Route 28 Corridor Traffic Study

Route 28 Corridor Study

ROUTE 28 CORRIDOR: AVON (AT RANDOLPH TOWN LINE) TO BRIDGEWATER (AT MIDDLEBOROUGH TOWN LINE)

June 2006

Old Colony Planning Council
70 School Street
Brockton, MA. 02301
(508) 583-1833
www.ocpcrpa.org

UPWP Task 3800 Route 28 Corridor Study (2005)
UPWP Task 3200 Regional Traffic Studies (2006)

This report was prepared under Contract with the Massachusetts Highway Department and with the cooperation of the Executive Office of Transportation, the Federal Highway Administration, and the Federal Transit Administration, under contract 4034021.

ACKNOWLEDGMENTS

The Old Colony Transportation Staff would like to thank the Federal Highway Administration (FHWA), the Executive Office of Transportation (EOT), the Massachusetts Highway Department (MHD), and the Old Colony Metropolitan Planning Organization, for providing the funding and support for this important transportation planning activity.

This ***Route 28 Corridor Study*** was prepared by the following members of the Old Colony Planning Council staff under the supervision of Pat Ciaramella, Executive Director, and Charles Kilmer, Transportation Planning Supervisor.

REPORT PREPARATION

Ray Guarino, Transportation Planner
rguarino@ocpcrpa.org

CONTRIBUTING STAFF

William McNulty, Transportation Planner
wmcnulty@ocpcrpa.org

Charles Kilmer, Transportation Planning Supervisor
ckilmer@ocpcrpa.org

Mike Mauro, Transportation Planner
mmauro@ocpcrpa.org

Jed Cornock, Transportation Planning Assistant
jcornock@ocpcrpa.org

Josh Cabral, Planning Intern

OLD COLONY METROPOLITAN PLANNING ORGANIZATION

James Harrington	Mayor, City of Brockton
Kenneth Tavares	Chairman, Board of Selectmen, Plymouth
Robert Wing	Chairman, Board of Selectmen, Abington
Frank Hegarty	Chairman, Board of Selectmen, Avon
John Cogliano	Secretary, EOT
Luisa Paiewonsky	Commissioner, MassHighway
Reinald Ledoux, Jr.	Administrator, BAT
Robert Overholtzer	President, OCPC

JOINT TRANSPORTATION COMMITTEE

JTC OFFICERS

JTC Chairman	Noreen O'Toole
JTC Vice Chairman	Saeed Kashi

JTC DELEGATES AND ALTERNATES

ABINGTON - *Delegate*	Kenan Connell
ABINGTON - *Alternate*	Bruce Hughes
AVON	Ed Sarni
BRIDGEWATER- *Delegate*	David Matton
BRIDGEWATER - *Alternate*	Robert Wood
BROCKTON - *Delegate*	Michael Thoreson
BROCKTON - *Alternate*	Elaine Czaja
EAST BRIDGEWATER - *Delegate*	John Haines
EAST BRIDGEWATER - *Alternate*	Richard O'Flaherty
EASTON - *Delegate*	Wayne P. Southworth
EASTON - *Alternate*	Maurice Goulet
HALIFAX	Troy Garron
HANSON	Noreen O'Toole
KINGSTON	Paul Basler
PEMBROKE	Michael Valenti
PLYMOUTH	Saeed Kashi
PLYMPTON	Jim Mulcahy
STOUGHTON	Carin Klipp
WEST BRIDGEWATER	Tom Green
WHITMAN	Michael Regan

AGENCY REPRESENTATION

EOT Supervisor	Tom Cahir
EOT Assistant	Mark Guenard
EOT	Joanne Telegen
MHD District 5	Bernard McCourt
MHD District 5	Mark Carmichael
MHD District 5	*Tim Kochan*
BAT	Reinald Ledoux, Jr
BAT	Kathy Riddell
DEP	Leah Weiss
FHWA	Edward Silva
FHWA	Michael Chong
FTA	Donna Laidley
FTA	Andrew Motter
Brockton Traffic Commission	Captain John Gomes

OCPC TRANSPORTATION STAFF

Charles Kilmer	Transportation Supervisor
Jed Cornock	Transportation Planning Assistant
Edward Coviello	Transportation Planner
Raymond Guarino	Transportation Planner
William McNulty	Transportation Planner
Susan McGrath	*GIS Coordinator*
Eric Arbeene	Transportation Intern
Andrew Vidal	GIS Intern

Old Colony Planning Council

OCPC OFFICERS

President	Robert Overholtzer
Secretary	Joseph Landolfi
Treasurer	Jeanmarie Kent Joyce

COMMUNITY	DELEGATE	ALTERNATE
ABINGTON	A. Stanley Littlefield	Joseph Murray
AVON	Frank Staffier	Charles Marinelli
BRIDGEWATER	Anthony P. Anacki	
BROCKTON	Robert G. Moran, Jr.	
EAST BRIDGEWATER	David A. Johnson	Richard O'Flaherty
EASTON	Jeanmarie Kent Joyce	Steve Donahue
HALIFAX	John G. Mather	Troy E. Garron
HANSON	Robert Overholtzer	Phillip Lindquist
KINGSTON	Paul Basler	
PEMBROKE	Gerard Dempsey	Brian Van Riper
PLYMOUTH	Lee Hartmann	
PLYMPTON	John Rantuccio	James Mulcahy
STOUGHTON	Joseph Landolfi	Robert E. Kuver
WEST BRIDGEWATER	Eldon F. Moreira	Nancy Bresciani
WHITMAN	Fred Gilmetti	
DELEGATE-AT-LARGE	Matthew Striggles	

OCPC STAFF

Pasquale Ciaramella	Executive Director
Eric Arbeene	Transportation Intern
Lila Burgess	Ombudsman Program Director
Jed Cornock	Transportation Planning Assistant
Edward Coviello	Transportation Planner
Hazel Gauley	Assistant Ombudsman Director
Raymond Guarino	Transportation Planner
Patrick Hamilton	AAA Administrator
Bruce G. Hughes	Economic Development Specialist
Charles Kilmer	Transportation Planning Supervisor
Jane E. Linhares	Grants Monitor/ Secretary
Janet McGinty	Fiscal Officer
Susan McGrath	GIS Coordinator
William McNulty	Transportation Planner
Anne Nicholas	Ombudsman Program Assistant
Norman Sorgman	Assistant Ombudsman Director
Jacqueline Surette	Fiscal Consultant
Ruth Taylor	Receptionist
Andrew Vidal	GIS Intern
James R. Watson	Comprehensive Planning Supervisor

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 PURPOSE OF STUDY

As part of the Congestion Management Process (CMP), the OCPC has completed a study of the Route 28 corridor within the region. The study was undertaken as part of the Unified Work Planning Program (UPWP). The Joint Transportation Committee has provided steering guidance for the study process. This study was completed in accordance with ongoing planning services provided by OCPC to its member communities.

The main objectives of this study include:

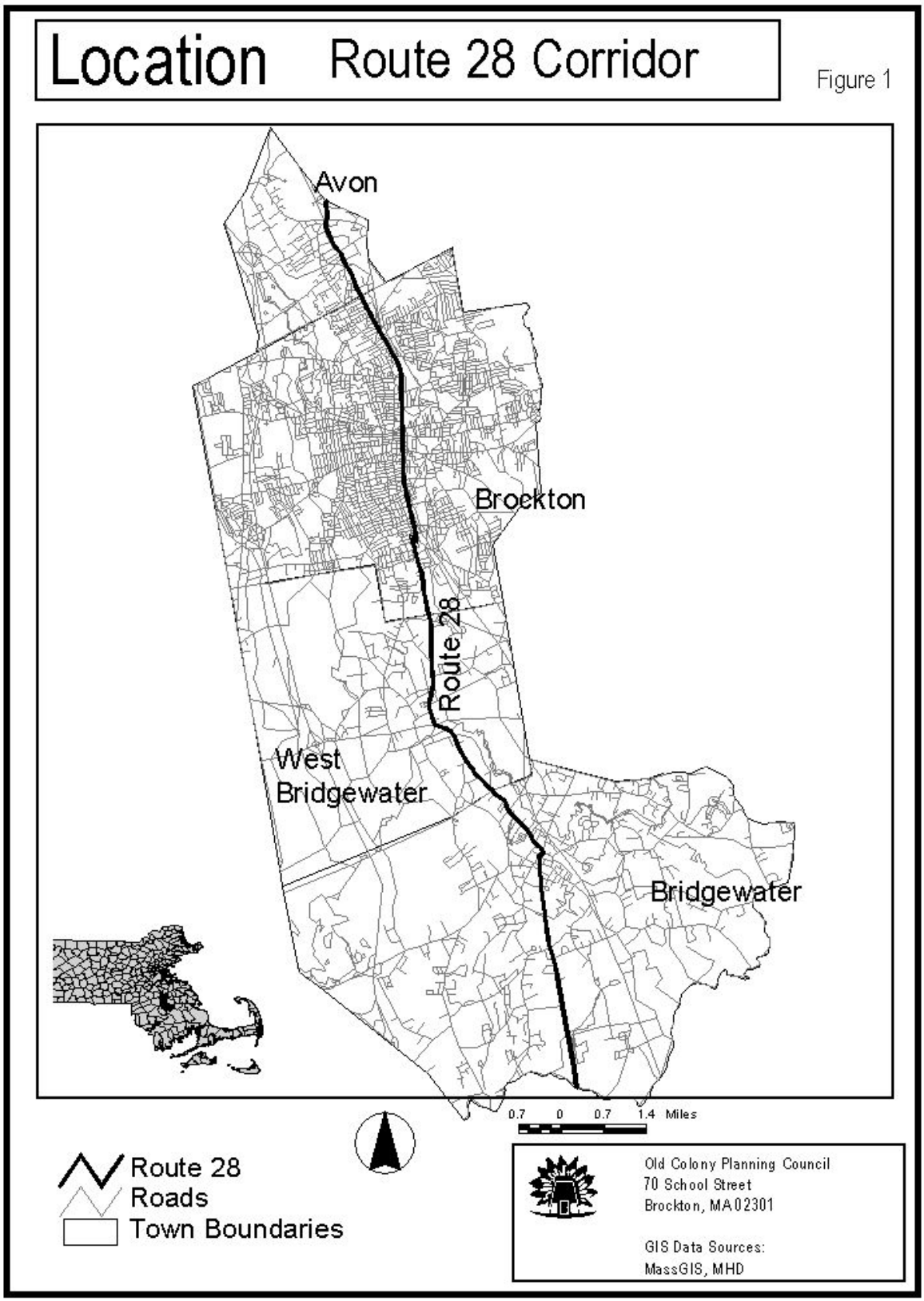
- Improving traffic safety
- Conserving and improving the operating capacity of the corridor
- Integrating the goals of the Route 28 communities to create a unified vision for future improvement and development of the corridor

The study scope includes the Route 28 corridor through the OCPC region (approximately 15 miles.) Route 28 traverses the following communities within the OCPC region: Avon (1.6 miles), Brockton (5.25 miles), West Bridgewater (3.15 miles), and Bridgewater (5.0 miles). As cited in the UPWP, safety conditions and level-of-service require improvements within the Route 28 corridor. Current traffic conditions along certain sections are congested and traffic volumes are expected to increase in the near future. Figure 1 shows the location of Route 28 within the OCPC Region.

1.2 STUDY METHODOLOGY AND PROCESS

This study includes traffic data collection (48-hour counts and peak hour turning movements), travel time runs, an inventory of physical conditions (pavement width, lane use, traffic control), a review of land use and community goals, and a review and analysis of crash data within the corridor. In addition, traffic forecasts and level-of-service analyses for existing and future (five-year horizon) peak hour conditions were performed for this study. Traffic analyses were completed utilizing standard practices published in the ITE Highway Capacity Manual. A variety of traffic analysis software was used to complete this study including Highway Capacity Software (HCS), SYNCHRO, and SimTraffic. In addition to data collection, other information was obtained from the United States Census, the Massachusetts Department of Motor Vehicles, the Massachusetts Highway Department (MHD), the Executive Office of Transportation (EOT), the Federal Highway Administration (FHWA), and the Massachusetts Geographic Information System (MassGIS).

A public participation plan was developed to provide a cooperative study effort between OCPC, EOT, MPO, MassHighway, local communities, and the public. Periodic updates were provided to the Joint Transportation Committee and the MPO over the course of the study. Updates on the study were included in the OCPC quarterly newsletter, Going Places. The OCPC staff also presented the findings of the study to local jurisdictions in order to provide review opportunities to the study area communities and the public. The alternatives, suggestions, and needs of the local communities, based on the presentations, have been incorporated in the final report.


Location Route 28 Corridor
Figure 1
Avon
Brockton
Route 28
West Bridgewater
Bridgewater
0.7 0 0.7 1.4 Miles
Route 28
Roads
Town Boundaries
Old Colony Planning Council
70 School Street
Brockton, MA 02301
GIS Data Sources:
MassGIS, MHD

2.0 EXISTING CONDITIONS

2.1 EXISTING ROUTE 28 CONDITIONS

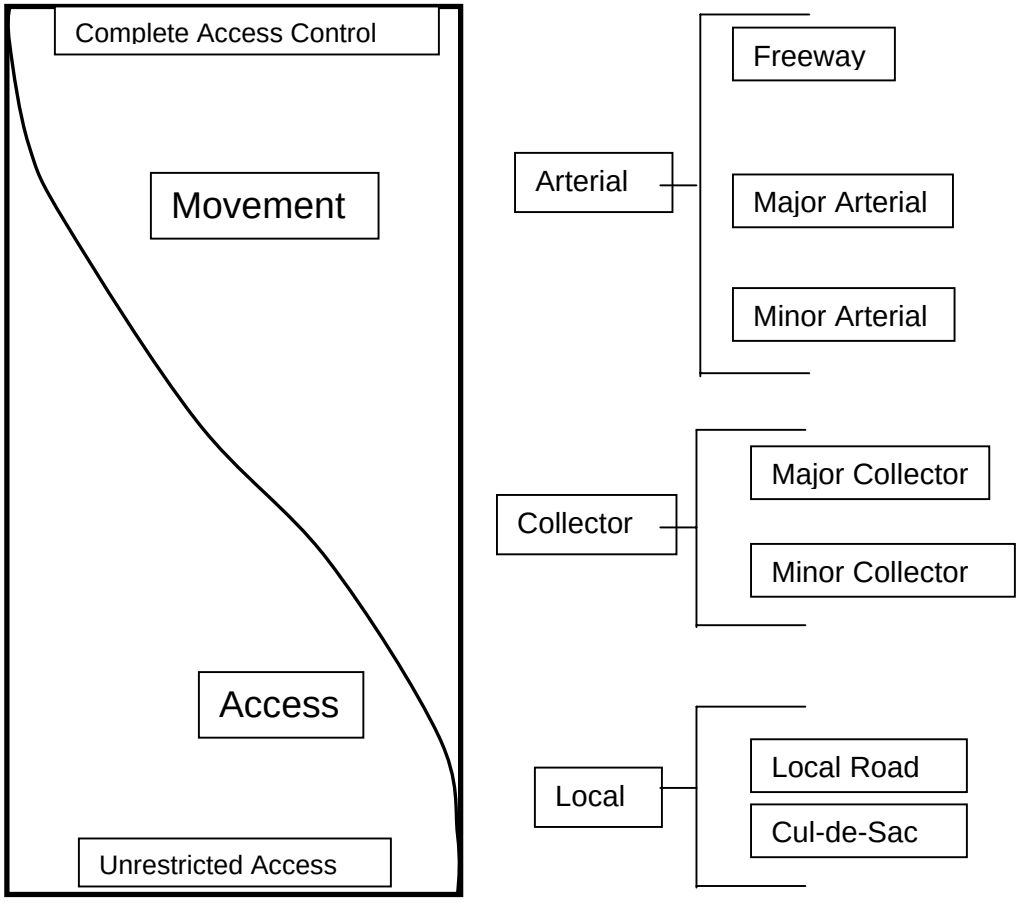
Route 28 is a major highway corridor in southeastern Massachusetts that connects Cape Cod and Boston. The Route 28 corridor, within the OCPC region, runs north to south from Avon to Bridgewater. Route 28 provides access to Route 24, Route 128 (I-93 and I-95), and I-495. Route 28 runs parallel to Route 24 and I-495 through most of southeastern Massachusetts. Route 28 is functionally classified as an Urban Arterial. As an arterial road, Route 28 is eligible for federal funding under the under the SAFETEA-LU statute. Federal funding programs require a state or local 20 percent funding match to an 80 percent federal funding. Route 28 is part of the NHS system in Bridgewater (excluding Central Square). This includes the section (Main Street) from the West Bridgewater town line to Broad Street, and the section from Central Square (Bedford Street) to the Middleborough town line. In addition, Route 28 (South Main Street) in West Bridgewater is part of the NHS system from East Center Street (Route 106) south to the Bridgewater town line. The remainder of Route 28 in West Bridgewater north through Brockton and Avon is eligible for federal funds under STP.

Route 28 intersects several major east west corridors in the region (Harrison Boulevard, Route 37, Route 123, Route 27, Route 106, and Route 104) and is often used as an alternative to Route 24 and Route 138 due to congestion on those roadways. Major land uses along Route 28 include Bridgewater State College, MCI Bridgewater, county, state, and federal courthouses in downtown Brockton, MBTA and BAT stations in Brockton, and numerous commercial and industrial facilities. The road width varies greatly throughout the corridor. Route 28 includes two and four lane sections in Avon and north Brockton, a narrow two-lane section through downtown Brockton, two and four lane sections in south Brockton, two lane sections through West Bridgewater to Bridgewater Center, and a high-speed, two lane section through Bridgewater south of the center as Route 28 merges with Route 18. The speed limits also vary with a 50-mile per hour section in Bridgewater south of the town center, 25 and 30 miles per hour sections in Brockton downtown, 35, 40, and 45 mile per hour sections in West Bridgewater, and 30, 35, and 45 mph sections in Avon.

Although Route 28 is designated as an Urban Arterial and an Urban Extension, it takes on varying functional characteristics within the region depending upon the lane use, road width, and traffic control within the corridor. The types and patterns of development of adjacent land use vary and impact the function of the road. The physical characteristics, speeds, and carrying capacities of the highway vary throughout the corridor.

Arterials, major and minor, are designed to provide movement between communities and regions. However, the roadway system is a dynamic one in which change occurs over time to meet the demands of economic growth and changing land use. Route 28 connects communities and regions as an arterial, but it also provides access to adjacent land uses, which is a typical function of collector and local roads. The density of commercial land uses, along with a multitude of access points, is accentuated along certain stretches of the corridor. Figure 2 shows the characteristics of road function in relation to the hierarchy of roadways. In the hierarchy scheme for roads, access to adjacent land use ranges from freeways, which maintain complete access control, to local roads, which have unrestricted access to adjacent properties. Route 28, as an arterial, is theoretically designated for vehicle movement; however, over time it has continued to provide access to adjacent properties, which is the primary function of the local road.

Figure 1.2 Roadway Function and Access

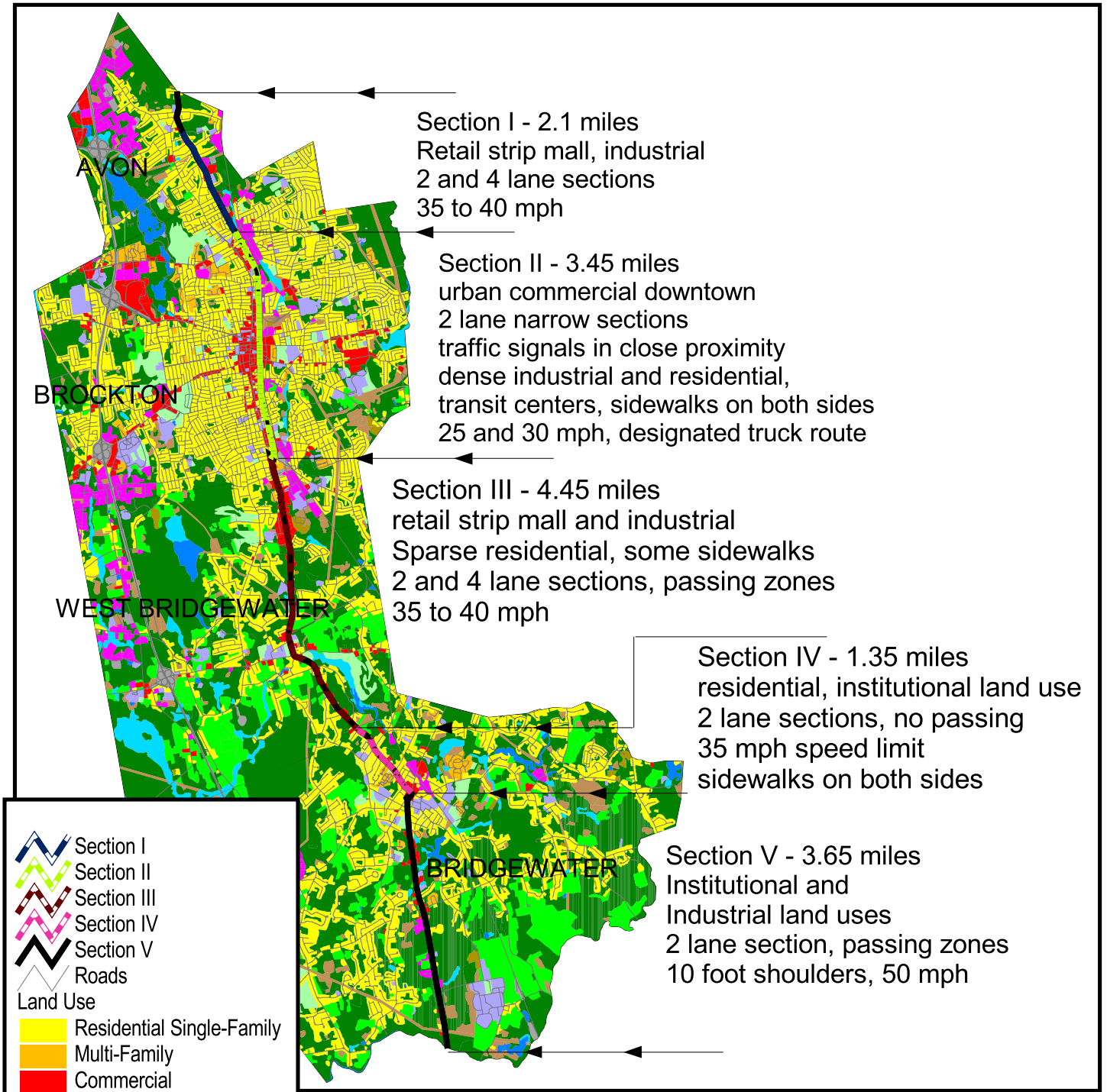


Source: Continuum of Movement and Access: TRB Record 1385

The Route 28 road corridor was divided into five distinct sections for analysis purposes, because of the varying nature of the road's land use and the road's physical and functional characteristics, in order to discern the deficiencies and opportunities that present themselves over the course of the study. Figure 2 shows the existing land uses along the corridor and five distinct study analysis sections.

