyclists. This practice could also benefit the businesses by increasing the availability of parking spaces.

Ensuring traffic signals are coordinated to provide a progression of green lights along the main corridors such as US-6, CT-10, CT-72, and CT-229. Traffic controls play a large role in regulating vehicle movement and speed on arterials. Anecdotal evidence shows that signals along the region's corridors do not appear to always be coordinated for a green wave. Complicating the coordination of these signals is the high density of signals due to development and intersection of major routes (such as CT-10 and I-84, CT-72 and CT-229). A cautionary note should be observed that signal coordination could lead to increased vehicle speeds. Although an increase in vehicle speeds inherently reduces delay, the increase in vehicle speeds could also lead to dangerous conditions for other vehicles and especially for non-motorized road users. Due to the relationship between road design and vehicle speed, signal coordination should be pursued in conjunction with appropriate road design that does not encourage excessive speed (such as traffic calming measures). Roundabouts could also be considered at intersections for traffic control. Roundabouts

perform the same function as signal coordination, to reduce delay, but roundabouts by nature of design do not lead to increases in vehicle speed. Improvements to traffic operations, whether by signal coordination or roundabouts, should reduce delay at intersections without encouraging higher vehicle speeds.

Linking local streets for a better connected network

Region-wide, the current road network is disconnected and provides few alternative routes to the major arterials. This forces local traffic to use the arterials, even for short trips, which increases traffic. The lack of connectivity also limits pedestrian and bicycling options. A better connected network can disperse traffic, reduce traffic on the main arterials, and provide safer alternative routes for local traffic, pedestrians, and bicyclists.

Supporting the viability of alternative modes of travel

Transit, pedestrian, and bicycling opportunities exist but are limited due to poor quality of service and conditions. Supporting these alternative modes can relieve congestion by shifting travelers out of cars.

Existing transit service does not adequately serve the population due to complexity, small geographic coverage, short operating hours, and inadequate trip lengths. The completion of the BRT system provides an opportunity to update the local bus service plan and coordinate with the new express service. Until then, existing transit routes could be simplified and consolidated with connecting services. For example, a transfer between buses could be eliminated if the BL line (from Bristol) is combined with the 66 line (to Hartford) or the C line (to New Britain).

There are a handful of projects that benefit pedestrians and bicyclists, but they are incomplete or not extensive. Several downtown areas are continuing to improve streetscapes and develop in a pedestrian-friendly manner. These will benefit those within a walking distance, and additional infrastructure projects will connect these centers to a larger population catchment. One such project is the FCHT, a north-south oriented multi-use pedestrian and bicycling facility spanning multiple towns that is incomplete but already immensely popular. Unaffiliated and unconnected with the FCHT, there is also an east-west oriented facility that is limited to

the boundaries of Plainville. There is an opportunity to develop additional paths and integrate with existing paths with the upcoming BRT project which includes plans for multi-use paths. There are current plans to extend paths from the New Britain BRT station east towards the town of Newington, but additional paths west towards Bristol can help truly develop a viable multi-use path network for non-motorized travel.

These strategies often overlap and support one another. For example, alternative modes of travel are more viable in dense mixed-use and transit-oriented development. Since the CMP functions as a supporting document for regional planning, many of these strategies are also found in the LRTP. Many of these strategies are at various implementation and planning stages. In addition to the upcoming BRT system, ongoing streetscape projects, and eventual completion of the FCHT, there are sidewalk improvements resulting from the Safe Routes to Schools program and a major private development in downtown Bristol. This development will include walkable mixed-use neighborhoods and has the potential to be served by the BRT system.

This report focuses on congestion but these alternative strategies also offer social, economic, and environmental benefits. As long as alternative modes of travel are viable, less vehicle use can promote healthier active lifestyles, reduce household expenses on transportation, and reduce greenhouse gas emissions. Encouraging compact development and avoiding road widening helps community character to remain intact; preserves water quality and does not exacerbate flooding; and helps grow a town's tax base without increasing costs for maintenance and providing services over a wide area. These strategies make sense not only for addressing congestion but also for reducing costs and enhancing communities.

XI *References*

ConnDOT. *2009 Connecticut Statewide Bicycle and Pedestrian Transportation Plan.*
http://www.ct.gov/dot/cwp/view.asp?a=1390&q=259656

ConnDOT. *2010 Traffic Volumes State Maintained Highway Network (Traffic Log).*
http://www.ct.gov/dot/cwp/view.asp?a=3532&q=330402

CRCOG, CCRPA, MRPA. *Transportation Monitoring & Management Report for Metropolitan Hartford Area: 2005.*
http://www.crcog.org/publications/transportation.html

Gary Toth. *Level of Service and Travel Projections. The Wrong Tools for Planning Our Streets?* 2012
http://www.pps.org/blog/levels-of-service-and-travel-projections-the-wrong-tools-for-planning-our-streets/

John Norquist. *The Case for Congestion*. 2011
http://www.theatlanticcities.com/neighborhoods/2011/12/case-congestion/717/#

US DOT FHWA. *Congestion Management Process: A Guidebook 2011*
http://www.fhwa.dot.gov/planning/congestion_management_process/cmp_guidebook/