Land Use

Figure 2



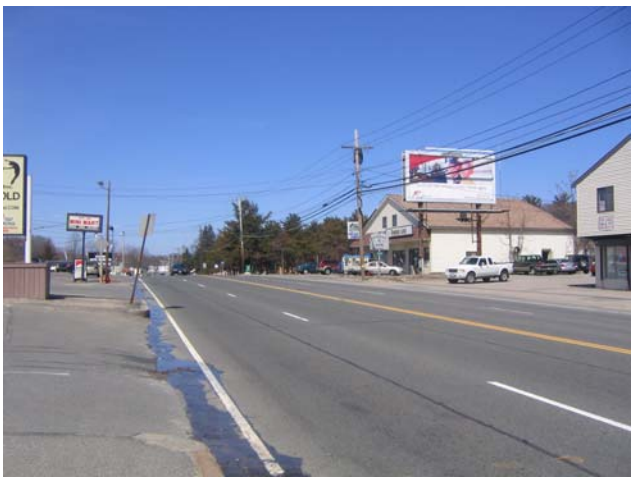
Old Colony Planning Council
70 School Street
Brockton, MA 02301

GIS Data Sources:
MassGIS, MHD, OCPC Field Data

June, 2005

Section I – This section runs south approximately 2.1 miles from the Avon/Randolph town line, through Avon center, to the intersection of Route 28 and Howard Street (Route 37) in Brockton. Route 28 provides two lanes (one lane for each direction) from the Randolph town line to Harrison Boulevard, with a short four-lane section through Avon center. The posted speed limit is 40 miles per hour north of Avon center and 30 miles per hour in the vicinity of Avon center. The road width varies from 46 feet north of Avon center (North Main Street) to 30 feet south of Avon center. Route 28 widens to four lanes south from Harrison Boulevard to Howard Street (Route 37). The road width in this section varies from 43 to 46 feet (East Main Street and Memorial Drive). The posted speed limit is 40 mph in the four-lane section, which is reduced to 35 miles per hour in the vicinity of the Howard Street (Route 37) intersection. The adjacent land use is characterized by retail strip-mall development with some industrial development. There are numerous curb cuts along the corridor, especially in the section between Harrison Boulevard and Howard Street. The surrounding land use also includes single-family residential development in Avon and north Brockton.

Route 28 - North Montello Street, Memorial Drive – at the Brockton/Avon line



Section II – This section of Route 28 runs for about 3.45 miles from the intersection of Howard Street (Route 37), through the center of the Brockton downtown, to the intersection of Plain Street in south Brockton. The width of Route 28 in this section varies from 24 to 30 feet. Sidewalks are provided on both sides of Route 28 throughout this section. Land use adjacent to the road in consists of dense commercial and industrial uses. The adjacent land use includes the redevelopment of properties and the transition of properties from industrial to commercial and residential uses. Route 28 runs parallel to the commuter rail route and the Brockton Downtown commuter rail station, along with the multi-modal bus center, is located just one block east of Route 28 (within walking distance of the downtown). In addition to the commuter rail station in the central downtown, two other commuter stations abut the Route 28 corridor in Brockton. These are the Montello Station in north Brockton and the Campello Station in south Brockton. Route 28 through Brockton is signed as a designating truck route. The speed limit is 30 miles per hour except for the downtown section, from the Court Street intersection to the Lawrence Street intersection, which is posted at 25 mph. There are no passing zones through this section of Route 28.

Route 28 - Montello Street through Brockton Downtown, parallel to Main Street

Section III – Section III runs south from Plain Street in Brockton for about 4.45 miles through West Bridgewater to the Bridgewater town line. The land use along Route 28 through this section is mainly retail strip-mall development with sparse single-family residential areas. In addition, the City of Brockton Housing for the Elderly apartment complex (Campello High Rise) is located off of Main Street just south of Plain Street. The Brockton Area Transit Maintenance Operations Facility is located off of Main Street adjacent to the housing for the elderly apartments. Route 28 is about 30 feet wide just south of its intersection with Plain Street. Route 28 through south Brockton provides four travel lanes from a point just south of Sargent's Way (at the K-Mart) to Friendship Drive just over the West Bridgewater line. The road is approximately 40 feet wide in this section with multiple curb cuts for access to adjacent land uses. Although the commercial area along Route 28 is denser in Brockton, there are numerous commercial land uses along the road in West Bridgewater with numerous open curb cuts for access. Route 28 in West Bridgewater contains a sidewalk along the west side of the road with an 8-foot shoulder along the east side. There are intermittent passing zones along this section and the speed limit is posted at 30 and 35 mph. Route 28 (North Main Street) in West Bridgewater is approximately 26 feet wide from the Brockton city line to the intersection of Route 106. Route 28 is 36 feet wide south of Route 106 as it continues as South Main Street to the Bridgewater town line. The posted speed limit is 45 mph in West Bridgewater south of Route 106.

Route 28 - Main Street, South Brockton

Route 28 - North Main Street, West Bridgewater north of Route 106

Section IV – As Route 28 runs south from West Bridgewater to Bridgewater, the land use along the road becomes residential in character beginning abruptly at the town line for about 1.35 miles to the Bridgewater town center. Route 28, within this section, provides two lanes of travel with intermittent passing zones. There are sidewalks provided on both sides of the road and the speed limit is posted at 35 miles per hour. Route 28 is approximately 36 feet wide from the West Bridgewater line to Bridgewater center. Commercial uses are prevalent at the town center, and Bridgewater State College, along with the commuter rail station, is located just east of the Bridgewater town center.

Route 28 - North Main Street, Bridgewater north of Town Center

Section V – Route 28 merges with Route 18 at Bridgewater center and runs about 3.65 miles to the Middleborough town line. Two travel lanes are provided as well as intermittent passing zones and 8-foot shoulders on both sides of the road within the corridor. The land use includes institutional (MCI Bridgewater), industrial, and single family home development. Route 28 in Bridgewater (Bedford Street) is about 30 feet wide just south of the town center and then opens up to about 40 feet wide to the Middleborough town line. The speed limit is posted at 35 miles per hour in the vicinity of Bridgewater center, and 50 miles per hour for the 40-foot wide section to the Middleborough town line.

Route 28 - Bedford Street, Bridgewater south of Town Center

2.2 EXISTING TRAFFIC VOLUMES

Morning and afternoon peak hour turning movement counts were conducted for the year 2004 for 41 study area intersections in the Route 28 corridor. In addition, 48-hour traffic volume counts were completed along sections of the road using automatic traffic recorders. Table 1 lists the study area intersections where turning movement counts were taken. Figures 3 through 6 show the intersection count locations on the Route 28 Corridor. Figure 7 shows the 48-hour traffic counts through the corridor. The peak hour turning movements for the study area intersections are shown in the appendix to this report. Figure 7 shows that the highest daily volumes within the corridor are located at Bridgewater center (30,000 vehicles per day) and in Avon just south of Harrison Boulevard (28,300 vehicles per day). The average daily traffic (ADT) through Brockton downtown ranges between 9,900 and 15,500 vehicles per day. The ADT through West Bridgewater ranges from 13,400 to 17,500 vehicles per day. The ADT on Route 28 south of Bridgewater center is about 16,800 vehicles per day and about 13,400 vehicles per day at the Middleborough town line.

Table 1 Study Area Intersections (Shown in Figures 3, 4, 5, and 6)

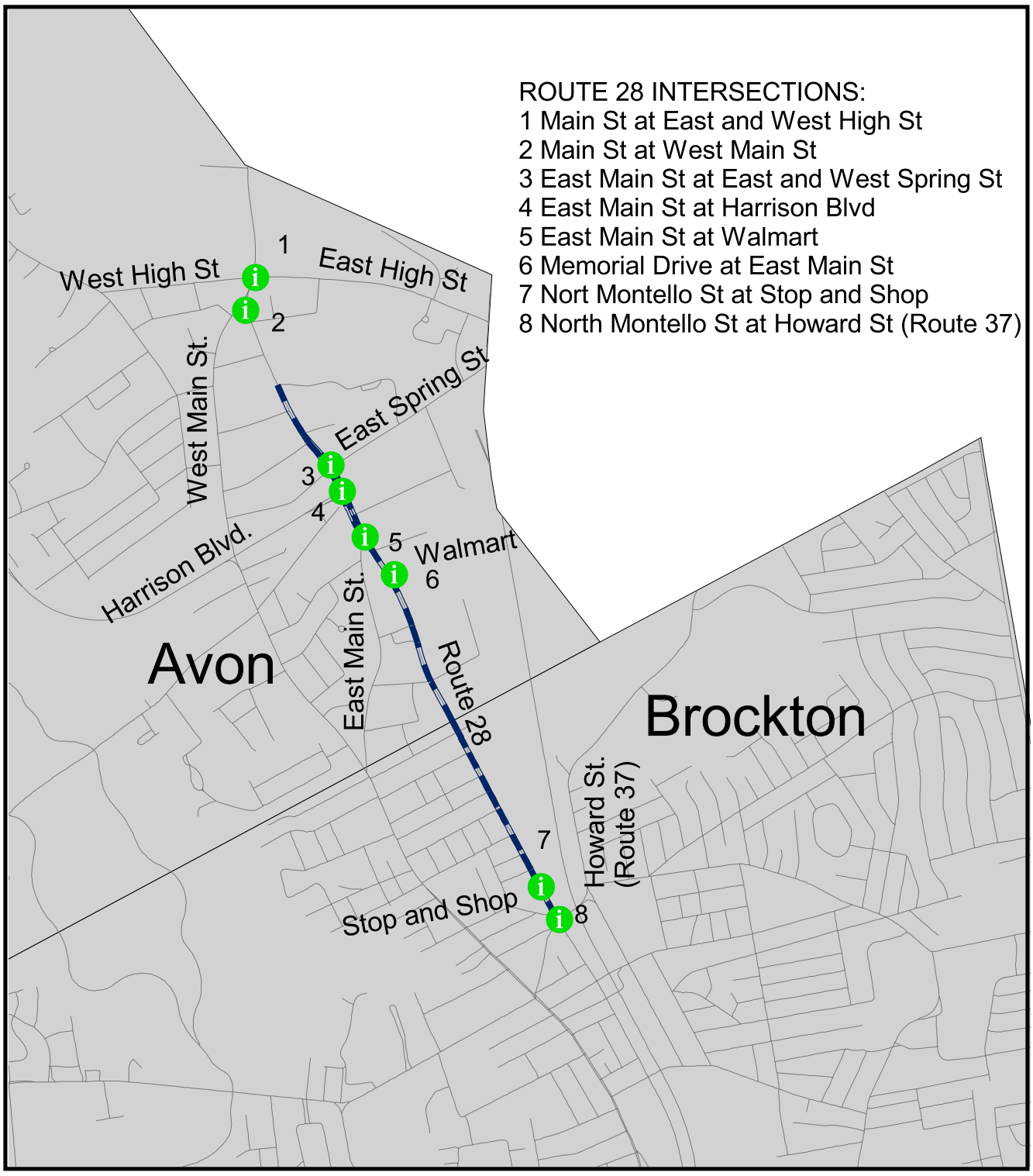
		Route 28 Name	Intersecting Street(s)	Control
1	**Avon**	North Main/Main Street	East/West High Street	Signal
2		Main/East Main Street	West Main Street	Signal
3		East Main Street	E/W Spring Street	Stop Sign
4		East Main Street	Harrison Boulevard	Signal
5		East Main Street	Walmart	Signal
6		E. Main St/Memorial Drive	East Main Street	Stop Sign
7	**Brockton**	N Montello Street	Stop and Shop Entrance	Signal
8		N Montello Street	Howard 37/Albion	Signal
9		N Montello Street	Wilmington Street	Stop Sign
10		N Montello Street	Field St/Livingston Rd	Stop Sign
11		N Montello Street	Ames Street	Signal
12		N Montello Street	East Battles Street	Stop Sign
13		N Montello Street	East Ashland Street	Signal
14		N Montello Street	Elliot Street	Signal
15		N Montello/Montello St	Court Street	Signal
16		Montello Street	Centre Street	Signal
17		Montello Street	School Street	Signal
18		Montello Street	Crescent Street	Signal
19		Montello Street	Lawrence Street	Signal
20		Montello Street	Grove Street	Signal
21		Montello Street	East Nilsson Street	Stop Sign
22		Montello Street	Perkins Avenue	Signal
23		Montello Street	Plain Street	Stop Sign
24		Main Street	Plain Street/Keith Avenue	Signal
25		Main Street	Brookside Avenue	Signal
26		Main Street	Sargents Way	Signal
27	**W.Bridgewater**	N Main Street	Copeland Street	Stop Sign
28		N Main Street	Matfield Street	Stop Sign
29		N Main Street	Howard Street	Stop Sign
30		N/S Main Street	E/W Center Street(River)	Signal
31		South Main Street	Bryant/Ash Streets	Stop Sign

Table 1 Study Area Intersections (Continued)

	Community	Route 28 Name	Intersecting Street(s)	Control
32	Bridgewater	Main Street	Center/High Streets	Signal
33		Main Street	Oak Street	Stop Sign
34		Main Street	Broad/Summer/Central Square	Signal
35		Central Square	Church/South Streets	Yield
36		Central Square	School/Bedford Streets	Yield
37		Bedford Street	Grove Street	Stop Sign
38		Bedford Street	Maple Avenue	Stop Sign
39		Bedford Street	Worcester Street	Stop Sign
40		Bedford Street	Winter Street	Stop Sign
41		Bedford Street	Flagg Street	Stop Sign

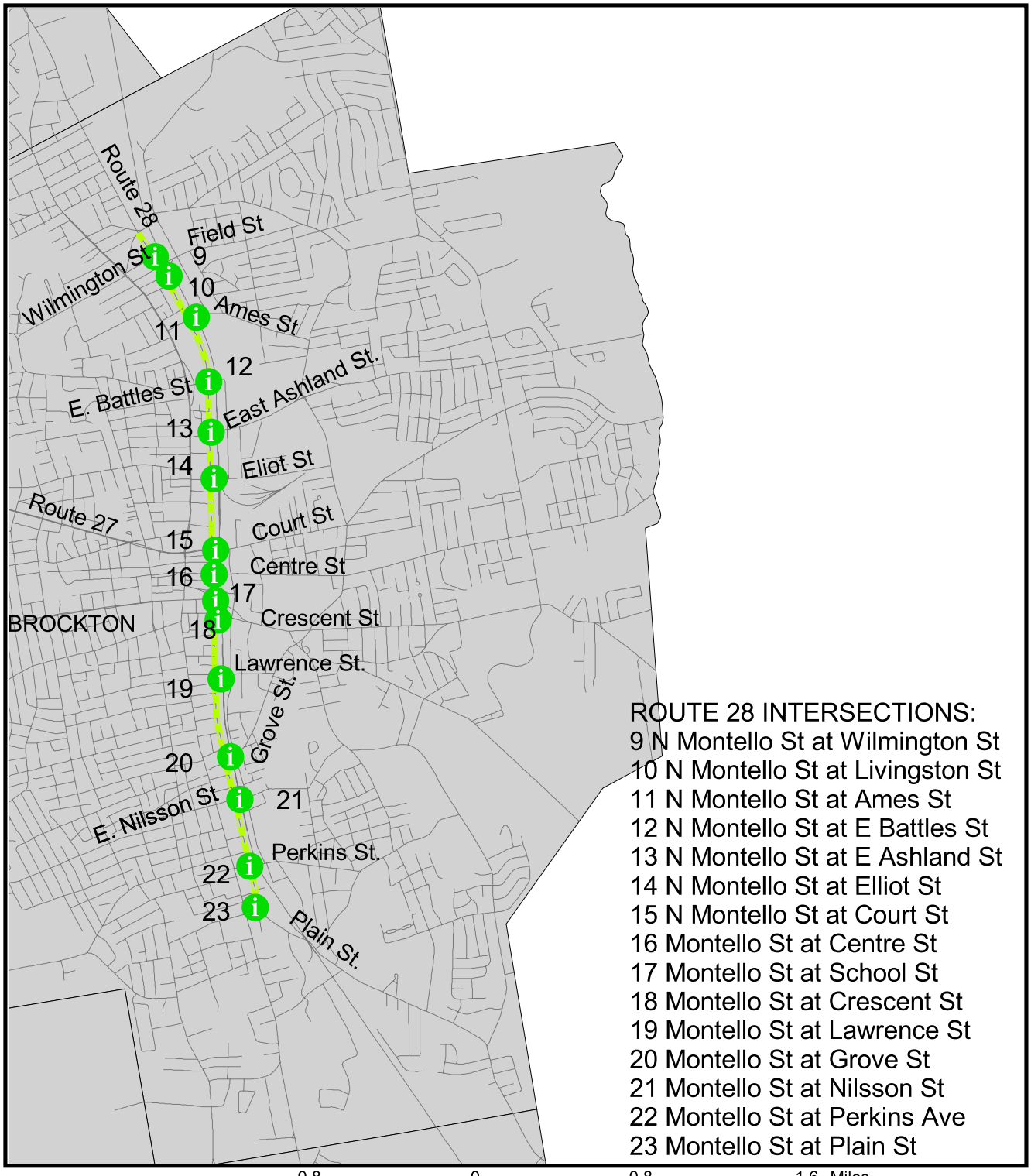
Section I Turning Movement Count Locations

Figure 3



Section II Turning Movement Count Locations

Figure 4

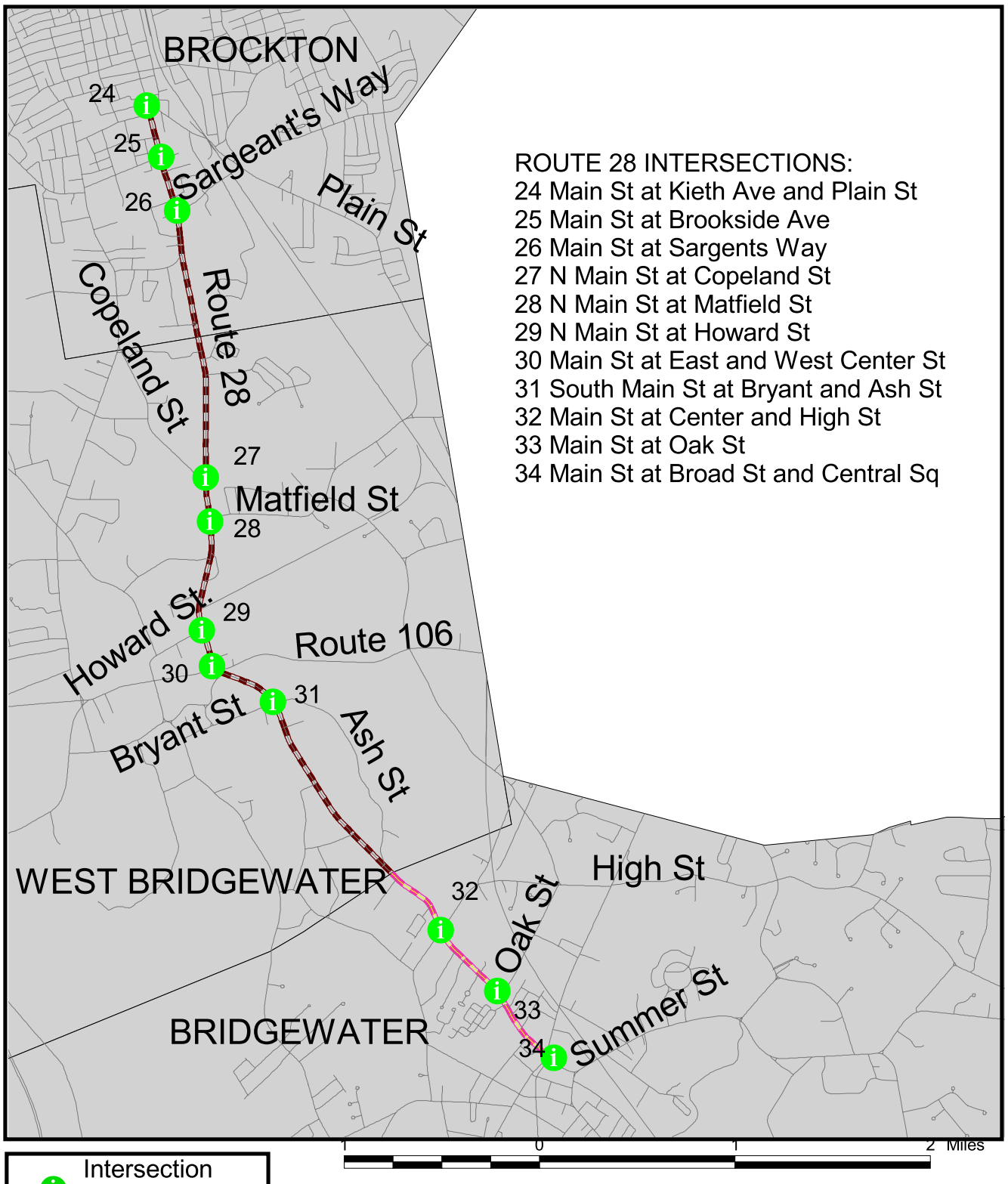


Old Colony Planning Council
70 School Street
Brockton, MA 02301

GIS Data Sources:
MassGIS, MHD

Sections III and IV Turning Movement Count Locations

Figure 5

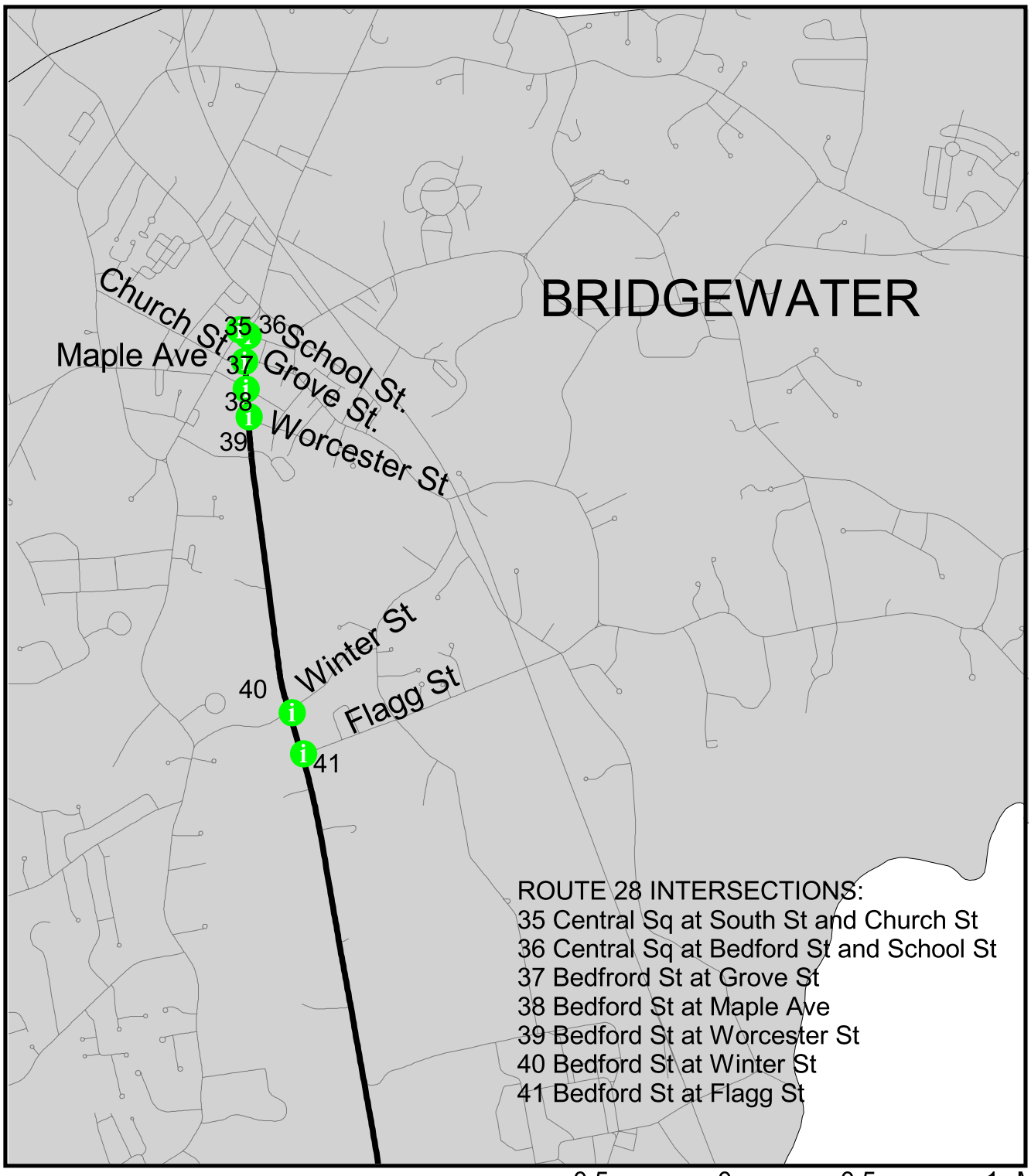


Old Colony Planning Council
70 School Street
Brockton, MA 02301

GIS Data Sources:
MassGIS, MHD

Section V Turning Movement Count Locations

Figure 6

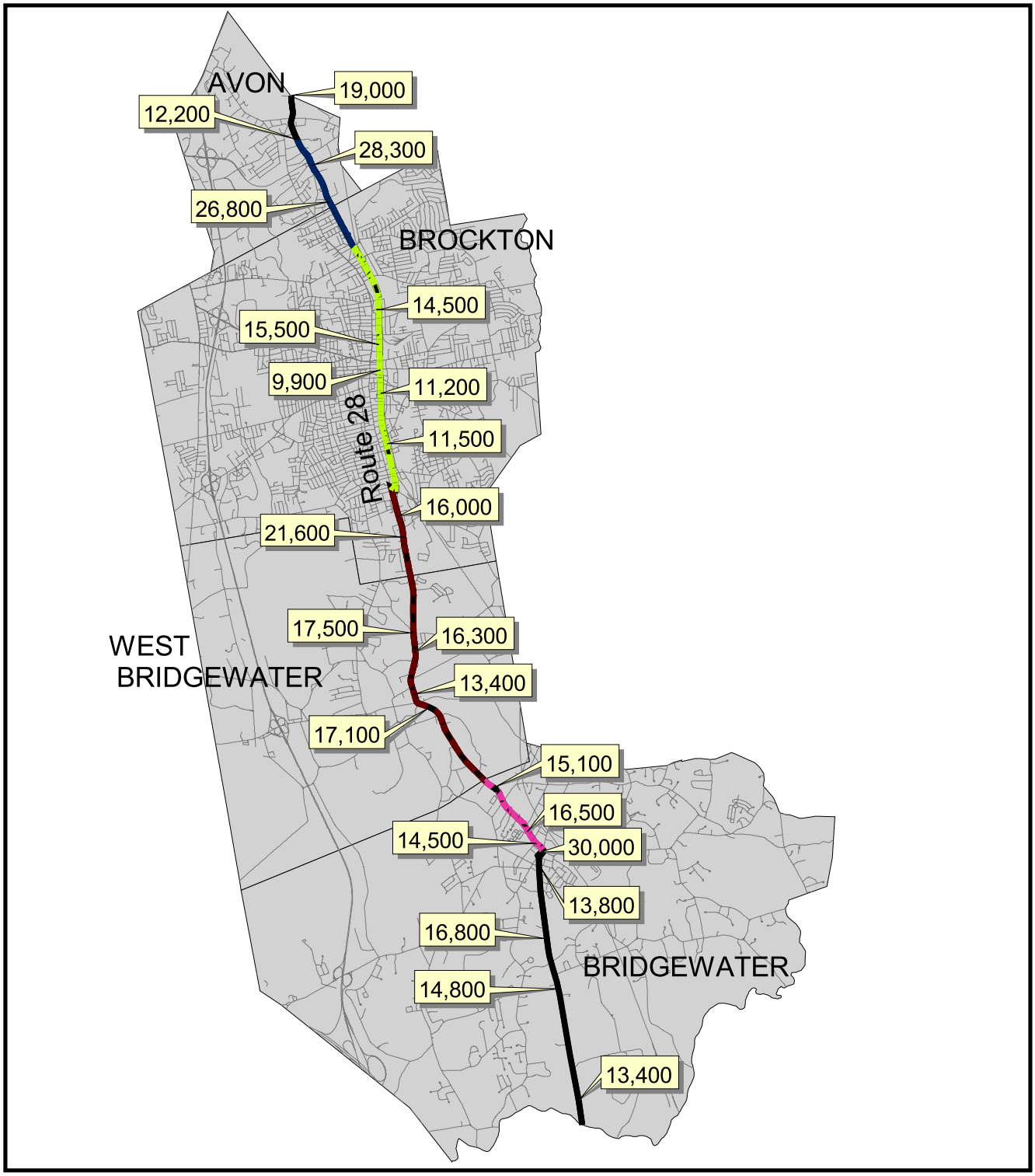


Old Colony Planning Council
70 School Street
Brockton, MA 02301

GIS Data Sources:
MassGIS, MHD

Average Daily Traffic

Figure 7



2.3 EXISTING TRAFFIC OPERATIONS

Level-of-service analyses (LOS) were completed for the study area intersections to determine the operating conditions that occur during the morning and afternoon peak hours. Level-of-service analysis is a qualitative and quantitative measure based on the analysis techniques published in the Highway Capacity Manual by the Transportation Research Board. Level-of-service is a general measure that summarizes the overall operation of an intersection or transportation facility. It is based upon the operational conditions of a facility including lane use, traffic control, and lane width, and takes into account such factors as operating speeds, traffic interruptions, and freedom to maneuver.

Level-of-service represents a range of operating conditions and is summarized with letter grades from “A” to “F”, with “A” being the most desirable. Level-of-service “E” represents the maximum flow rate or the capacity on a facility. The following describes the characteristics of each level-of-service:

> LOS "A" represents free flow. Individual users are virtually unaffected by the presence of others in the traffic stream.
> LOS "B" is in the range of stable flow, but the presence of other users in the traffic stream begins to be noticeable. Freedom to select desired speeds is still relatively unaffected.
> LOS "C" is in the range of stable flow, but marks the beginning of the range of flow in which the operation of individual users becomes significantly affected by interactions with others in the traffic stream. Occasional backups occur behind turning vehicles.
> LOS "D" represents high-density, but stable, flow. Speed and freedom to maneuver are restricted, and the driver experiences a below average level of comfort and convenience. Small increases in traffic flow will generally cause operational problems at this level.
> LOS "E" represents operating conditions at or near the capacity level. All speeds are reduced to a low, but relatively uniform level. Freedom to maneuver within the traffic stream is extremely limited, and generally requires forcing other vehicles to give way. Congestion levels and delay are very high.
> LOS "F" is representative of forced or breakdown flow. This condition exists wherever the amount of traffic approaching a point exceeds the amount that can traverse the point, resulting in lengthy queues and delay.

The LOS definitions describe conditions based on a number of operational parameters. There are certain parameters utilized as measures of effectiveness for specific facilities. In the case for intersections, two-lane highways, and arterials, which represent the physical conditions that typify the Route 28 corridor, time delay, average stop delay, and average travel speed are used as measures of operational effectiveness to which levels of service are assigned.

Table 2 shows the signalized and un-signalized LOS for the Route 28 study area intersections under existing peak hour conditions. Congestion at intersections in Table 2 (LOS "E" and "F") is shown in shaded blocks.

Table 2 Existing LOS

				Control	Morning	Afternoon
	Community	Route 28 Name	Intersecting Street(s)		LOS	LOS
1	Avon	North Main/Main Street	East/West High Street	Signal	B	B
2		Main/East Main Street	West Main Street	Signal	B	A
3		East Main Street	E/W Spring Street	Stop Sign	F	F
4		East Main Street	Harrison Boulevard	Signal	D	D
5		East Main Street	Walmart	Signal	C	B
6		E. Main St/Memorial Drive	East Main Street	Stop Sign	E	F
7	Brockton	N Montello Street	Stop and Shop Entrance	Signal	A	A
8		N Montello Street	Howard 37/Albion	Signal	D	D
9		N Montello Street	Wilmington Street	Stop Sign	D	F
10		N Montello Street	Field St/Livingston Rd	Stop Sign	F	F
11		N Montello Street	Ames Street	Signal	B	C
12		N Montello Street	East Battles Street	Stop Sign	F	F
13		N Montello Street	East Ashland Street	Signal	C	B
14		N Montello Street	Elliot Street	Signal	B	B
15		N Montello/Montello St	Court Street	Signal	C	C
16		Montello Street	Centre Street	Signal	C	D
17		Montello Street	School Street	Signal	B	C
18		Montello Street	Crescent Street	Signal	B	C
19		Montello Street	Lawrence Street	Signal	B	B
20		Montello Street	Grove Street	Signal	B	B
21		Montello Street	East Nilsson Street	Stop Sign	C	F
22		Montello Street	Perkins Avenue	Signal	B	B
23		Montello Street	Plain Street	Stop Sign	F	F
24		Main Street	Plain Street/Keith Avenue	Signal	B	D
25		Main Street	Brookside Avenue	Signal	A	B
26		Main Street	Sargents Way	Signal	C	D
27	W.Bridgewater	N Main Street	Copeland Street	Stop Sign	B	D
28		N Main Street	Matfield Street	Stop Sign	F	F
29		N Main Street	Howard Street	Stop Sign	F	D
30		N/S Main Street	Route 106 E/W Center Street(River)	Signal	D	F

Table 2 Existing LOS (Continued)

				Control	Morning	Afternoon
	Community	Route 28 Name	Intersecting Street(s)		LOS	LOS
31	Bridgewater	South Main Street	Bryant/Ash Streets	Stop Sign	C	C
32		Main Street	Center/High Streets	Signal	B	C
33		Main Street	Oak Street	Stop Sign	C	C
34		Main Street	Broad/Summer/Central Square	Signal	C	E
35		Central Square	Church/South Streets	Yield	D	E
36		Central Square	School/Bedford Streets	Yield	E	F
37		Bedford Street	Grove Street	Stop Sign	D	E
38		Bedford Street	Maple Avenue	Stop Sign	C	E
39		Bedford Street	Worcester Street	Stop Sign	C	D
40		Bedford Street	Winter Street	Stop Sign	F	F
41		Bedford Street	Flagg Street	Stop Sign	E	F

The LOS in Table 2 for signalized intersections is an overall measure of the operating conditions. The LOS in Table 2 for un-signalized intersections represents the LOS of the critical movement (left, through, or right turn from the minor street, or left turn from the major street.) The delays under LOS "D" operations are generally considered acceptable in urban areas. Level-of-service "E" operations are considered to represent the capacity level of a facility, and LOS "F" conditions are considered forced flow or failed traffic operations.

As shown in Table 2, there are two un-signalized intersections in Avon that experience failed conditions. Traffic operations at Route 28/East and East West Spring Street are characterized as failed conditions, with LOS "F" conditions on the critical movements during the morning and afternoon peak hours. The turning movements on the side street approaches at the Route 28 and East Main Street intersection experience LOS "E" conditions during the morning peak hour and LOS "F" conditions during the afternoon peak hours.

In Brockton, the Route 28 (North Montello Street) intersections that are at failed conditions include several un-signalized intersections. Turning movements from the minor street approaches at the Wilmington Street/North Montello Street intersection are at LOS "F" during the afternoon peak. The Livingston Street/North Montello Street and the East Battles Street/North Montello Street un-signalized intersections experience failed conditions, LOS "F", on the side street approaches during both the morning and afternoon peak hours.

South of the downtown, there are two un-signalized intersections that experience failed operations on the side street approaches. These include Montello Street at East Nilsson Street (LOS "F" during the afternoon peak hour), and Montello Street at Plain Street, which experiences LOS "F" operations during the morning and afternoon peak hour on the side street approaches.

West Bridgewater has two un-signalized intersections and one signalized intersection that experience failed operating conditions within the Route 28 corridor. The North Main Street/Matfield Street intersection is at LOS "F" on the minor street approaches during the

morning and afternoon peak hour hours, and the North Main Street/Howard Street intersection is at LOS "F" on the minor street approaches during the morning peak hour. The signalized Route 28/Route 106 East West Center Street intersection (at the town center) is at overall LOS "F" during the afternoon peak hour.

In Bridgewater, the signalized intersection of Route 28/Broad Street/Summer Street, at the northern end of the town center, is at LOS "E" during the afternoon peak hour. At the southern end of the town center, the yield approach on South Street into the town center is at LOS "E" during the afternoon peak. The Bedford Street yield approach, which is adjacent to the South Street approach at the town center, operates at LOS "E" during the morning peak and LOS "F" during the afternoon peak.

On the stretch of Route 28, which is Bedford Street and signed Route 18/28 south of Bridgewater Center to the Middleborough town line, four un-signalized intersections operate under failed conditions. These include Bedford Street/Grove Street (LOS "E" afternoon peak), Bedford Street/Maple Avenue (LOS "E" afternoon peak), Bedford Street/Winter Street (LOS "F" morning and afternoon peak), and Bedford Street/Flagg Street (LOS "E" morning peak and LOS "F" afternoon peak.)

The LOS analysis indicates that most of the signalized intersections within the Route 28 corridor operate within acceptable LOS "D" levels and above during the peak hours, except for the Route 28/Route 106 intersection at West Bridgewater center (LOS "F) and the Broad Street/Summer Street/Route 28 intersection in Central Square Bridgewater (LOS "E"). The LOS analysis for un-signalized intersections shows a pattern throughout the corridor in all study area communities in which the side street approaches experience congestion (LOS "E" and "F") during the morning and afternoon peak hours. This is due mostly to heavy peak hour volumes on the major street movements (Route 28). The through movements on the major street approaches (Route 28) provide very few or no acceptable gaps for vehicles to enter from the minor street approaches. Situations arise, as in the case of the East Main Street/Route 28 (Memorial Drive) intersection in Avon, whereby through movement traffic must slow or stop for signals (at Harrison Boulevard) and block vehicles from entering Route 28 from the side streets creating long queues and forced flow traffic conditions.

2.4 CRASH ANALYSIS

Information on reported crashes at the 41 study area intersections was obtained from the Massachusetts Highway Department (MHD). The data was for the most recent three-year period available (2002, 2003, and 2004). The data was tabulated and analyzed in accordance with the standard practices published by the Institute of Transportation Engineers in the Manual of Traffic Engineering Studies. The purpose for analyzing crash data includes:

- To define and identify high crash locations
- To justify actions for the installation of traffic control devices
- To evaluate the geometric design (including lane use) and proposed changes in traffic regulations
- To justify expenditures for improvements that offer crash reduction or prevention
- To identify a need for traffic enforcement
- To identify needs in pedestrian safety and certain actions causing crashes that can be prevented through driver and/or pedestrian public education

The crash rate is a good indicator of the frequency of crashes at intersections. The crash rate helps measure the crash exposure at an intersection. It is based on the number of crashes per million entering vehicles (MEV). The number of crashes often increases as traffic volumes increase. Traffic growth creates more opportunities for crashes to occur and therefore increases vehicle exposure to crashes. A particular condition that causes crashes at an intersection can become exacerbated with increased traffic, and frequency will therefore rise. The crash rates calculated for intersections in this study are based upon the ITE equation in the Manual of Traffic Engineering Studies. The rate equation is shown in the appendix to this report. The crash rate per million entering vehicles is the number of accidents in a year times one million, divided by the number of vehicles entering the intersection in a year. Table 3 shows the number of crashes and crash rates for the study area intersections. The intersections have been ranked in Table 3 based on the highest number of accidents (frequency) and highest rates (exposure).

As shown in Table 3, the intersection of Route 28 (North Montello Street) and Howard and Albion Streets in Brockton has the highest number of crashes of the study area intersections with 60 crashes within the 2002-2004-study period. This intersection also has the highest crash rate of the study area intersections with a crash rate of 1.821 crashes per MEV. This is 116.8% above the MassHighway District 5 average for signalized intersections. The North Montello Street/East Battles Street intersection had the second highest number of crashes and the second highest crash rate among the study area intersections. This intersection had 34 crashes in three years and a rate of 1.780 crashes per MEV. This rate is 201.68 % over the MassHighway District 5 average for un-signalized intersections. This intersection has the highest number of crashes and highest crash rate among the un-signalized intersections. Table 4 summarizes the frequency of different types of crashes for the study area intersections that have a crash rate above the MassHighway District 5 average (0.84 for signalized intersections and 0.59 for un-signalized intersections.) The recurrence of certain types of crashes can provide insight into the types of improvement needed at hazardous intersections.

As shown in Table 4, the Route 28/Howard Street/Albion Street intersection had three head-on crashes occurring within the three-year study period, although these collisions are typically rare. This intersection is a five-way signalized intersection with additional turning movements not typical of a regular four-way or three-way intersection. In addition, this intersection has a high number of angle type and rear-end type accidents. Adding pavement markings (single broken white lines) that extend the approach lanes through the intersection may help motorists navigate through the intersection with the least amount of confusion and may help to cut down on head-on collisions, as well as other collisions. Other intersections that experience high numbers of angle type collisions in Brockton include North Montello Street at East Battles street (un-signalized), North Montello Street at East Ashland Street (signalized), North Montello Street at Field Street and Livingston Road (un-signalized), and Montello Street at Crescent Street (signalized). In addition, the East Main Street at East and West Spring Street intersection in Avon (un-signalized) and the Bedford Street at Winter Street in Bridgewater (un-signalized) experience a high number of angle type crashes.

Table 3 - 2002 – 2003 – 2004 Crashes

Community	Route 28 Name Intersecting Street(s)	Traffic Control	Number of Crashes	Rank Highest Crashes	Crash Rate	Rank Highest Rate	District 5 Average Crash Rate	Percent over/ under crash rate
Brockton	**N Montello St at Howard 37/Albion**	**Signal**	60	1	1.821	1	0.84	116.80%
Brockton	**N Montello St at East Battles St**	**Stop Sign**	34	2	1.780	2	0.59	201.69%
Brockton	**N Montello/Montello St/Court St**	**Signal**	32	3	1.182	10	0.84	40.72%
Brockton	**N Montello St/E Ashland St**	**Signal**	30	4	1.342	6	0.84	57.91%
Brockton	**N Montello St/Field St/Livingston**	**Stop Sign**	29	5	1.666	3	0.59	182.39%
Avon	**E Main St/Harrison Boulevard**	**Signal**	28	6	0.926	18	0.84	10.25%
Avon	**East Main St/E/W Spring St**	**Stop Sign**	27	7	1.300	7	0.59	121.90%
Brockton	**N Montello St/Ames St**	**Signal**	27	7	1.206	8	0.84	43.58%
W.Bridgewater	**N/S Main St/E/W Center St(River)**	**Signal**	26	9	0.771	22	0.84	-8.19%
Bridgewater	**Main St/Broad/Summer/Central Sq**	**Signal**	26	9	0.829	21	0.84	-1.32%
Brockton	**Montello St/Crescent St**	**Signal**	25	11	1.183	9	0.84	40.83%
Brockton	**Montello St/Centre St**	**Signal**	23	12	1.053	16	0.84	25.31%
Bridgewater	**Bedford StWinter St**	**Stop Sign**	23	12	1.133	14	0.59	92.09%
Brockton	**Main St/Brookside Ave**	**Signal**	22	14	1.470	4	0.84	75.01%
Bridgewater	**Main St/Center/High St**	**Signal**	22	14	0.949	17	0.84	13.00%
Brockton	**Montello St/Lawrence St**	**Signal**	21	16	1.348	5	0.84	60.63%
Brockton	**N Montello St/Elliot St**	**Signal**	20	17	1.167	12	0.84	38.89%
Bridgewater	**Bedford St/Grove St**	**Stop Sign**	20	17	1.169	11	0.59	98.16%
Brockton	**Main St/Plain St/Keith Ave**	**Signal**	19	19	0.864	19	0.84	2.83%
Brockton	**Montello St/Perkins Ave**	**Signal**	17	20	1.067	15	0.84	27.07%
Brockton	**Montello St/East Nilsson St**	**Stop Sign**	16	21	1.149	13	0.59	94.67%
Brockton	**Main St/Sargents Way**	**Signal**	15	22	0.612	25	0.84	-27.12%
Brockton	**Montello St/Grove St**	**Signal**	13	23	0.770	23	0.84	-8.29%
Brockton	**Montello St/Plain Street**	**Stop Sign**	13	23	0.858	20	0.59	45.35%
Brockton	**N Montello St/Wilmington St**	**Stop Sign**	11	25	0.705	24	0.59	19.44%
Bridgewater	**Bedford St/Flagg Street**	**Stop Sign**	10	26	0.558	26	0.59	-5.49%
Avon	**N Main/Main St/E/W High St**	**Signal**	9	27	0.260	33	0.84	-68.92%
W.Bridgewater	**N Main St/Copeland St**	**Stop Sign**	9	27	0.536	27	0.59	-9.13%
Avon	**Main/East Main St/West Main St**	**Signal**	8	29	0.370	31	0.84	-36.82%
Brockton	**Montello St/School St**	**Signal**	8	29	0.500	29	0.84	-40.43%
W.Bridgewater	**N Main St/Howard St**	**Stop Sign**	8	29	0.489	30	0.59	-17.08%
Bridgewater	**Central Sq/School/Bedford St**	**Yield**	7	32	0.508	28	0.59	-13.93%
Avon	**E. Main St/Memorial Dr/E Main St**	**Stop Sign**	5	33	0.209	34	0.59	-64.67%
W.Bridgewater	**N Main St/Matfield St**	**Stop Sign**	5	33	0.206	35	0.59	-65.10%
Bridgewater	**Main St/Oak St**	**Stop Sign**	5	33	0.337	32	0.59	-42.91%
Bridgewater	**Central Sq/Church/South St**	**Yield**	4	37	0.160	38	0.59	-72.87%
Avon	**East Main St/Walmart**	**Signal**	4	36	0.166	37	0.84	-80.29%
Bridgewater	**Bedford St/Maple Ave**	**Stop Sign**	3	37	0.170	36	0.59	-71.20%
W.Bridgewater	**South Main St/Bryant/Ash St**	**Stop Sign**	2	39	0.128	39	0.59	-78.37%
Bridgewater	**Bedford St/Worcester St**	**Stop Sign**	2	39	0.120	40	0.59	-86.63%
Brockton	**N Montello St/Stop and Shop**	**Signal**	1	41	0.044	41	0.84	-94.81%

Table 4 - Types of Crashes

Community	Route 28 Name Intersecting Street(s)	Traffic Control	Number of Crashes	Injury Crashes	Angle	Head-on	Rear-end	Ped-estrian	Ran off road	Side-swipe	Bi-cycle	Un-known
Brockton	**N Montello St/Howard 37/Albion**	**Signal**	60	19	17	3	25	1	8	3	0	3
Brockton	**N Montello St/East Battles St**	**Stop Sign**	34	12	22	0	8	1	1	0	1	1
Brockton	**N Montello St//Court St**	**Signal**	32	13	12	2	11	0	4	2	0	1
Brockton	**N Montello St/East Ashland St**	**Signal**	30	17	18	0	9	0	0	2	0	1
Brockton	**N Montello St/Field St/Livingston Rd**	**Stop Sign**	29	12	23	0	5	0	0	0	0	1
Avon	**East Main St/Harrison Blvd**	**Signal**	28	12	6	0	15	0	0	4	0	3
Avon	**East Main St/E/W Spring St**	**Stop Sign**	27	5	19	0	1	0	3	1	0	3
Brockton	**N Montello St/Ames St**	**Signal**	27	7	14	1	7	0	2	1	0	2
Brockton	**Montello St/Crescent St**	**Signal**	25	12	18	1	2	0	1	1	0	2
Brockton	**Montello St/Centre St**	**Signal**	23	8	14	1	3	2	1	1	0	1
Bridgewater	**Bedford St/Winter St**	**Stop Sign**	23	6	21	1	1	0	0	0	0	0
Brockton	**Main St/Brookside Ave**	**Signal**	22	10	7	0	11	1	1	1	1	0
Bridgewater	**Main St/Center/High St**	**Signal**	22	9	10	0	8	0	1	1	0	2
Brockton	**Montello St/Lawrence St**	**Signal**	21	13	13	1	6	0	1	0	0	0
Brockton	**N Montello St/Elliot St**	**Signal**	20	9	12	0	5	0	1	1	0	1
Bridgewater	**Bedford St/Grove St**	**Stop Sign**	20	10	13	0	2	0	2	0	0	0
Brockton	**Main St/Plain St/Keith Ave**	**Signal**	19	7	4	1	9	0	2	0	0	3
Brockton	**Montello St/Perkins Ave**	**Signal**	17	7	11	0	4	0	0	1	1	0
Brockton	**Montello St/East Nilsson St**	**Stop Sign**	16	11	12	0	1	1	1	0	0	1
Brockton	**Montello St/Plain Street**	**Stop Sign**	13	7	3	1	7	1	1	0	0	0
Brockton	**N Montello St/Wilmington St**	**Stop Sign**	11	5	7	0	1	2	1	0	0	0

Angle crashes at an un-signalized intersection can be alleviated through signalization, especially in corridors where the speeds on the major street are high, as along Bedford Street in Bridgewater, and where the intersection is not in close proximity to existing signals. The MUTCD criteria for signal installation (Warrant 7, Crash Experience) states that a signal is warranted if; “Five or more reported crashes, of types susceptible to correction by a traffic control signal, have occurred within a twelve month period.” In addition, the volumes entering an un-signalized intersection must meet the minimum major and minor street volumes listed for the Eight-Hour Vehicular Volume warrant in the MUTCD. Traffic signal installation at the Bedford Street/Winter Street intersection was recommended in a recently completed town-wide traffic study for Bridgewater by the engineering firm of Vanasse/Hangen/Brustlin (VHB). The study showed that this intersection meets the criteria for signal installation based on accident experience and traffic volumes. This intersection is currently under design and is included in the FFY 2006-2010 Transportation Improvement Program (TIP). The intersection of Bedford

Street and Grove Street was also a subject in the VHB study. Although this intersection meets the accident experience criteria for signal installation, it does not meet the minimum traffic volume criteria.

In addition to screening the crash data for study area intersections, the MassHighway's list of Top 1,000 High Crash Locations was also reviewed to discern potential hazard locations within the Route 28 corridor. MassHighway produces a report each year that lists the top 1,000 highest crash locations in the state. This list of intersections is based on a standardized score given to each location. MassHighway uses a weighted scoring system to rank the high frequency crash locations. The weights have been established according to crash severity and are ranked as such: a property damage crash receives a score of one, a personal injury crash receives a score of five, and a fatal crash receives a score of ten. There were five Route 28 corridor intersections on the state's list (based on 1999 to 2001 crash data). These include Route 28 at Route 106 in West Bridgewater (ranked 226), Route 28 at Route 37 in Brockton (ranked 610), Montello Street at Centre Street in Brockton (ranked 782), North Montello Street at East Ashland Street in Brockton (ranked 834), and Route 28 at Broad Street Central Square in Bridgewater (ranked 523).

2.4.1 Fatal Crashes

Information on fatal crashes for the Route 28 corridor and the 41 study area intersections was obtained from the Massachusetts Highway Department. The data was for the ten-year period from 1994 to 2004. Table 5 summarizes the number of fatal crashes for Route 28.

Table 5 Fatal Crashes Route 28

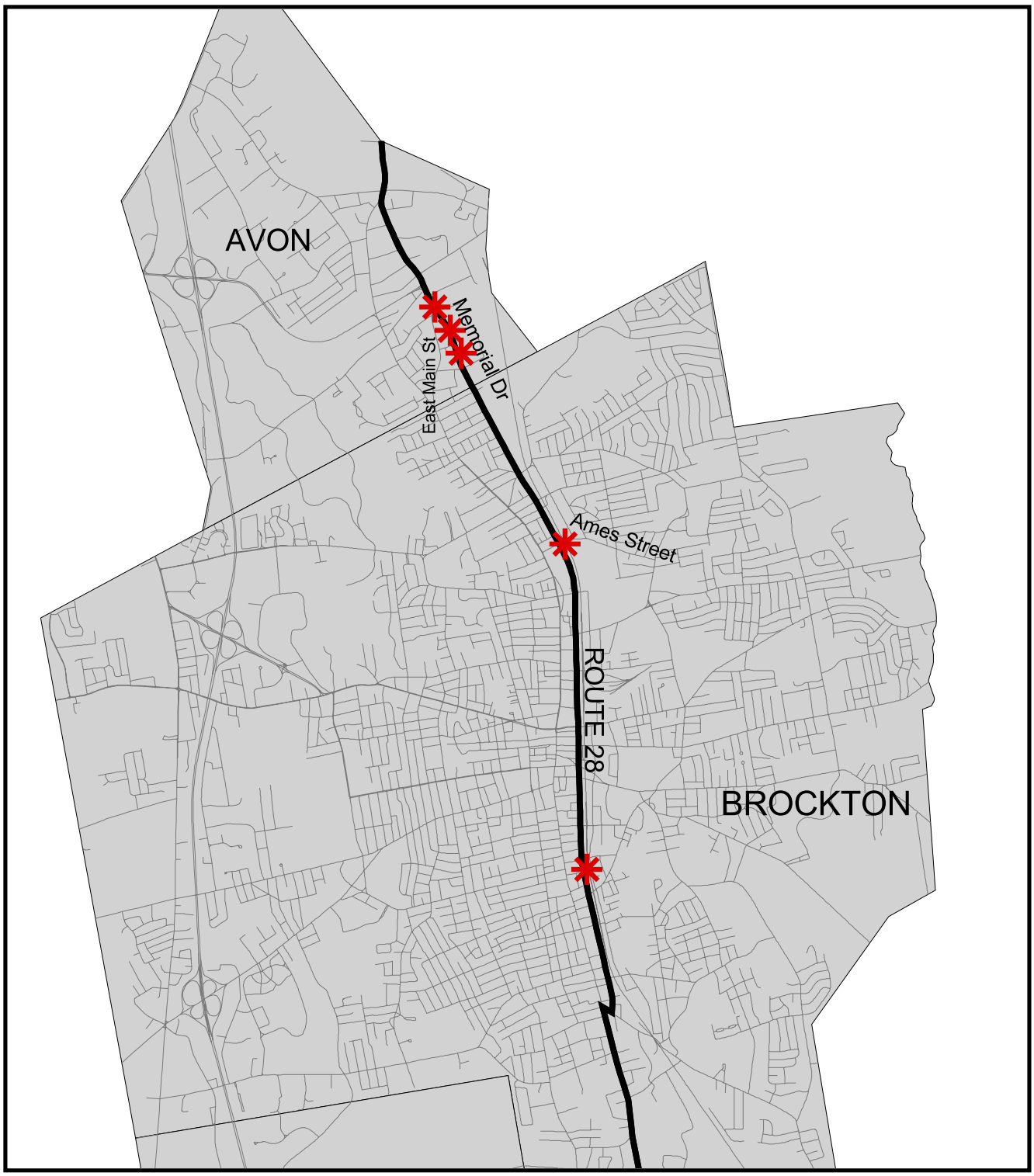
	Community	Location	Collision Type	Date	Number Killed
1	Avon	Memorial Dr. (Rte 28)/East Main St.	Pedestrian	4/29/1999	1
2	Avon	Memorial Dr.	Pedestrian	7/30/1999	1
3	Avon	Memorial Dr.	Motor Vehicles	12/13/2001	1
4	Brockton	at 362 Montello St	Pedestrian	2/4/1996	1
5	Brockton	Ames St at North Montello St.	Pedestrian	12/4/1999	1
6	Bridgewater	Pearl/Main St (Rte 28)	Angle	4/11/1999	1
7	Bridgewater	Bedford St (Route 28)	Angle	1/31/1996	1
8	West Bridgewater	Copeland/N Main (Rte 28)	Overturn	5/7/1994	1
9	West Bridgewater	Matfield/N. Main (Rte 28)	Rear End	2/19/1995	1
10	West Bridgewater	N. Main (Rte. 28)	Ran off Road	6/29/1997	1
11	West Bridgewater	S. Main St (Rte 28)	Ran off Road	12/19/1999	1
12	West Bridgewater	East Center St(Rte 106)/S. Main(Rte 28)	Ran off Road	11/1/2003	1

As shown in Table 5, there were 12 fatalities on Route 28 within the 10-year study period. There were four pedestrian fatalities on Route 28 in the ten-year period. Two of these fatalities occurred in Avon and two occurred in Brockton. Two of the pedestrian fatalities occurred at intersections and two occurred due to a pedestrian crossing at mid-block. Two of the fatalities

were angle crashes occurring in Bridgewater at Pearl Street and Main Street (Route 28) and on Bedford Street (exact location not specified.) In addition, there was one fatality due to a crash between motor vehicles on Memorial Drive in Avon. The exact location and type of crash was not specified in the data received from Mass Highway. There were four fatal crashes resulting from single vehicle crashes that ran off the road (three ran off road and one overturn). All of these occurred in West Bridgewater. There was one fatal crash due to a rear-end collision occurring at the intersection of Matfield Street and North Main Street in West Bridgewater. Figures 14 and 15 show the locations of the fatal crashes along the Route 28 corridor between 1994 and 2004.

Fatal Crashes Avon and Brockton

Figure 8



Fatal Crash Location

Route 28

Roads

Town Boundaries

0.8 0 0.8 1.6 Miles

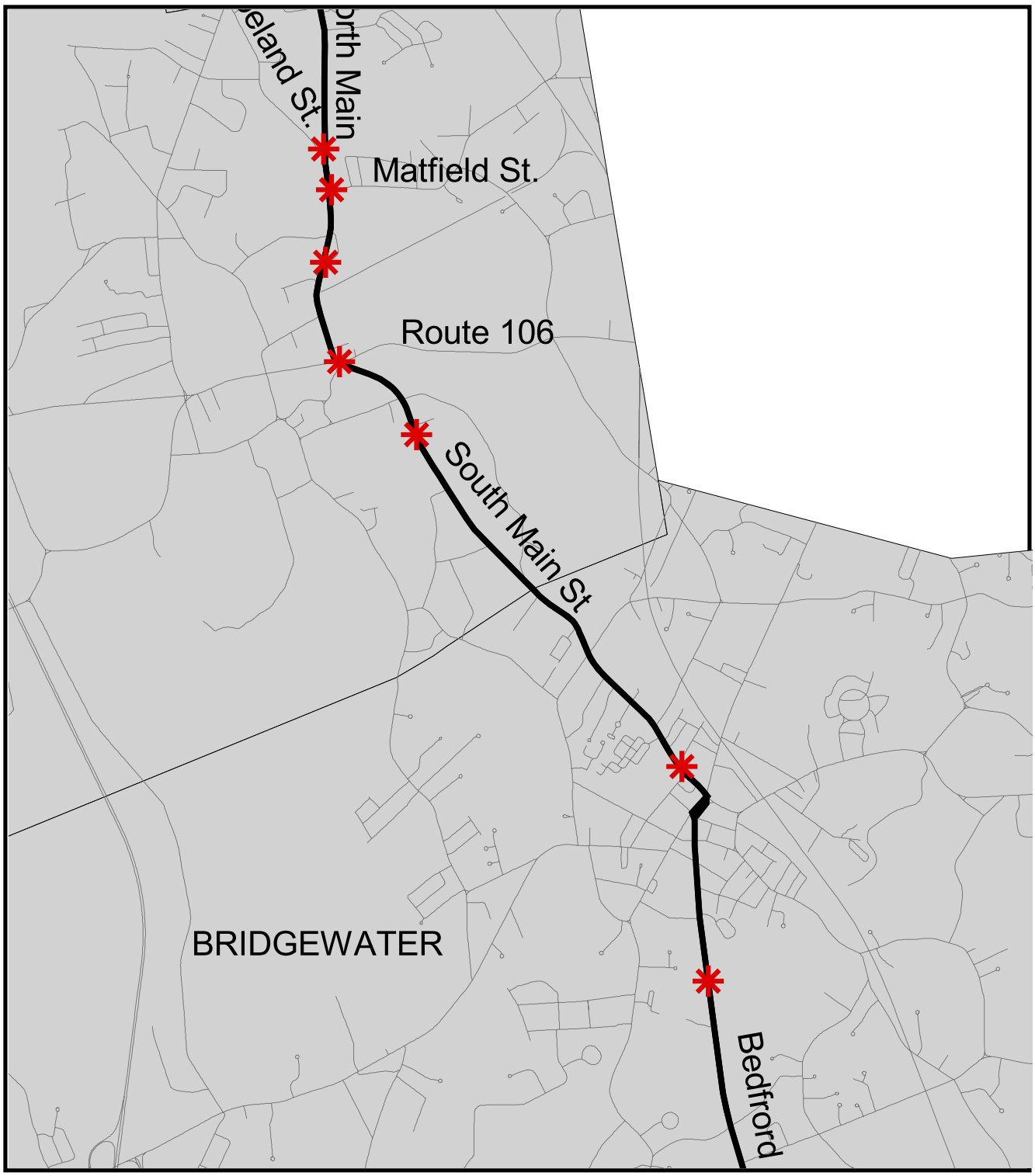
* Note: Locations are approximated for those crashes in which no specific location was available

Old Colony Planning Council
70 School Street
Brockton, MA 02301

GIS Data Sources:
MassGIS, MHD

Fatal Crashes West Bridgewater and Bridgewater

Figure 9



Fatal Crash Location

Route 28

Roads

Town Boundaries

* Note: Locations are approximated for those crashes in which no specific location was available

1 0 1 Miles

Old Colony Planning Council
70 School Street
Brockton, MA 02301

GIS Data Sources:
MassGIS, MHD

2.5 TRAVEL TIME AND DELAY STUDIES

The purpose of travel time and delay studies is two fold: 1) To determine the quality of traffic flow movement through a corridor, and 2) To determine the location, type, and extent of re-occurring delays within a road corridor.

Travel time studies were conducted along the Route 28 corridor in accordance with the techniques published by the Institute of Transportation Engineers (ITE) in the Manual of Traffic Engineering Studies. Old Colony Planning Council staff members conducted the studies during both the peak morning and afternoon commute times. The amount of time in seconds to travel between given points was recorded and an average speed was calculated using the measured distance. These travel time studies were done on random days over a period of several weeks in various weather conditions to assure an adequate data sample. In addition, the stop delay at each of the control point locations was measured to determine the average stop delays experienced at intersections. According to ITE, for an average range in travel speed between 25 and 40 miles per hour, the number of sample runs (a one-way trip through the corridor either northbound or southbound) should be at least 14. Fourteen sample runs were completed in February and March of 2005 for the northbound and southbound directions during both the morning and afternoon peak hours. The results of the studies showing the average stop delays and average speeds are shown in Figures 10 through 15.

Figures 10 and 11 show the average stop delay per vehicle at key intersections along the Route 28 corridor for the morning and afternoon peak hours. The highest delays recorded in Avon occurred at the Harrison Boulevard intersection (southbound morning peak). There were several intersections in Brockton experiencing extensive delay. These included: East Ashland Street (southbound afternoon peak), Perkins Street (southbound morning and afternoon peak), Court Street (northbound afternoon peak), and Route 37 Howard Street (northbound morning and afternoon peak). Although the stop delays through Brockton downtown at Route 28 intersections were between 5 and 20 seconds, the delays have an overall accumulative effect on traffic flow because the intersections are in close proximity. These include four intersections in the heart of the downtown: Route 28/Court Street, Route 28/Centre Street, Route 28/School Street, and Route 28/Crescent Street.

The Route 28/East West Center Street (Route 106) intersection in West Bridgewater experienced extensive delays for northbound traffic and especially for southbound traffic during the morning and afternoon peak hours. The most extensive delays in Bridgewater occurred at the town center with extensive delays at the Broad Street signalized intersection on the northbound approach, and at the Bedford Street/School Street intersection at the northbound approach into the town center, which had very extensive delays during the afternoon peak.

Figures 12 and 13 show that speed through the corridor is hampered at Bridgewater center northbound during the morning peak; in south Brockton beginning at Sargent's Way to Plain Street; through Brockton downtown; through the intersections at Lawrence Street and Court Street; and in the corridor from Ames Street to Howard Street. Progression is slowed northbound in Avon in the vicinity of Harrison Boulevard and at Avon center. In the southbound direction through the Route 28 corridor, progression is slowed in Avon at the town center and at East and West Spring Street to Harrison Boulevard. In Brockton, progression is slow through the Route 27 Howard Street intersection and throughout the corridor through the downtown. Speeds become extremely slow in the southbound direction in the vicinity of Plain Street but pick up at the West Bridgewater town line. Figures 14 and 15 show that southbound

progression through Bridgewater center is with little or no delay in both the morning and afternoon peak hours.

Figure 10 Average Stop Delay

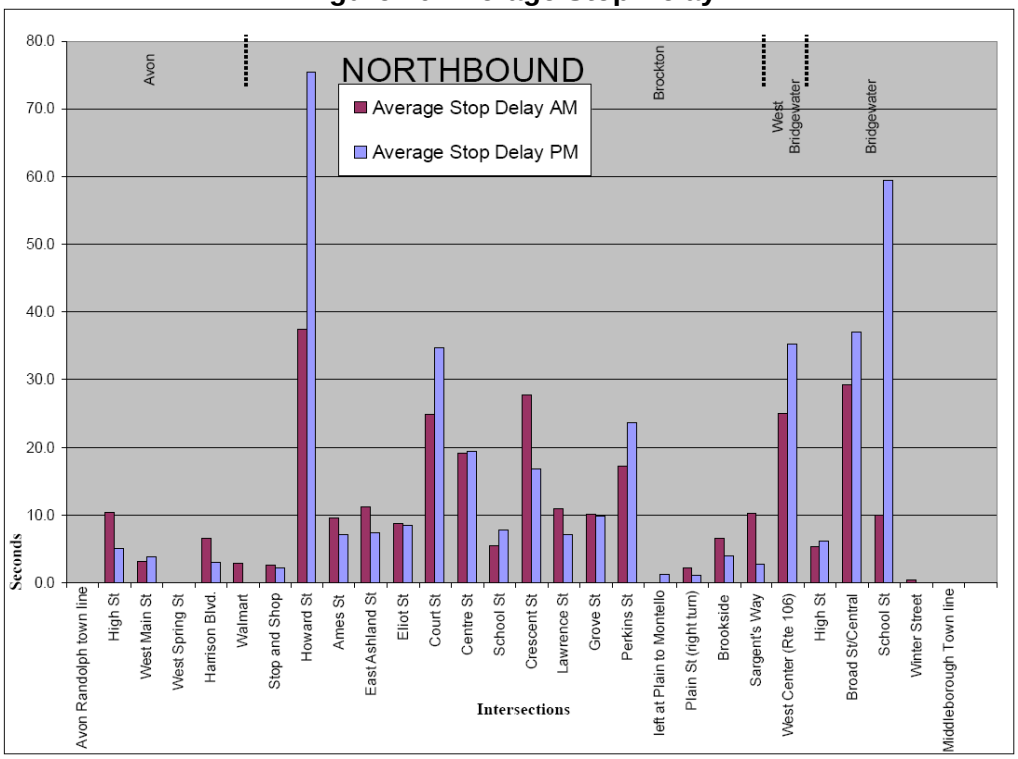


Figure 11 Average Stop Delay

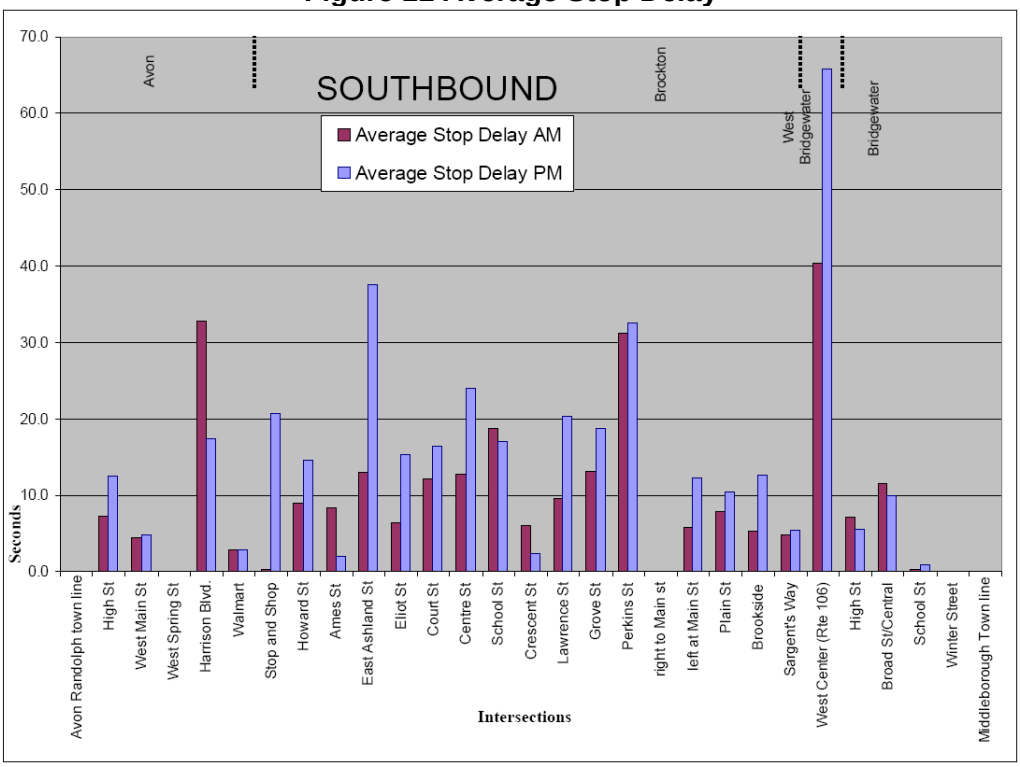


Figure 12 Average Speeds

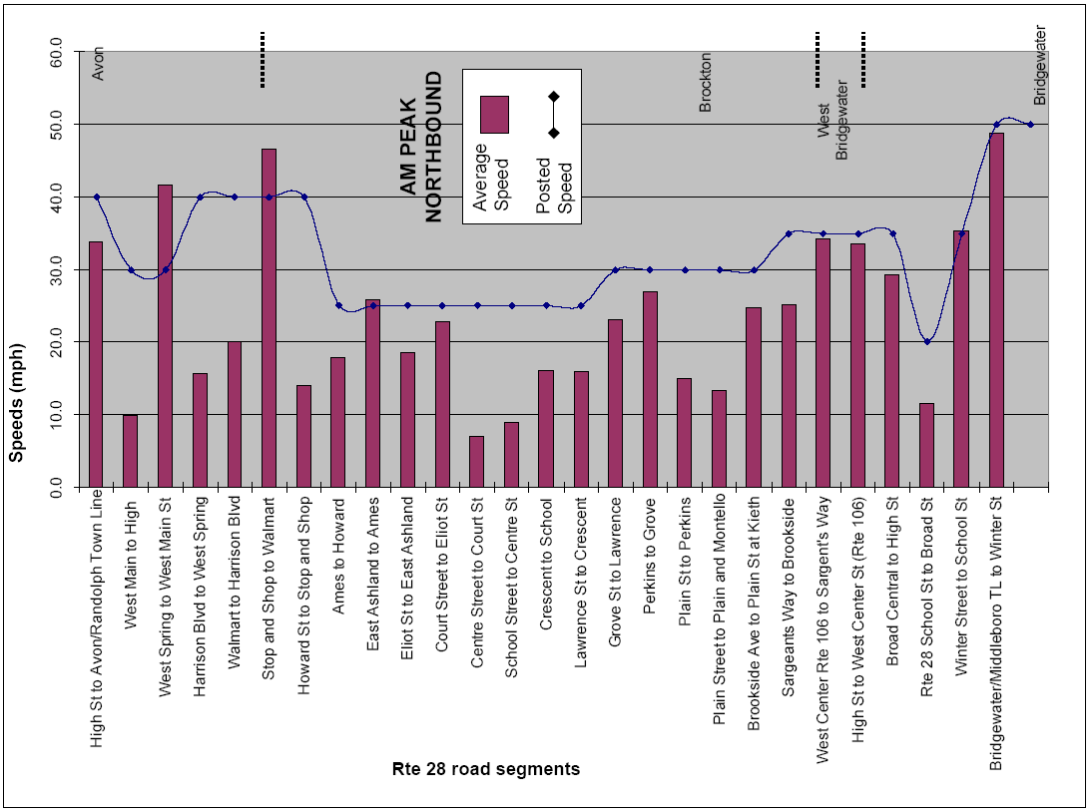


Figure 13 Average Speeds

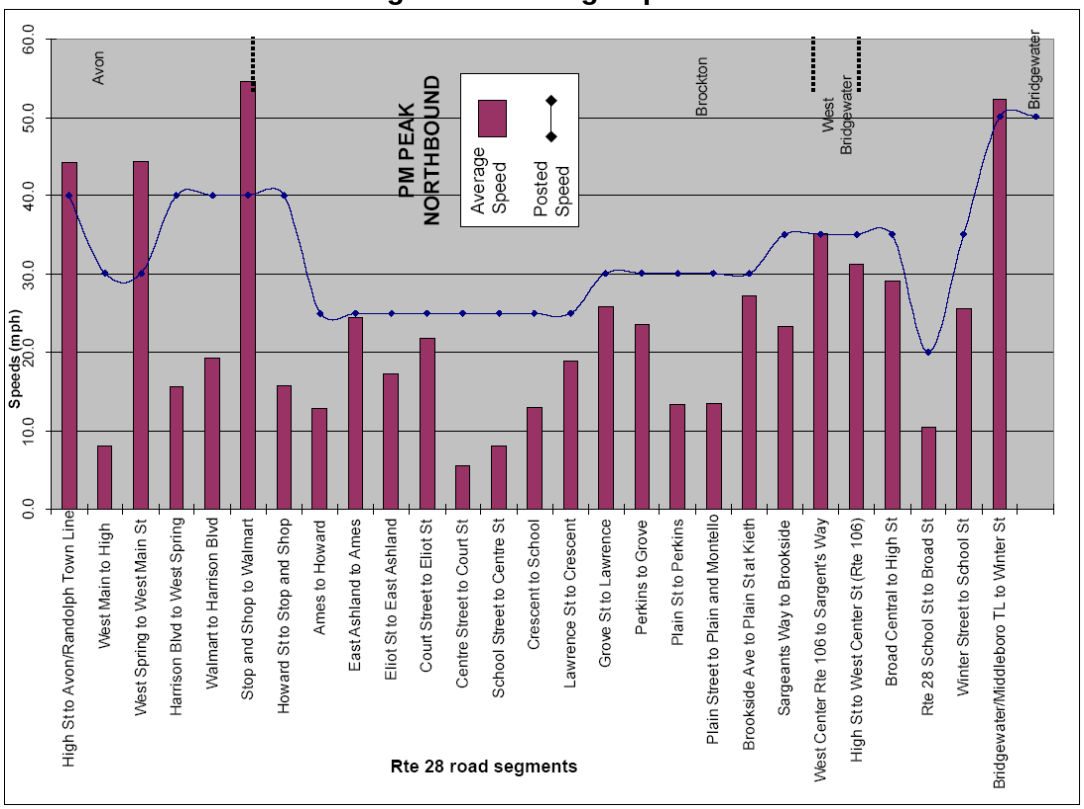


Figure 14 Average Speeds

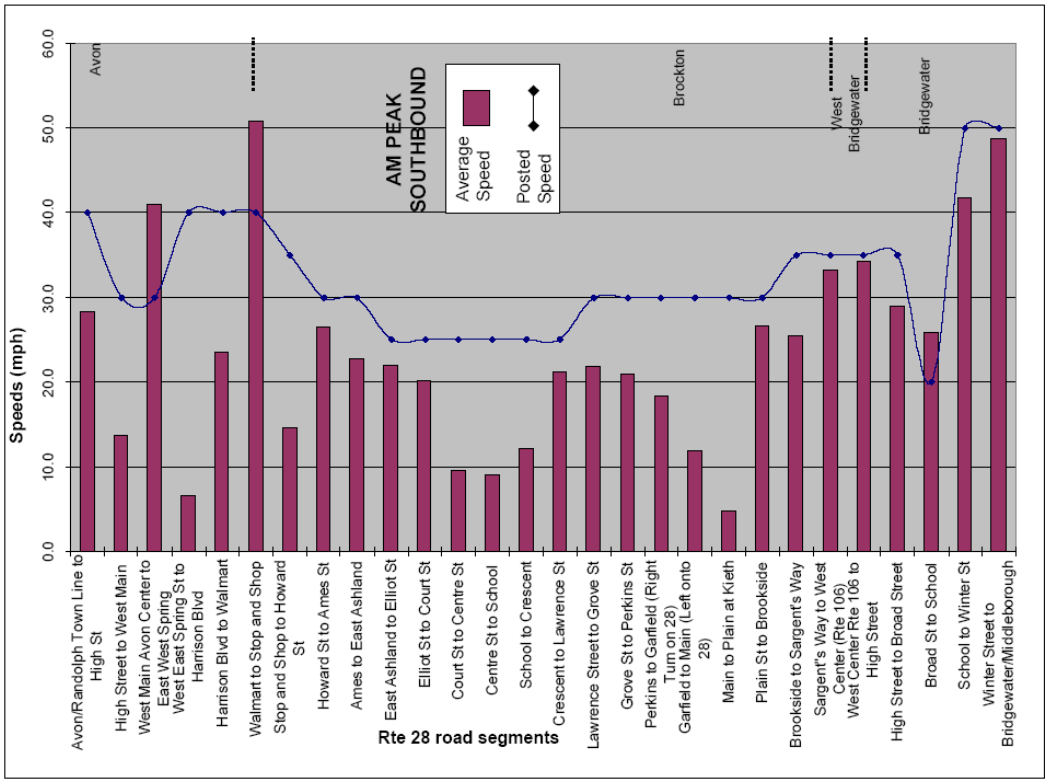
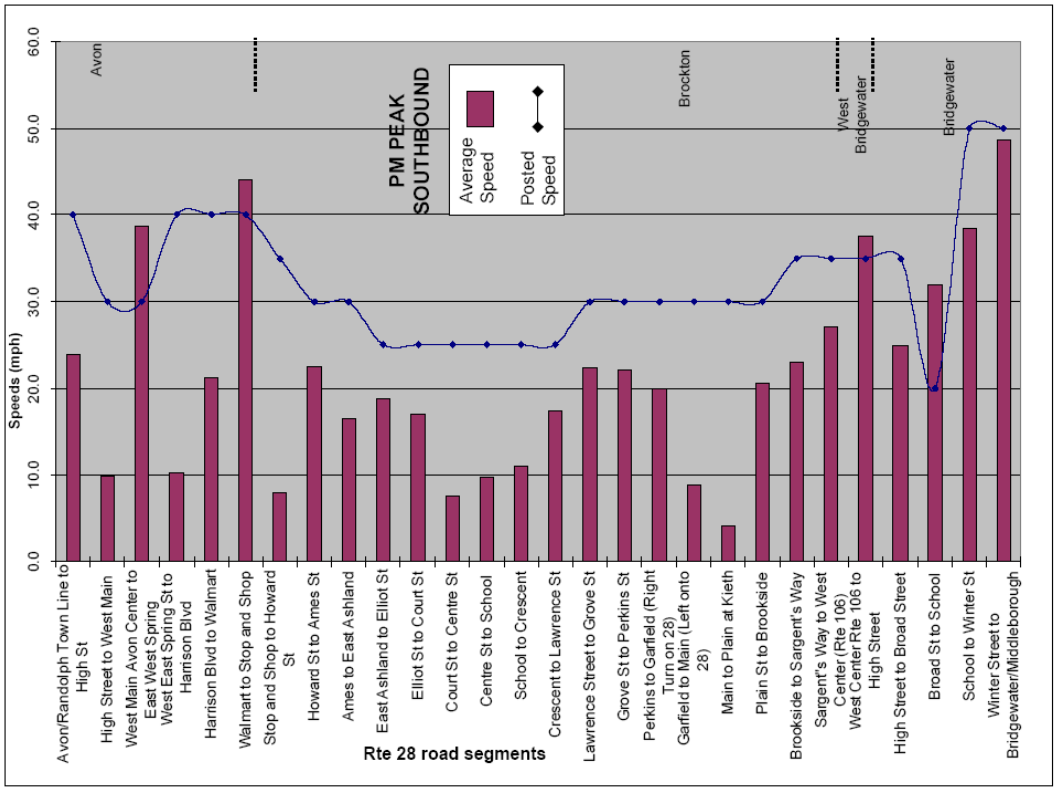


Figure 15 Average Speeds



2.6 SPOT SPEED STUDIES

The OCPC staff measured vehicle speeds under prevailing conditions at specific locations on Route 28. These speed studies were conducted using automatic traffic recorders. Spot speed data collection occurs over the course of a 24 to 48 hour period unlike the travel time and delay study, which focuses on the peak hour. The use of automatic recorders allows for non-peak as well as peak hour data collection. Tables 6 and 7 summarize the speed data collected for the Route 28 corridor. The tables include the average daily traffic (ADT), the posted speed limit, the average speed, and the 85th percentile speed. The 85th percentile speed is the speed at or below in which 85 percent of all vehicles travel. It is often used to determine the posted speed limit on a road.

Table 6 Spot Speeds Avon and Brockton

Location	ADT	Speed Limit (mph)	Average Speed	85th Percentile
Rte 28 N. Main St. at Randolph line southbound – Avon	9,250	40	34	40
Rte 28 N. Main St. at Randolph line northbound – Avon	9,600	40	33	41
Rte 28 E. Main north of E/W Spring southbound – Avon	6,280	30	35	42
Rte 28 E. Main north of E/W Spring northbound – Avon	5,940	30	35	42
Rte 28 E. Main St south of Harrison Blvd. southbound – Avon	20,560	40	34	42
Rte 28 E. Main St south of Harrison Blvd. northbound – Avon	7,765	40	24	40
Rte 28 Memorial Dr at Brockton line southbound – Avon	18,330	40	39	48
Rte 28 Memorial Dr at Brockton line northbound – Avon	8,500	40	27	45
Rte 28 N. Montello St. north of E. Ashland southbound – Brockton	7,300	30	25	34
Rte 28 N. Montello St. north of E. Ashland northbound – Brockton	7,195	30	29	35
Rte 28 N. Montello north of Court St. southbound – Brockton	8,215	30	24	32
Rte 28 N. Montello north of Court St. northbound – Brockton	7,125	25	26	32
Rte 28 Montello St north of Crescent St southbound – Brockton	5,670	25	21	29
Rte 28 Montello St north of Crescent St northbound – Brockton	4,240	25	17	26
Rte 28 Montello St south of Crescent St southbound – Brockton	4,590	25	28	34
Rte 28 Montello St south of Crescent St northbound – Brockton	5,625	25	27	34
Rte 28 Montello St south of Grove southbound – Brockton	6,200	30	27	34
Rte 28 Montello St south of Grove northbound – Brockton	5,300	30	27	34
Rte 28 Main St. north of Sargent's Way southbound – Brockton	7,500	30	23	33
Rte 28 Main St. north of Sargent's Way northbound – Brockton	8,540	30	25	34
Rte 28 Main St. south of Sargent's Way southbound – Brockton	11,000	35	30	38
Rte 28 Main St. south of Sargent's Way northbound – Brockton	10,600	35	29	36
Rte 28 Main St at W. Bridgewater line southbound – Brockton	7,000	35	41	49
Rte 28 Main St at W. Bridgewater line northbound – Brockton	6,810	35	39	46

Table 7 Spot Speeds West Bridgewater and Bridgewater

Location	ADT	Speed Limit (mph)	Average Speed	85th Percentile
Rte 28 N, Main St. north of Matfield southbound – W. Bridgewater	8,910	35	34	40
Rte 28 N, Main St. north of Matfield northbound – W. Bridgewater	8,600	35	35	41
Rte 28 N, Main St. south of Matfield southbound – W. Bridgewater	8,365	35	35	41
Rte 28 N, Main St. south of Matfield northbound – W. Bridgewater	7,975	35	36	42
Rte 28 N. Main north of W. Center St. southbound – W. Bridgewater	6,575	35	31	39
Rte 28 N, Main north of W, Center St. northbound – W. Bridgewater	6,855	35	29	38
Rte 28 S. Main St. south of West Center St southbound – W. Bridgewater	8,645	45	36	43
Rte 28 S. Main St. south of West Center St northbound – W. Bridgewater	8,535	35	35	42
Rte 28 Main St north of High St. southbound – Bridgewater	7,560	35	28	37
Rte 28 Main St north of High St. northbound – Bridgewater	7,550	35	32	39
Rte 28 Main St. south of Oak St southbound – Bridgewater	8,230	35	31	39
Rte 28 Main St. south of Oak St northbound, Bridgewater	8,325	35	33	40
Rte 28 Main St north of Central Sq. southbound – Bridgewater	7,995	35	22	31
Rte 28 Main St north of Central Sq. northbound – Bridgewater	6,575	35	26	34
Central Sq southbound – Bridgewater	16,000	*	22	27
Central Sq. northbound – Bridgewater	14,000	*	19	25
Rte 28 Bedford St. south of Central Sq. southbound- Bridgewater	6,460	*	30	35
Rte 28 Bedford St. south of Central Sq. northbound- Bridgewater	7,310	35	23	33
Rte 28 Bedford St north of Winter St. southbound	8,360	50	42	49
Rte 28 Bedford St. north of Winter St. northbound	8,514	50	42	49
Rte 28 Bedford St. south of Flagg St. southbound – Bridgewater	7,160	50	32	49
Rte 28 Bedford St. south of Flagg St. northbound – Bridgewater	7,629	50	41	50
Rte 28 Bedford St. at Middleborough line southbound – Bridgewater	6,240	50	32	53
Rte 28 Bedford St. at Middleborough line northbound – Bridgewater	7,235	50	46	55

** speed limit not posted*

In some instances, the average speed at certain locations can fall below the posted speed and the 85th percentile speed. This is most likely due to congestion at that road segment location, whereby traffic is either stopped or moving along at slow speeds. Table 6 shows that traffic headed northbound on Route 28 in Avon just south of Harrison Boulevard experiences an average speed of 24 mph, although the posted speed limit is 40 mph. The Route 28 count location at the Avon-Brockton line experiences an average speed of 27 mph northbound, even though the posted speed limit is 40 mph. Table 6 shows that the average speeds on Route 28 through the Brockton downtown are typically below the posted speed limits for both northbound and southbound traffic (Route 28 north of East Ashland Street, Route 28 north of Court Street and Route 28 north of Crescent Street). Other locations that experience average speeds substantially below the speed limit include Route 28 north of Central Square (southbound into

the center), and Bedford Street Route 28 south of Central Square in Bridgewater (northbound into the center).

2.7 HEAVY VEHICLE TRAFFIC

The OCPC staff conducted vehicle classification studies using automatic traffic recorders on Route 28. The data was classified into categories based on the Federal Highway Administration (FHWA) classification system. The Old Colony Planning Council then calculated the percentage of heavy vehicles within the traffic. Table 8 shows the percentage of heavy vehicles in the traffic flow. The individual FHWA classifications are shown in the appendix to this report. Any vehicle with a minimum of two axles and six tires is considered a heavy vehicle.

Table 8 - Percent Truck Traffic

Location	ADT	Percent Heavy Vehicles
Rte 28 N. Main St. at Randolph line - Avon	19,000	6.2%
Rte 28 E. Main north of E/W Spring - Avon	12,200	5.5%
Rte 28 E. Main St south of Harrison Blvd. - Avon	28,300	9.5%
Rte 28 Memorial Dr at Brockton line - Avon	26,800	8.0%
Rte 28 N. Montello St. north of E. Ashland - Brockton	14,500	6.1%
Rte 28 N. Montello north of Court St. - Brockton	15,500	6.6%
Rte 28 Montello St north of Crescent St - Brockton	9,900	6.7%
Rte 28 Montello St south of Crescent St - Brockton	10,200	6.9%
Rte 28 Montello St south of Grove - Brockton	11,500	7.4%
Rte 28 Main St. north of Sargent's Way - Brockton	16,000	6.2%
Rte 28 Main St. south of Sargent's Way - Brockton	21,600	6.6%
Rte 28 N, Main St. north of Matfield W. Bridgewater	17,500	6.5%
Rte 28 N, Main St. south of Matfield W. Bridgewater	16,300	6.4%
Rte 28 N, Main St. north of W. Center St. - W. Bridgewater	13,400	7.8%
Rte 28 S. Main St. south of West Center St - W. Bridgewater	17,100	5.2%
Rte 28 Main St north of High St.- Bridgewater	15,100	5.0%
Rte 28 Main St. south of Oak St Bridgewater	16,500	4.0%
Rte 28 Main St north of Central Sq.- Bridgewater	14,500	6.2%
Central Sq - Bridgewater	30,000	6.0%
Rte 28 Bedford St. south of Central Sq. Bridgewater	13,800	6.3%
Rte 28 Bedford St north of Winter St. - Bridgewater	16,800	5.7%
Rte 28 Bedford St. south of Flagg St. - Bridgewater	14,800	5.9%
Rte 28 Bedford St. at Middleborough line - Bridgewater	13,400	5.1%

The percentage of heavy vehicle volume on a roadway is an important attribute because high volumes of heavy vehicles can have a substantial impact on the efficiency of a roadway segment or an intersection. Heavy vehicles take up more space than passenger vehicles and have longer start-up times after stopping at traffic signals and stop signs. Heavy vehicle volumes also have an impact on safety, and heavier wheel loads result in faster deterioration of roadway surfaces. In addition, road segments with steeper grades can slow down heavy vehicles, which often slows down traffic on two-lane highways such as Route 28 with limited passing zones. Despite their impact on capacity and road surfaces, heavy vehicles play an

important role in the overall economic well being of the Route 28 corridor and the region, and especially in those segments of Route 28 that have predominantly commercial and industrial land uses. Route 28 in Brockton is a designated commercial truck route with signs posted indicating truck use in this section of the corridor.

Table 8 shows that the highest heavy vehicle traffic on Route 28 is located on the sections of the corridor south of Harrison Boulevard in Avon (9.5 %) and at the Brockton-Avon line (8.0 %). This section of Route 28 provides access to Harrison Boulevard and ultimately to Route 24 for inter-regional travel. Route 28 Main Street south of Oak Street in Bridgewater had the lowest percentage of heavy vehicle traffic (4.0 %). Heavy vehicle traffic on most of Route 28 ranges between 6 and 7 percent of the total traffic.

2.8 PAVEMENT CONDITIONS

A Pavement Management System (PMS) is maintained by OCPC under contract with the EOT. OCPC uses the *Road Manager* software program, which includes a pavement deterioration curve that demonstrates the rate of deterioration of pavement and the implications for cost of maintenance. Road Manager calculates Pavement Condition Index (PCI) scores for the surveyed road segments. The PCI is an index derived from an evaluation of pavement distress factors, average daily traffic, and roadway classification. PCI is based on a scale of 1 to 100, with 100 indicating a flawless road surface.

A series of classifications for the PCI scores were developed by the Pavement Management Users Group, which OCPC continues to use to assess pavement data. PCI scores of 95 or higher indicate that the road surface is in excellent condition. PCI scores between 85 and 94 normally indicate that the road has some distresses but is in good condition. Roads with scores between 65 and 84 are in fair condition and are in need of maintenance or mill and overlay repairs less than two inches. Roads with scores below 65 need base rehabilitation or reconstruction. Tables 9 and 10 show the PCI classifications, recommended repairs, and maintenance strategies.

Table 9 PCI Classification

Condition	Excellent	Good	Fair	Poor
PCI Score	100 to 95	94 to 85	84 to 65	64 to 0

Table 10 Road Manager Repair and Maintenance Recommendations

Repair or Maintenance	No immediate maintenance	Routine maintenance	Preventative maintenance	Rehabilitation	Reconstruction

Source: OCPC Pavement Management System

Windshield surveys were taken in April of 2005 by OCPC staff to update the condition files for the Route 28 corridor in Road Manager software. Figure 16 shows the pavement condition needs within the Route 28 corridor. The surface conditions table for Route 28 segments in the OCPC region and the recommended repair or maintenance for each segment is shown in the appendix to this report.

Most of Route 28 within Avon requires routine and preventative maintenance, except for sections of Memorial Drive and East Main Street that are in “fair” condition that require rehabilitation. At present, there are several segments of Route 28 that are in poor condition.

This includes a number of segments in Brockton including: the segment from East Ashland Street to Elliot Street, Garfield Street from Montello to Main Street (as Route 28 transitions from Montello Street to Main Street), and Main Street in south Brockton to the Sargent's Way intersection.

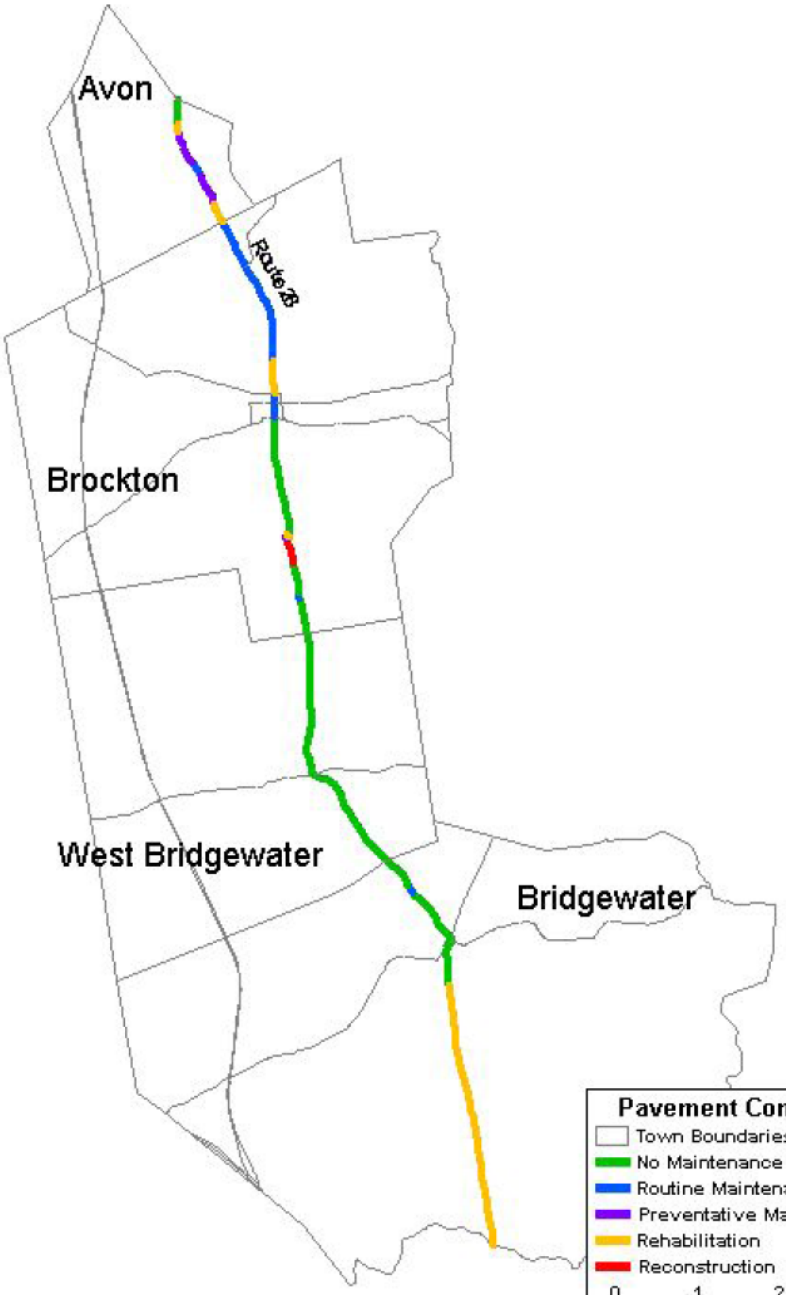
In West Bridgewater (including a section in south Brockton), MassHighway completed rehabilitating the pavement within the Route 28 corridor. This reclaim and resurfacing project for Route 28 begins in Brockton, just south of Sargent's Way, extends into West Bridgewater, and includes the entire length of Route 28 in West Bridgewater (North Main Street and South Main Street). The pavement replacement includes a mill of the existing surface and an overlay repair.

The pavement surface on Route 28 (Bedford Street) in Bridgewater is in excellent shape south of the center (for approximately ½ mile); however, for the remaining three miles to the Middleborough town line, Route 28 is in poor condition and in need of serious rehabilitation and reconstruction. The maintenance and repair of this section of Bedford Street to the Middleborough town line is the responsibility of MassHighway.

Pavement rehabilitation on Route 28 south Brockton (to extend through West Bridgewater to the Bridgewater line.)

Pavement Repairs

Figure 16



Old Colony Planning Council
70 School Street
Brockton, MA 02301

GIS Data Sources:
MassGIS, MHD

2.9 COMMUNITY GOALS AND VISIONS

A review of the latest available master plan for each of the Route 28 communities was completed for this study in order to discern the vision that each of the communities has for future development within the Route 28 corridor. In addition, a review of the existing zoning for each town was completed to determine if the zoning is adequate to fulfill the community goals for the corridor. Maps of existing zoning (in general terms, based on information from Massachusetts GIS data) are provided in the appendix to this report.

Avon Master Plan 2001:

The Avon Master Plan encourages a mix of residential and industrial uses for Route 28 in the four-lane section (Memorial Drive) south of Harrison Boulevard, and an encouragement of commercial uses north of Harrison Boulevard within the town center. The plan calls for traffic flow improvements at the Route 28/Harrison Boulevard intersection and the Route 28/East West Spring Street intersection. The town desires to keep Route 28 as a two-lane highway north of Harrison Boulevard through the Avon center to the Randolph town line. The plan calls for improved safety for pedestrians and improvements to the sidewalk system within this section. The Avon plan proposes the construction of two east to west bicycle paths that will cross Route 28. One path is proposed in the north most part of town across Route 28 just south of the Randolph town line. A second path is proposed to cross the four-lane section of Route 28 (Memorial Drive) just north of the Brockton city line. This path will run from D.W. Field Park to the Ames Nowell State Park. A review of zoning in Avon (see appendix) shows that commercial land uses are allowed throughout the Route 28 corridor in Avon with a zone for industrial uses in close proximity to Route 28 in the south section of the town.

Brockton Comprehensive Policy Plan 1999:

The Brockton plan emphasizes the creation of a balanced multi-modal transportation system that encourages economic development (commercial, industrial, and office uses) in the downtown. The plan calls for policies that permit a range of housing (apartments, condos, live-work spaces) in the downtown. The plan encourages the commercial, industrial, and office uses on Montello Street (Route 28 through the downtown) and on Main Street (Route 28) in the south of Brockton. The policies outlined in the plan recommend the establishment of higher density housing, Transit Oriented Development (TOD), and Pedestrian Oriented Development (POD) in the downtown in order to take full advantage of the existing mass transit facilities adjacent to Route 28. The plan also states that policies should be directed to minimize the negative impacts of non-local traffic on neighborhoods by using traffic calming techniques. A review of existing zoning in Brockton within the Route 28 corridor shows that a mix of commercial, industrial, and residential uses is allowed within the corridor from north to south in Brockton.

West Bridgewater 2001 Master Plan:

The West Bridgewater 2001 Master Plan considers the reconstruction of the Route 28/Route 106 intersection as a high priority to address the traffic congestion problems that occur at this location. This intersection is located in the center of West Bridgewater. The plan calls for changes in the town center that promote a village center concept. The plan describes these changes in its “Town Center Greenbelt Plan” initiative. This calls for physical changes to the town center that minimize traffic impacts, enhance pedestrian circulation, and encourage mixed

uses to create a central village environment. This plan states that changes to the town center should be brought about through changes in zoning that include design standards. In addition, the master plan calls for new zoning districts that encourage commercial growth on Route 28 (North Main Street) between the Brockton town line and the town center (Route 106). Zoning changes slated for Route 28 (South Main Street) in the plan will be designed to manage growth and limit commercial uses (no drive through sales or auto sales) in order to limit sprawl. The plan also states that access management techniques (such as limiting the number and placement of curb-cuts) should be implemented in commercial districts along major arteries such as Route 28 through changes in zoning. The plan calls for widening the entire length of Route 28 through West Bridgewater from the Brockton city line south to the Bridgewater town line. Although widening Route 28 (North Main Street) in the north would be consistent with Route 28 in Brockton, which is commercial in land use and is already widened to four lanes, it would not be consistent with Route 28 in Bridgewater, which has two lanes and is zoned residential. Bridgewater's plan, which is discussed in the next section, is to keep its segment of Route 28 between West Bridgewater and Bridgewater center residential in nature, with discreet changes in land uses (limited office and bed and breakfast establishments). A review of the existing zoning in West Bridgewater shows that commercial uses are allowed within the entire Route 28 corridor within the town from north to south. The zoning in the north corridor is consist with Route 28 in Brockton; however, West Bridgewater's commercial zoning for the South Main Street Route 28 corridor is not consistent with Bridgewater's zoning for Route 28, which allows mainly residential uses. The Town of West Bridgewater has laid the groundwork to rectify this inconsistency in land use along the Route 28 corridor, as it transitions into Bridgewater, through policies that promote zoning district changes to reduce sprawl in its 2001 Master Plan. The town still needs to identify and implement the appropriate zoning to achieve this end.

The Bridgewater 2003 Master Plan:

The Bridgewater Master Plan divides the town into 14 "Land Use Management Units." The Route 28 corridor from the West Bridgewater town line to Bridgewater center falls within a residential only management unit. The existing zoning for this corridor allows residential uses with limitations on commercial use. There are few retail and commercial establishments along Route 28 (some service stations at the West Bridgewater line). The corridor is residential in nature to the town center where retail uses are allowed. This section of Route 28 in Bridgewater is designated as a bicycle route in the master plan. Route 28, at the Bridgewater Town Center Oval, runs through a town center commercial district and a designated historical district as it merges with Routes 18 and 104. The plan states that traffic is a major concern at Central Square. Congestion occurs at the signalized intersection of Broad Street at Main Street and Summer Street (Route 18, Route 28, Route 104) at the north end of the oval. In addition, the south intersections, which are yield control at the approaches, also experience congestion during the peak hours. The plan also cited congestion at the Maple Avenue/Route 28 intersection and at the Grove Street/Route 28 (Bedford Street) intersection due mainly to vehicles attempting to bypass congestion at the center oval. The plan outlined policies for addressing traffic congestion in the Route 28 corridor south of the town center (Bedford Street). It calls for the signalization of the Winter Street/Route 28 intersection 9currently under design) and the monitoring of the Flagg Street/Route 28 intersection. At present, the Flagg street intersection does not meet warrants to satisfy the installation of a traffic signal. The plan outlined the town's "Gateway Streetscape Project." The purpose of this project is to create a limited mixed-use district to improve aesthetics and pedestrian friendly amenities on Route 28 within the section from Winter Street to Flagg Street by implementing standards for site design.

3.0 FUTURE ROUTE 28 CORRIDOR CONDITIONS

3.1 TRAFFIC FORECASTS

A five-year time horizon has been chosen for analysis of future conditions, which is consistent with state guidelines for traffic studies. A review of traffic growth rates within the Route 28 corridor shows that there has been rapid growth in some areas and no growth in other segments of the Route 28 corridor. This has been mainly due to re-development and changes in the land use in some areas to retail and commercial uses. The area in north Brockton (north of the Route 37 intersection) and south Avon (south of Harrison Boulevard) has seen a traffic growth of about 5 percent per year over the course of three to six years. These increases in traffic have been most likely brought about by the opening of Walmart and Stop and Shop within this corridor. Other segments of Route 28 have experienced negative growth or zero growth in traffic over the past five years, including Brockton downtown and Bridgewater north of Central Square. West Bridgewater experienced an average annual growth rate of 2.7 percent on Route 28 south of Route 106 since 1998. The overall average annual increase in traffic for the corridor is about 1.1 percent. An annual growth rate of 1.5 percent has been chosen for analysis purposes for this study in order to account for increases in those segments of Route 28 (especially in the retail segments) that have experienced above average annual growth rates. Variations in traffic growth within the corridor reflect the dual nature of the function of the road. Although there might be little or no growth in long distance or through trips, certain segments experience heavy traffic growth due to development. An annual growth rate of 1.5 percent over a five-year horizon has been applied to the existing turning movement volumes in order to discern the future peak hour turning movements. The future peak hour volumes are shown in the appendix to this report.

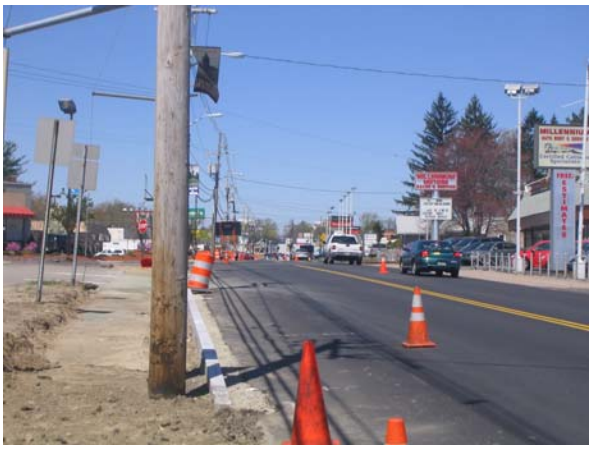
3.2 PROGRAMMED IMPROVEMENTS

Improvements within the Route 28 corridor have been identified in the Transportation Improvement Program (TIP), the 2003 Regional Transportation Plan, and through study review and feedback from community officials from the study area communities. Future improvements have been divided into two main categories: 1) Programmed improvements, and 2) Planned improvements. Programmed improvements include future projects that are included in the region's Transportation Improvement Program (TIP). These projects are currently targeted for funding, design, and construction. Planned improvements include projects identified in the 2003 Regional Transportation Plan that have not been programmed for funding and implementation. These projects are mostly in the conceptual stage, although some projects have been defined in more detail.

The 2006-2010 Transportation Improvement Program (TIP) for the region contains a number of improvement projects within the Route 28 study area. The reconstruction of the Route 37 (Howard Street)/Route 28 intersection is nearly complete. The reclamation and resurfacing of Route 28 pavement from Sargent's Way in Brockton through West Bridgewater, although not a TIP project (this project is part of MassHighway's Highway Maintenance Program) was recently completed. Improvements at the Route 37 (Howard Street)/Route 28 intersection include widening the northbound approach from one to two lanes and coordinating the traffic signals with the Route 28/Stop and Shop intersection. The improvement slated for the Route 28/High Street intersection in Bridgewater is a town project with no participating federal funding. Table 11 summarizes programmed improvements within the Route 28 corridor.

Table 11 Route 28 Corridor Programmed Improvements

Community	Location	Description	MHD Number	Project Status
Brockton	Route 37 (Howard St) at Route 28	Reconstruct intersection, upgrade traffic signals. Widen northbound approach to two lanes.	602557	Complete 2006
Brockton	Route 28/ Lawrence St	Intersection improvements		Preliminary Design
Brockton	Perkins Ave – from Summer St to Main	Upgrade roadway and traffic infrastructure – Re-surfacing and related work	601642	Preliminary Design 2008
Brockton	Route 28/Keith Ave/Plain St	Upgrade traffic signals, add turning lanes, and widen Route 28 approaches.	602233	75 % Design
Brockton/ West Bridgewater	Resurface Route 28	Reclaim and resurface Route 28 from Sargent's Way through West Bridgewater to Bridgewater line		Completed
West Bridgewater	Route 28/Route 106	Intersection improvements to address congestion issues and safety, add exclusive left turns Rte 106 EB and WB.	603457	Preliminary Design Winter 2007
Bridgewater	Route 28/18 (Bedford St)	Resurface Route 28/18 from just south of the town center, through Middleborough, to the Route 44 Rotary	601104	Design stage to begin winter 2005/2006
Bridgewater	Route 28 at Center St/High St	Upgrade signals, add southbound right lane, add northbound left turn lane	Town Project	Design Stage
Bridgewater	Route 28/18 (Bedford St) at Winter St	Install traffic signals to enhance safety – add bicycle lanes and improve roadway geometry	603568	75 % plans complete begin 2006
Bridgewater	Route 28/18 (Bedford St)	Replace bridge over Taunton River at the Middleborough line	603385	Final Planning Stage, begin summer 2005




Repaving on Route 28 (left) at the Brockton/West Bridgewater line, now complete. Reconstruction of the Route 37/Route 28 intersection in Brockton (right) is nearly complete.

The Route 28/Route 37 (Howard Street) intersection, Brockton – The reconstruction of this intersection is nearing completion. The major improvements at this intersection include the addition of a northbound approach lane, an upgrade of traffic signals, and the coordination of signals at this intersection with the existing signals at the Stop and Shop entrance/Route 28 intersection.

Route 28 and Lawrence Street, Brockton – The design for improvements at this intersection are currently in the preliminary stage.

Perkins Avenue from Summer Street to Main Street, Brockton - The Perkins Avenue project in Brockton is in preliminary design at present. The signal equipment at the Route 28/Perkins Avenue intersection and at the Perkins Avenue/Main Street intersection is the oldest in the City of Brockton. The signal timing at these intersections operates with an automatic pedestrian phase that gives green time for pedestrian movements (and therefore all red to all vehicle approaches) whether or not any pedestrians are actually present and crossing at the intersection. Although the Perkins Avenue/Route 28 intersection operates at acceptable levels of service during the morning and afternoon peak hours, an upgrading of the signal equipment and timing should be included in the design of this TIP project in order to add a push button for pedestrian actuation to the timing and phasing. This would allow actuation of pedestrian phases only when pedestrians are actually at the intersection. This improvement would allow more green time to be utilized on vehicular movements (during the absence of pedestrians) and would cut the average delays in half on the northbound and southbound Route 28 approaches. The signal upgrade at the Route 28/Perkins Avenue intersection should coincide with upgrades at the Main Street/Perkins Avenue intersection. The signal timing and phasing at both intersections should be coordinated to ensure maximum traffic flow and capacity utilization.

Route 28 (Main Street)/Keith Avenue/Plain Street, Brockton, - An initial design of this project has been completed by a consultant for Brockton that includes the widening of the northbound and southbound approaches to the intersection. This project is eligible for funding through the Congestion Mitigation and Air Quality Program (CMAQ). This intersection is in close proximity to the Route 28 (Montello Street)/Plain Street intersection, which operates under failed conditions during the existing peak hour. Any finalization of the design plans for the Keith Ave/Route 28/Plain Street intersection should include improvements at the Route 28/Plain Street intersection. This intersection satisfies the MUTCD warrants for the installation of a traffic signal. The installation of a signal at this intersection will improve peak hour operations;

however, the signal timing and phasing should be coordinated with that of the Route 28 (Main Street)/Keith Avenue/Plain Street intersection due to the close proximity of the two intersections.

Reclaim and resurface Route 28 from Sargent's Way in Brockton through West Bridgewater – The resurfacing of this section of Route 28 is complete.

Route 28 at Route 106 intersection, West Bridgewater – This project is presently in the preliminary design stage. Analysis for the future peak conditions shows that improvements to level-of-service can be achieved through the addition of lanes on the eastbound and westbound Route 106 approaches. In addition, the intersection needs to be realigned to allow for easier flow to and from the northbound Route 28 approach. Based on the latest available information from MHD, the design of this intersection is still in the earliest stages; therefore, no information is currently available regarding the number of lanes or lane use to be included in the final design. The design of this project should be consistent with the town's plans for a pedestrian safe town center at this location. This project received a congressional earmark in SAFETEA-LU. In addition, this project is eligible for CMAQ funding.

Route 28 at Center Street and High Street, Bridgewater – This project is currently in the design stage. The town will implement improvements at this intersection, although the project is listed in the TIP for informational purposes. The project includes the upgrade of signals and the addition of a southbound right lane and a northbound left turn lane.

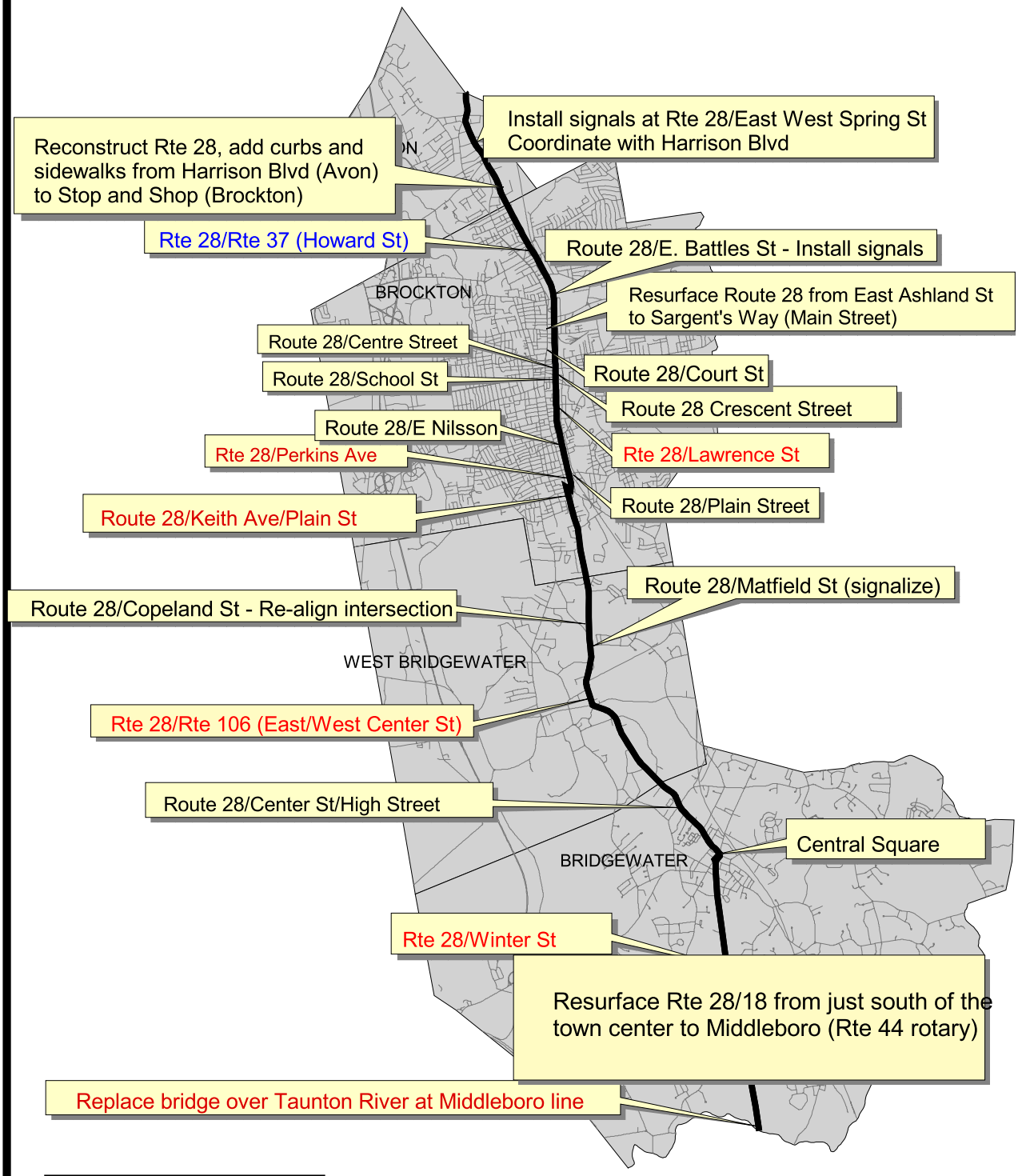
Resurface Route 28/18 (Bedford Street) from just south of the town center to the Middleborough town line, Bridgewater - This resurfacing project is currently in the design stage.

Install traffic signals to enhance safety at Route 28/18 (Bedford St) at Winter St, Bridgewater – Signals will be installed at this intersection to improve safety and traffic flow. In addition, bicycle lanes will be added to and the roadway geometry and alignment will be improved.

Replace the Route 28/18 Bridge over Taunton River at the Bridgewater/Middleborough town line – This project has been advertised and a contract for construction has been awarded.

Route 28 Improvements

Figure 17



Old Colony Planning Council
70 School Street
Brockton, MA 02301

GIS Data Sources:
MassGIS, MHD

3.3 PLANNED IMPROVEMENTS AND IMPROVEMENT ALTERNATIVES

Congestion problems at major intersections and potential improvements to Route 28 have been identified in the 2003 Regional Transportation Plan. Some of these potential improvements have not yet been programmed in the TIP for implementation. Some have been defined in more advanced detail than others in the Plan, and have been included based on the findings and conclusions of local assistance studies completed by OCPC. In addition, a number of potential improvements in this section of the report have been developed based on the results of the analysis for this study. Figure 17 shows the location of improvements presently underway (blue), improvements programmed for implementation (red), and locations in which improvements should be developed for programming (in black).

Potential improvement alternatives for Route 28 not yet programmed in the TIP are as follows:

AVON

Route 28 Avon Center, north and south of West Main Street intersection – *Improvements include, Traffic Calming, Pedestrian Improvements, and extending sidewalks along both sides of the road.* Route 28 through Avon center is mostly designated for two travel lanes (one northbound and one southbound) except for the approaches to the West Main Street intersection, which have additional lanes for turning movements. Route 28 is approximately 45 to 50 feet wide through the town center and south of West Main Street, which presents a long distance for pedestrians to cross with no center refuge. The section south of West Main Street provides two travel lanes with 10 foot paved shoulders along both sides of the road. Although the speed limit is posted at 30 miles per hour, the prevailing speeds, based on OCPC data collection using automatic traffic recorders, are 35 miles per hour (average speed) and 41 miles per hour (85^{th} percentile speed) for both northbound and southbound traffic. In addition, motorists often use the shoulders along the side of the road as an additional lane to pass around vehicles that are making turns from Route 28 to adjacent driveways, which exacerbates hazardous conditions for pedestrians traveling along the road or crossing the road. Sidewalks are needed in this section to provide for safe pedestrian movement. The 30-mile per hour speed limit signs posted in the town center are blocked by vegetation. Some of the traffic calming techniques that can be applied to the town center include raised crosswalks, bump-outs, textured crosswalks, and adding a center median for pedestrian refuge (on Route 28 south of the West Main Street intersection.) In addition, the signage needs improvement for warning motorists that pedestrians are crossing, and improved police presence and enforcement will help to lower prevailing speeds (35 to 41 mph) through the 30-mile per hour zone.

Route 28/East West Spring St, Avon – *Potential Improvement: Install traffic signals and coordinate the signals with the existing signals at the Route 28/Harrison Boulevard intersection.* The Route 28/East West Spring Street intersection is presently under stop sign control. The minor street approaches to this intersection (East and West Spring Street) operate under level-of-service "F" conditions (failed conditions) during the existing morning and afternoon peak hours. This intersection is ranked seventh out of the 41 study area intersections for both the highest crash rate and number of crashes. Installing signals at this intersection will alleviate the forced flow conditions on the westbound approach and reduce the number of crashes at the intersection. Future peak operations (2010) are expected to be at LOS "B" with the installation of signals. This intersection is approximately 350 feet north of the Route 28/Harrison Boulevard intersection; therefore, future analysis should include coordinating the signal systems of both intersections to prevent queues from each of the intersections from interfering with the

operations of the other. A signal warrant analysis was performed to evaluate the feasibility of installing signals at this intersection. The analysis (please see the appendix) showed that both Warrant 9 (four-hour warrant) and Warrant 11 (Peak Hour Volume) of the Manual on Uniform Traffic Control Devices (MUTCD) were satisfied, indicating that this intersection location is a candidate for signal installation.

Route 28 Avon from Harrison Boulevard to Stop and Shop in Brockton – *Potential Improvement: Reconstruct and resurface, add sidewalks to both sides of the road.* This section of Route 28 lacks sidewalks links for existing sidewalks to complete the system on both sides of the road for safe pedestrian movement. The width of the road varies, and curbs are needed to separate the road and adjacent sidewalks and properties. There are very few sidewalks, no shoulders, and no buffer or curb between vehicles traveling at speeds of 30 to 45 miles per hour and pedestrians walking along the side of the road within this corridor. There have been two pedestrian fatalities in this section of Route 28 in the past ten years. There has been a noticeable increase in foot traffic within this corridor with the opening up of the Stop and Shop supermarket in Brockton and the Walmart in Avon. Foot traffic along this section of Route 28 has worn pathways in the grass along the side of the road.

BROCKTON

Route 28/East Battles Street, Brockton – *Potential Improvement: Install traffic signals.* The LOS analysis for this intersection shows that the side street approaches operate under failed conditions during the peak hour. A warrant analysis for this intersection shows that it satisfies the MUTCD Warrant for peak hour volumes. The installation of signals will improve levels-of-service to LOS "B," thereby reducing delays on the side streets greatly, and will improve overall safety at the intersection.

Route 28 from East Ashland Street to Sargent's Way, Brockton – *Potential Improvement: Rehabilitate pavement surface.* The surface condition of this segment of Route 28 is in poor condition with extensive alligator cracks, potholes, and high severity longitudinal cracks. The Road Manager software recommends rehabilitation of the road and surface for this section of Route 28 (Montello Street) from the East Ashland Street intersection, though the downtown, and continuing on Garfield Street and Main Street to the intersection of Sargent's Way.

Route 28/Centre Street, Route 28/Court Street, Route 28/School Street, and Route 28/Crescent Street, Downtown Brockton – *Potential Improvements: Upgrade and coordinate traffic signals and upgrade pedestrian crossings.* Although the LOS analysis for these intersections in the heart of Brockton downtown indicates that the intersections are within acceptable levels (LOS "D" and better), the travel run surveys shows a cumulative delay in traffic traversing the Route 28 corridor because of the intersections are in close proximity. Preliminary analysis, using SYNCHRO Software, indicates that coordinating the signals at these four intersections within the downtown corridor is recommended. SYNCHRO provides a "coordinatability factor" that measures the desirability of coordinating intersection signals. The criteria used to determine this factor includes: travel time between intersections, average traffic back-up per cycle exceeding the distance between intersections, the creation of platoons of traffic during the cycle, main street traffic volumes, and the compatibility of cycle lengths from intersection to intersection. A coordinatability factor above 80 indicates that the signals should be coordinated to avoid blocking problems; a score below 20 indicates that the intersections are too far apart and coordination is not desirable. A SYNCHRO report showing coordinatability analysis for the downtown corridor is provided in the appendix to this report. The report shows that the Route 28 link between the Crescent Street and School Street intersections has a 103 coordinatability

factor, the Route 28 link between School Street and Centre Street has a factor of 78, and the Route 28 link between Centre Street and Court Street has a factor of 74.

The Route 28 downtown Brockton corridor presents a pedestrian barrier, as does the railroad right-of-way, which also runs north south parallel to Rte. 28, between the inter-modal center and Brockton downtown. Pedestrian amenities, such as enhanced signage and textured crosswalks that produce realistic brick and stone effects, across Route 28 at the Route 28/Court Street intersection and the Route 28 Centre Street intersection, can help link pedestrian traffic from the multi-modal center on the east side of Route 28 to Brockton Downtown located a block west of Route 28. These designated pedestrian walkways will help enhance safety and will designate a pedestrian route between public transit and the downtown, thereby adding to the economic vitality of Brockton's downtown.

Streetprint textured asphalt crosswalks.

Left: existing inter-modal signs at Centre Street/Rte. 28. Right: example of enhanced pedestrian signage.

Route 28/East Nilsson Street, Brockton – *Potential Improvement: Install traffic signals.* Traffic entering the intersection from the side street (East Nilsson Street) experiences LOS "F" conditions (failure) during the afternoon peak hour. This intersection is presently under stop sign control and has the fifth highest crash rate (1.651 crashes per million entering vehicles) among the 41 Route 28 study area intersections. A signal warrant analysis completed for this study to evaluate the potential for the installation of traffic signals shows that the intersection volumes satisfy Warrant 2, Four-Hour Vehicular Volume, of the MUTCD.

Route 28 (Montello Street)/Plain Street, Brockton – *Potential Improvement: Install traffic signals and coordinate signals with the signals at Route 28/Main Street/Keith Avenue intersection.* This intersection is presently under stop sign control and operates under LOS "F" conditions during the morning and afternoon peak hours under existing conditions. Coordination of signals between this intersection and the Route 28/Main St/Keith Ave/Plain Street intersection would be preferred due to their close proximity. Montello Street ends at its intersection with Plain Street, and Route 28 transitions to Main Street via Garfield Street (in the southbound direction). A signal warrant analysis performed to evaluate the potential for installing signals at this intersection showed that the intersection volumes satisfy Warrant 2, Four-Hour Vehicular Volume, of the MUTCD. Level-of-service analyses for future 2010 conditions show that operations will be at LOS "C" during the morning and afternoon peak hours at this intersection if traffic signals were in place.

WEST BRIDGEWATER

Route 28 at Copeland Street, West Bridgewater – *Realign the intersection to form a "T"-type intersection at a 90-degree angle*. This intersection is currently a "Y"-type intersection as Copeland Street meets Route 28 from the west. The intersection should be re-aligned to form a "T"-type intersection at 90-degrees to improve sight distances for motorists entering Route 28 from Copeland Street. Based on aerial photos, there is area available adjacent to the intersection for re-alignment with little or no need for a right of way taking.

Route 28 at Matfield Street, West Bridgewater – *Potential Improvement: Install traffic signals.* The plan to install traffic signals at this intersection requires MHD approval for TIP programming. This intersection operates under LOS "F" failed conditions during the morning and afternoon peak hours under existing conditions. Signal warrant analysis shows that this intersection satisfies the MUTCD Warrants for Warrant 2, Four-Hour Vehicular Volume. Level-of-service analyses for future 2010 peak hour conditions show that this intersection will operate at LOS "C" during the morning and afternoon peak hours. The crash data compiled for this study shows that there has been one fatality at this intersection within the past ten years. The installation of signals will improve the overall safety and operation at this intersection.

Route 28 at Route 106, West Bridgewater – *Potential Improvement: Reconstruct Central Square.* Central Square in West Bridgewater is located at the intersection of Routes 28 and 106. This location is at the town center where government and municipal services are located. This is also the location of one of the worst traffic problems areas in the corridor. The most significant factor contributing to the traffic problems at this location is the large amount of traffic traveling through the intersection daily, and especially during the morning and afternoon peak hours. Both intersecting roads are major regional highways serving southeastern Massachusetts. Route 106 provides access to Route 24 to the west and carries large volumes of commuter traffic during the peak hours. The limited number of approach lanes, signal timing and phasing, and lane use at this intersection simply do not provide enough capacity for the

volume of traffic. In addition, the intersection alignment, which is a modified five-way, creates confusion for motorists executing turning movements at the intersection.

The town's business and civic center is located at this intersection. Businesses located within the town center include a shopping plaza on the southeast corner, an automobile service shop on the southwest corner, a Honey Dew Donuts shop on the southwest corner, and a new Dunkin Donuts on the northeast corner. Other businesses abut the northwest corner of Route 28 and Route 106. The alignment of the intersection creates a problem for large trucks attempting to turn right from Route 28 North Main Street onto Route 106 East Center Street.

It is recommended that this intersection be reconstructed with a new design that realigns the intersection in a manner bringing Route 106 and Route 28 together at right angles to form a four-way intersection. Currently, the southern leg of Route 28 enters the intersection at a 45-degree angle to Route 106. River Street intersects the intersection from the south at 90 degrees to form a five-way intersection (along with the Route 28 southbound approach and the Route 106 eastbound and westbound approaches). River street is one-way southbound with traffic traveling away from the intersection, which limits the number of turning movements. Realignment will reduce the total number of turning movements to that of a typical four-way and increase safety.

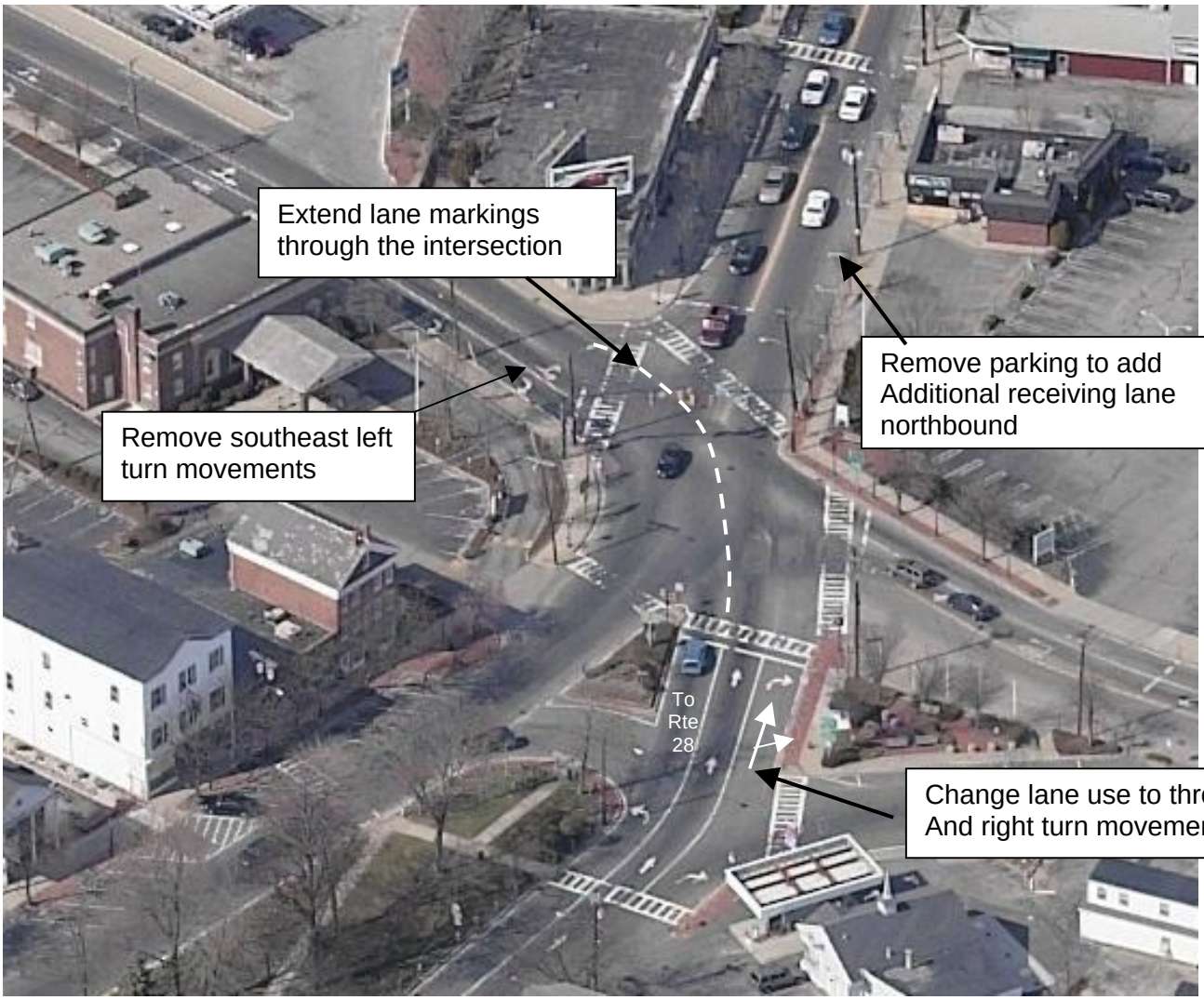
The analysis of peak hour traffic operations shows that acceptable levels of service can be achieved by re-aligning the intersection as a typical four-way. This concept was originally presented in a town center study completed for West Bridgewater by the Conway School of Landscape Design. The town center plan proposed three concepts for the re-alignment of the intersection including two four-way type intersections and a roundabout. The concept that provided acceptable levels-of-service involves the re-routing of Route 28 traffic around the town center monument to River Street and closing off the 90 degree Route 28 approach from the south. OCPC operations analysis includes adding exclusive left turn lanes to River Street northbound (designated as Route 28) and the Route 106 eastbound and westbound approaches. Both Route 106 approaches and the Route 28 River Street northbound approach would have three approach lanes including an exclusive left turn, an exclusive through movement, and a shared through right turn lane. The Route 28 southbound approach would have two approach lanes consisting of a shared through left turn lane and a shared through right turn lane.

BRIDGEWATER

Central Square, Bridgewater – A number of improvement concepts have been tested for future 2010 operations for Central Square in Bridgewater. At present, the Route 28 Main Street/Broad Street/Summer Street intersection operates at LOS "E" levels during the afternoon peak hour. In addition, traffic experiences long delays on the Bedford Street (Route 28) northbound yield approach into the town oval. Vehicle queues from northbound traffic at the Main Street/Summer Street/Broad Street intersection tend to back up into the town center creating delays for traffic trying to enter the oval on the Bedford Street northbound approach. In addition, there are deficiencies in the alignment of the Main Street/Broad Street/Summer Street intersection that lead to motorist confusion. An extension of lane markings through the intersection could help to reduce congestion and confusion over lane use at this intersection. Another potential modification to this intersection includes the prohibition of left turning vehicles from Route 28 Main Street approach (headed southeast) to Route 18 northbound. This would eliminate a phase in the cycle allowing more green time on other approaches such as the northbound approach with traffic entering the intersection from the town oval. This would help reduce back-

ups into the oval from this approach that in turn blocks the South Street and Bedford Street yield approaches. Traffic can access Route 18 from the Route 28 Main Street approach (southeast approach) by going around the oval and returning to the intersection northbound to Route 18. In addition, the elimination of parking on the east side of Route 18 (Broad Street) north of the oval would provide two receiving lanes for traffic headed northbound on Route 18. The re-striping of this approach to allow for two northbound through movements will also contribute to the relief of congestion on the northbound approach and therefore reduce back-ups into the oval during peak periods. SYNCHRO analysis shows that the overall afternoon peak hour LOS improves from LOS "E" to LOS "D" at this intersection with these modifications in place. Figure 18 illustrates the potential improvements to Central Square.

Figure 18 – Improvements to Central Square, Bridgewater



Route 28/18 Broad Street/Summer Street intersection at Central Sq. Bridgewater.

Access Management

A commonality throughout the Route 28 corridor, within each of the study area communities, is the lack of control, placement, spacing, and width of curb cuts that provide access to adjacent properties. These conditions, which are prevalent throughout the corridor whether in urban or rural and suburban settings, have led to situations in which safety and traffic flow have been compromised. In some situations at some locations, the degree of compromise is more severe than at other locations. Never the less, access management is important throughout the Route 28 corridor.

Access Management is defined as the planning of the design, location, and operation of driveways, median openings, interchanges, and street connections. Access management provides two important advantages when applied to a roadway corridor:

1. Improved Safety
2. Improved Capacity

These advantages are achieved through Access Management techniques that seek to obtain the following results:

- Limit the number of conflict points in turning movements
- Separate conflict areas
- Remove turning vehicles from through traffic lanes
- Reduce conflicting volumes
- Improve roadway operations
- Improve driveway operations

Commercial and retail activities are extremely important within certain segments of the Route 28 corridor. Although some access management techniques include limiting the number of curb cuts, adding medians, and reducing turning movements, studies show that well planned access management design and modifications do not negatively impact businesses. Access Management applications result in reduced blocking of driveways by queues, better access between neighborhoods and businesses, and safer overall driving conditions. All of these attributes are important to both retailers and the customers they serve.

The prevailing conditions along the Route 28 corridor are such that much of the land adjacent to the road has already been developed, especially in the more urbanized areas. Development along the corridor sometimes results in the redevelopment of parcels that were abandoned or are in transition in regards to use. The techniques applied to these segments will involve retrofitting access management to existing curb cut access, which sometimes requires the consolidation of access points.

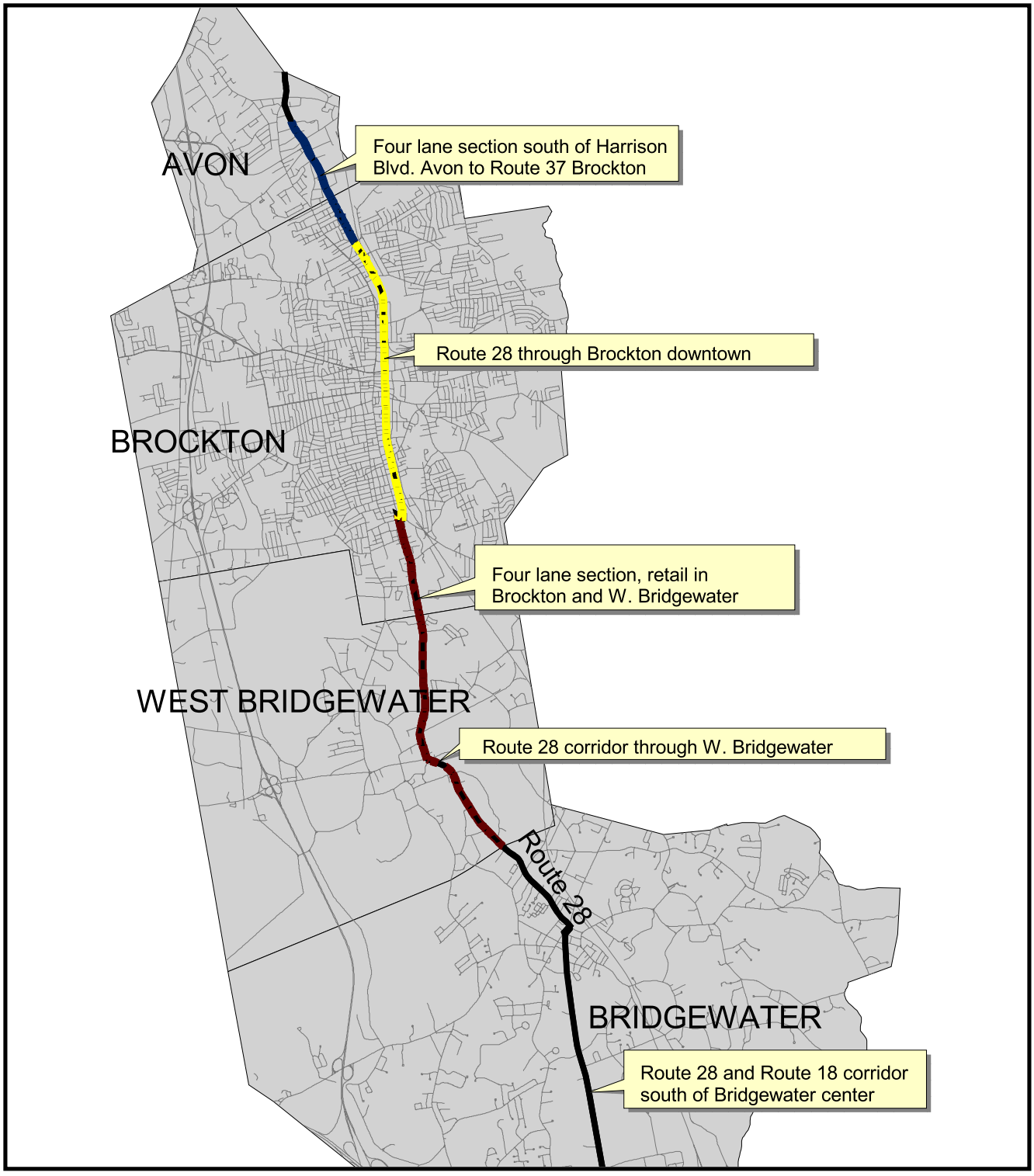
The areas within the Route 28 corridor in which access management techniques should be a prime focus are shown in Figure 20. These include:

- Route 28 (Memorial Drive) in Avon from Harrison Boulevard south to Route 37 (Howard Street) in north Brockton. Route 28 has four-lanes through this segment that includes numerous curb cuts. Some of these curb cuts are extremely wide. This segment of Route 28 traverses a growing commercial and retail area.

- Route 28 through the Brockton downtown (between Route 37 and Plain Street) is an urban area in transition in which land use is evolving from industrial uses to retail and residential uses. In addition, pedestrian traffic across Route 28 is heavy due to individuals accessing the downtown from the Inter-modal Center (BAT buses and commuter rail). There is also heavy foot traffic across Route 28 due to the close proximity of schools to the corridor.
- Route 28 in south Brockton (Main Street) and West Bridgewater (North Main Street) provides a four-lane section through a commercial area. In addition to retail establishments, there are numerous car dealers within this segment.
- Route 28 in West Bridgewater (North Main Street) provides two lanes of travel north of the town center. The land use and zoning in this segment is geared for retail and commercial activity. Numerous open curb cuts within this section lack on-site control for access and egress from Route 28.
- Route 28 in West Bridgewater south of the town center (South Main Street) contains a number of commercial enterprises including car dealers. This segment, as in other sections of Route 28 in south Brockton and West Bridgewater, lacks management and control of vehicle access to and from adjacent properties.
- The Route 28 (Bedford Street) Route 18 corridor south of Bridgewater center. The speed limit within this segment of Route 28 is 50 miles per hour. Route 28 provides two lanes of travel and a paved shoulder within this section. Although there are some commercial establishments, the focus of land use adjacent to this corridor is institutional and industrial.

Access Management Needs

Figure 19



Roads
Town Boundaries

Old Colony Planning Council
70 School Street
Brockton, MA 02301

GIS Data Sources:
MassGIS, MHD

Examples of typical access management applications include:

1. Access Spacing
   - Limit the number of access points to properties
   - Consolidate redundant, low-volume drivesEstablish a minimum distance between drives
   - Limit the width of access points based on the site use
2. Turning Lanes
   - Establish minimum turning radii to slow traffic in high traffic pedestrian areas
   - Improve corner clearance
   - Establish deceleration/acceleration lanes
   - Add Two-Way Turning Lanes
3. On-Site Remedies
   - Share drives between sites
   - Add longer “throat lengths” to internal driveways in lots
   - Connect adjacent commercial properties
   - Construct service roads with multiple drives but less access points on the arterial
4. Median Treatments
   1. Add Medians and turning lanes

Implementation of access management can be achieved at the local level through a number of avenues:

1. Master Plan
   - The master plan is the responsibility of the Planning Board and outlines policies for development
2. Zoning Ordinance
   - The zoning ordinance codifies land-use regulations
3. Subdivision regulations and site plan review
   - Regulates parcel subdivision
   - Encourage developers to include Access Management

3.4 FUTURE TRAFFIC OPERATIONS

Level-of-service analysis (LOS) was completed for the study area intersections under future peak hour operating conditions to estimate future levels of congestion within the study area corridor. The Level-of-service analysis was completed for each intersection under conditions in which future estimated traffic (five year horizon to year 2010) was added to each intersection. The analysis was performed without the consideration of any improvements and for a future scenario in which improvements were assumed, in order to determine the potential impacts from improvements at each intersection. Table 12 shows the LOS for each study area intersection under 2010 conditions with no improvements and for 2010 conditions with improvements for those intersections in which improvements have been proposed.

Table 12 Future Intersection LOS

			Year 2010		Year 2010 with improvements	
	Community	Route 28 Intersection	AM Peak LOS	PM Peak LOS	AM Peak LOS	PM Peak LOS
1	Avon	North Main St/East/West High St	B	B	N/A	N/A
2		East Main St/West Main St	A	B	N/A	N/A
3		East Main St/ E/W Spring St*	F	F	B	B
4		East Main St Harrison Blvd	D	D	N/A	N/A
5		E. Main St/Memorial Drive	F	F	N/A	N/A
6		East Main St/ Walmart	C	B	N/A	N/A
7	Brockton	N Montello St/ Stop and Shop	A	C	N/A	N/A
8		N Montello St/ Howard 37/Albion	C	D	N/A	N/A
9		N Montello St/ Wilmington St	C	E	N/A	N/A
10		N Montello St/ Field St/Livingston Rd	E	F	N/A	N/A
11		N Montello St/ Ames Street	B	C	N/A	N/A
12		N Montello St/ East Battles St*	F	F	B	B
13		N Montello St/ East Ashland St	B	C	N/A	N/A
14		N Montello St/ Elliot Street	B	C	N/A	N/A
15		N Montello/ Court Street	C	C	N/A	N/A
16		Montello St/Centre St	D	E	N/A	N/A
17		Montello St/ School Street	C	C	N/A	N/A
18		Montello St/ Crescent Street	B	C	N/A	N/A
19		Montello St/ Lawrence Street	B	B	N/A	N/A
20		Montello St/ Grove Street	B	C	N/A	N/A
21		Montello St/ East Nilsson Street*	C	F	B	B
22		Montello St/ Perkins Avenue	C	C	N/A	N/A
23		Montello St/ Plain Street*	F	F	C	C
24		Main St/ Plain Street/Keith Ave**	B	E	B	C
25		Main St/ Brookside Ave	B	B	N/A	N/A
26		Main St/ Sargents Way	D	D	N/A	N/A
27	West Bridgewater	N Main St/ Copeland Street	C	E	N/A	N/A
28		N Main St/ Matfield Street*	F	F	C	C
29		N Main St/ Howard Street	F	F	N/A	N/A
30		N/S Main St/ Route 106 E/W Center Street (River)**	D	F	C	D
31		South Main St/ Bryant/Ash St	C	C	N/A	N/A

Table 12 Future Intersection LOS (Continued)

			Year 2010		Year 2010 with improvements	
	Community	**Route 28 Intersection**	**AM Peak LOS**	**PM Peak LOS**	**AM Peak LOS**	**PM Peak LOS**
32	**Bridgewater**	**Main St/ Center/High St****	C	D	C	C
33		**Main St/ Oak Street**	C	C	N/A	N/A
34		**Main St/ Broad/Summer/Central Sq**	D	F	N/A	D
35		**Central Sq/ Church/South St**	D	E	N/A	N/A
36		**Central Sq/ School/Bedford St***	E	F	D	D
37		**Bedford St/ Grove Street**	D	F	N/A	N/A
38		**Bedford St/ Maple Avenue**	F	E	N/A	N/A
39		**Bedford St/ Worcester St**	D	E	N/A	N/A
40		**Bedford St/ Winter St****	F	F	B	B
41		**Bedford St/ Flagg Street**	E	F	N/A	N/A

N/A=Not Applicable – no improvements * Planned improvements requiring approval ** Improvements programmed for construction/ implementation

4.0 CONCLUSIONS AND RECOMMENDATIONS

A draft of the study analyses and potential improvements was distributed to stakeholders within the Route 28 study area including OCPC delegates, Old Colony Metropolitan Planning Organization members (MPO), community planning board chairs, community selectmen chairs, and local officials (highway DPW directors, planning departments, and police departments.) The stakeholders were asked for their input regarding potential improvement measures. Table 13 summarizes the potential improvement measures based on the study analyses and stakeholder input.

Table 13 Improvement Measures – Route 28 Corridor

Town	Improvement Type	Location and Description	Jurisdiction
Avon	Pedestrian safety improvements	Add curbing and link existing sidewalks from Route 37 in Brockton to Avon center to foster safer pedestrian travel.	EOT/MassHighway
Avon	Pedestrian safety improvements	Add crosswalks and pedestrian amenities to improve safety in and around Avon center. Widen sidewalks along Route 28 from Harrison Blvd. to the town center to raise granite curbs and add a landscaped buffer.	EOT/MassHighway
Avon	Intersection improvements, congestion reduction and safety	Traffic signals are warranted at the intersection of East and West Spring Street and Route 28. The traffic signals should be coordinated with those at the Harrison Boulevard/Route 28 intersection.	EOTMassHighway
Brockton	Pedestrian safety improvements	Pedestrian amenities are needed (textured crosswalks and signage) in the downtown for pedestrian safety and to better delineate the connection between the downtown and the BAT Inter-modal Center.	Brockton
Brockton	Intersection improvements, congestion reduction and pedestrian safety	Route 28 traffic signals need to be updated, including the coordination of signals, at intersections along the corridor through the downtown and south of the downtown.	Brockton
Brockton	Access Management	Access management retrofits will improve vehicle flow on Route 28 in the section from Sargents Ave. to the West Bridgewater line.	EOT/MassHighway
Brockton	Pavement repair	The pavement is in good condition on Route 28 in Brockton except for two short sections: one section south of East Ashland to the downtown, and a section as Route 28 transitions to Main Street, from Plain Street to Sargents Way (including Garfield Street).	Brockton

Table 13 Recommendations – Route 28 Corridor (continued)

Town	Improvement Type	Location/Description	Jurisdiction
West Bridgewater	Intersection safety	Copeland Street needs to be re-aligned with Route 28 (North Main Street) to improve sight distances.	EOT/MassHighway
West Bridgewater	Intersection safety and congestion	Traffic signal installation is warranted at the Route 28/Matfield Street intersection.	EOT/MassHighway
West Bridgewater	Access management	Access Management retrofits should be implemented in the section of Route 28 that includes North Main Street from Route 106 to Brockton.	MassHighway/ West Bridgewater
West Bridgewater	Intersection re-alignment, widening, and signal upgrades	Improvement scenarios for the Route 28/Route 106 intersection were tested using SYNCHRO software, based on the Town Center Plan for West Bridgewater. These include the re-alignment of the Route 28 south leg around the monument to form a conventional four-way intersection, and a roundabout concept. Analyses showed that the roundabout would most likely not work from a level-of-service standpoint. The four-way re-alignment of the intersection, with timing and phasing improvements, would result in acceptable levels-of-service with additional lanes on the Route 106 approaches. Both improvement scenarios assumed ROW takings.	EOT/MassHighway
West Bridgewater	Zoning Improvements	The Route 28 corridor (South Main Street) south of the center should undergo zoning changes to connect existing land use with the recommendations in the West Bridgewater Master Plan. This would make the corridor in West Bridgewater compatible with existing land use and zoning along Route 28 in Bridgewater, which is zoned less for commercial activities and more for residential and home office type uses.	West Bridgewater (zoning jurisdiction)
Bridgewater	Traffic operational improvements	Central Square poses the biggest impediment to traffic flow along Route 28 in Bridgewater. Peak hour analysis shows that delays at the signalized intersection of Broad Street/Main Street/Summer Street cause back-ups at the northern end of the oval, which in turn cause back-ups at the south end of the oval at the South Street yield approach and the Bedford Street yield approach.	Bridgewater

Traffic Operations

Traffic along a number of areas on Route 28 experience hindered traffic progression, based on the LOS analyses and the travel runs conducted for this study (for both existing and future peak hour conditions). These segments include Route 28 at the East/West Spring Street intersection in Avon, Route 28 (Montello Street) within the Brockton downtown, Route 28 (Montello Street) to Plain Street and Main Street (as Route 28 transitions to Main Street in Brockton), Route 28 at the Route 106 intersection in the center of West Bridgewater, and Route 28 at Central Square in Bridgewater. In addition, a reoccurring phenomenon exists in the corridor whereby peak hour traffic is extremely heavy on through movements (northbound and southbound) on Route 28 causing heavy back-ups and delays on the side streets at un-signalized intersections due to the lack of adequate gaps in the mainstream traffic. This occurs in Avon at the East Spring Street/Route 28 intersection and at the East Main Street/ Route 28 (Memorial Drive) intersection. In addition, there are a number of un-signalized intersections in Brockton, West Bridgewater, and Bridgewater that experience congestion on the side street approaches to Route 28 during the peak hour including these at: Wilmington Street (a.m. peak), Field Street and Livingston Street (a.m. and p.m. peaks), East Battles Street (a.m. and p.m. peaks), East Nilsson Street (p.m. peak), and Plain Street (a.m. and p.m. peaks), all located in Brockton. West Bridgewater un-signalized intersections that experience long delays and congestion at the side street approach to Route 28 include: North Main Street at Matfield Street (a.m. and p.m. peaks) and North Main Street at Howard Street (a.m. peak). In Bridgewater, un-signalized intersections with long delays and congestion on the side street approaches include; Bedford Street at Grove Street (p.m. peak), Bedford Street at Maple Avenue (p.m. peak), Bedford Street at Winter Street (a.m. and p.m. peak), and Bedford Street at Flagg Street (a.m. and p.m. peak).

Signal Warrant analyses, conducted as part of this study (see appendix), show that the installation of traffic signals can be justified at the Route 28/East and West Spring Street intersection in Avon. These signals should be coordinated with the existing signals at the Route 28/Harrison Boulevard Signal Warrant analyses for un-signalized intersections in Brockton show that the installation of signals can be justified at three of the un-signalized intersections that presently experience congestion on the side street approaches. These are: North Montello Street and East Battles Street, Montello Street at East Nilsson Street, and Montello Street at Plain Street. The Montello Street and Plain Street intersection should be coordinated with the signals at Keith Avenue/Main Street/Plain Street due to their close proximity. The North Main Street/Matfield Street intersection satisfies warrants for signal installation in West Bridgewater. In Bridgewater, the Bedford Street/Winter Street intersection satisfies the warrants for installation of signals in Bridgewater. A project for the installation of signals at this intersection is currently listed in the OCPC region's TIP and is in the design stage. The installation of signals at un-signalized intersections along Route 28 that satisfy the signal warrants in the MUTCD can be used to ameliorate the delays and congestion that currently exist on the side street approaches to the Route 28 corridor.

In addition to the installation of signals at specified un-signalized intersections, the upgrading of signals in the Brockton downtown to allow signal coordination will improve north-south progression within the Route 28 corridor. The intersections in the Brockton downtown that should be coordinated include Montello Street at Court Street, Montello Street at Centre Street, Montello Street at School Street, and Montello Street at Crescent Street. Analysis of the peak hour conditions along Route 28 in the downtown using SYNCHRO analysis software shows that signal coordination of these four intersections is desirable and would improve progression through the corridor (see report summary in the appendix). An upgrade of traffic signals at the Montello Street/Perkins Street intersection will also improve progression within the corridor. This intersection currently contains a signal with fixed phasing that includes a pedestrian phase

in the cycle, even if there are no pedestrians crossing at the intersection. A signal with a pedestrian actuated button will allow more green time to be used on vehicle approaches to the intersection and will allow a protected pedestrian phase for pedestrians when needed. The upgrading of signals at this intersection should coincide with the upgrading of signals at the Main Street/Perkins Street intersection and should include coordination of the two signals due to their close proximity.

Pedestrian Amenities

There are at three segments within the Route 28 corridor that are in need of enhancement of pedestrian amenities: 1) Route 28 in Avon from Harrison Boulevard to the Route 37 intersection in Brockton, 2) Route 28 through the Brockton downtown, and 3) Route 28 (Main Street) south of Plain Street to Sargent's Way.

1. There are limited sidewalk sections along Route 28 in Avon from Harrison Boulevard to Route 37 in Brockton. This segment experiences pedestrian activity to the point in which pedestrian paths have been worn along the sides of the road. In addition, there have been two pedestrian fatalities within this segment within the past ten years. The installation of sidewalks along both sides of this segment of Route 28 to link existing segments, along with the consolidation of curb cuts and other access management measures, will improve pedestrian safety and encourage more pedestrian trips to the growing commercial and retail establishments within the corridor. In addition, the sidewalks along Route 28 from Harrison Boulevard north to the Avon Town center require important safety improvements. There are vegetated obstructions and the road overlay is such that the curbing is almost at the same level of the road. The Massachusetts Highway Design Guidebook states: "In urban areas or village/town centers, raised curb and curb cut ramps are usually provided with sidewalks. A landscaped buffer between vehicular traffic and the sidewalk can provide greater separation from motor vehicles, increasing the comfort and safety of pedestrians." This sidewalk should be re-built and widened to re-emphasize the raised curb, and to provide a landscaped buffer between Route 28 traffic and pedestrians for greater safety along this section of Route 28.

2. Route 28 through the Brockton downtown, along with the railroad that runs parallel in the north south direction, presents a barrier to pedestrian movement between the inter-modal center and the Brockton downtown. Enhanced crosswalks, utilizing textured and colored pavements, along with larger signs directing pedestrians to and from points downtown, will encourage pedestrian traffic and will add to the economic vitality of the area.

3. A City of Brockton Housing for the Elderly apartment complex (Campello High Rise) is located off of Main Street just south of Plain Street. Pedestrian activity is high in this section of Route 28, between Plain Street and Sargent's Way. Improved safety can be achieved as in the Route 28 downtown section through the installation of colored, textured crosswalks and enhanced signage.

5.0 APPENDIX

Glossary

AADT	Average Annual Daily Traffic
ADT	Average Daily Traffic
Crash Rate	Number of crashes per million entering vehicles
EB	Eastbound
FHWA	Federal Highway Administration
LOS	Level of Service
Level of Service	A letter grade given to intersections based on the average delay per vehicle
MassHighway	Massachusetts Highway Department
MHD	Massachusetts Highway Department
MPH	Miles per Hour
NB	Northbound
Queue	The total length of stopped traffic waiting for a signal phase
SB	Southbound
WB	Westbound

FHWA Heavy Vehicle Classifications:

- CYCL : Motorcycles
- CARS : Passenger Cars, with or without Trailers
- 2A-L : 2 axle 4 tire pickups, vans, etc.
- BUS : Buses
- 2A-6 : 2 Axle, 6 tire single units
- 3A-S : 3 Axle, single units
- 4A-S : 4 Axle, single units
- <5A-D : 4 or less axle, double units (1 unit is a truck)
- 5A-D : 5 axle, double units (1 unit is a truck)
- >6A-D : 6 or more axle, double units (1 unit is a truck)
- <6A-M : 5 or less axle, multi-units
- 6A-M : 6 axle multi-units
- >6A-M : 7 or more axle, multi-units

Heavy Vehicles represents those vehicles with two (2) axle, six tires or more.

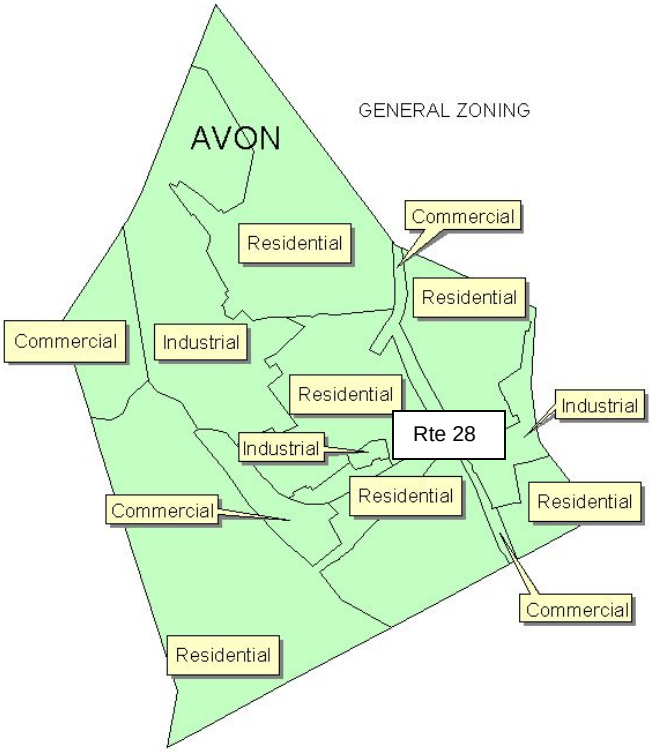
Route 28 Corridor Pavement Conditions

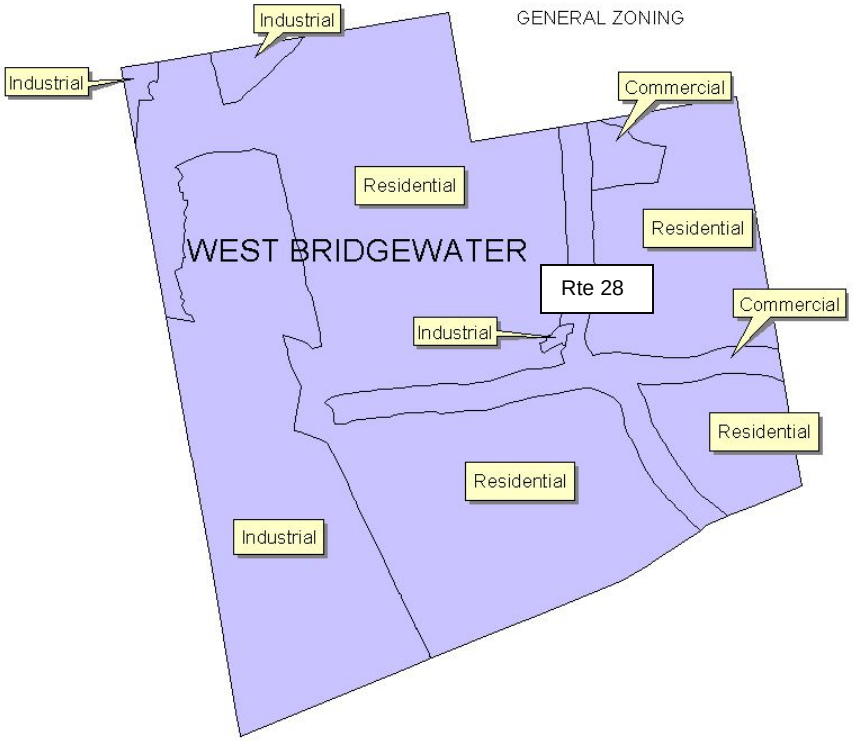
Route 28 Road Section	Community	PCI	Recommended Repair	Estimated Cost	Condition
MEMORIAL DRIVE	Avon	75	Rehabilitation	$64,556	FAIR
EAST MAIN STREET	Avon	80	Rehabilitation	$137,889	FAIR
MEMORIAL DRIVE	Avon	82	Preventative Maintenance	$24,208	FAIR
EAST MAIN STREET	Avon	83	Preventative Maintenance	$8,792	FAIR
MAIN STREET	Avon	83	Preventative Maintenance	$11,000	FAIR
MEMORIAL DRIVE	Avon	83	Preventative Maintenance	$44,000	FAIR
EAST MAIN STREET	Avon	85	Routine Maintenance	$13,931	GOOD
NORTH MAIN STREET	Avon	93	No Immediate Maintenance	$0	GOOD
MAIN STREET	Brockton	43	Reconstruction	$216,480	POOR
MAIN STREET	Brockton	53	Reconstruction	$221,383	POOR
GARFIELD STREET	Brockton	63	Rehabilitation	$10,689	POOR
NORTH MONTELLO ST	Brockton	63	Rehabilitation	$71,800	POOR
MAIN STREET	Brockton	75	Rehabilitation	$6,496	FAIR
MAIN STREET	Brockton	75	Preventative Maintenance	$21,723	FAIR
NORTH MONTELLO ST	Brockton	82	Rehabilitation	$14,067	FAIR
MAIN STREET	Brockton	85	Routine Maintenance	$17,831	GOOD
NORTH MONTELLO ST	Brockton	85	Routine Maintenance	$15,842	GOOD
NORTH MONTELLO ST	Brockton	85	Routine Maintenance	$23,615	GOOD
NORTH MONTELLO ST	Brockton	85	Routine Maintenance	$2,546	GOOD
NORTH MONTELLO ST	Brockton	88	Routine Maintenance	$17,600	GOOD
NORTH MONTELLO ST	Brockton	89	Routine Maintenance	$10,782	GOOD
MONTELLO STREET	Brockton	90	Routine Maintenance	$8,972	GOOD
NORTH MONTELLO ST	Brockton	90	Routine Maintenance	$6,158	GOOD
NORTH MONTELLO ST	Brockton	90	Routine Maintenance	$24,640	GOOD
MONTELLO STREET	Brockton	98	No Maintenance	$0	EXCEL
MONTELLO STREET	Brockton	99	No Maintenance	$0	EXCEL
MONTELLO STREET	Brockton	99	No Maintenance	$0	EXCEL
MONTELLO STREET	Brockton	99	No Maintenance	$0	EXCEL

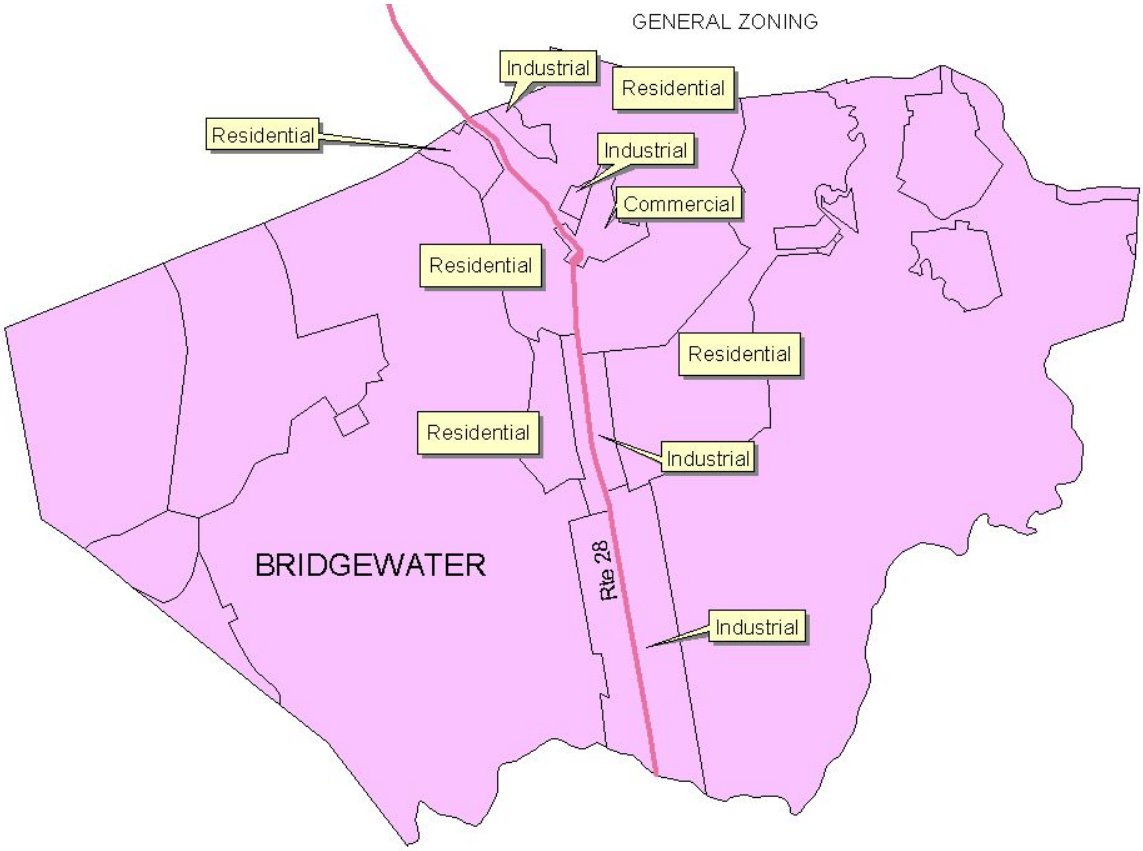
Pavement Condition Table (Continued)

Route 28 Road Section	Community	PCI	Recommended Repair	Estimated Cost	Condition
NORTH MAIN STREET	West Bridgewater	100	No Immediate Repair	New Pavement	Excellent
SOUTH MAIN STREET	West Bridgewater	100	No Immediate Repair	New Pavement	Excellent
BEDFORD STREET	Bridgewater	57	Rehabilitation	$75,789	Poor
BEDFORD STREET		62	Rehabilitation	$666,444	Poor
CENTRAL SQUARE	Bridgewater	87	No Immediate Repair	$0	Good
CENTRAL SQUARE	Bridgewater	93	No Immediate Repair	$0	Good
MAIN STREET	Bridgewater	87	No Immediate Repair	$0	Good
MAIN STREET	Bridgewater	89	No Immediate Repair	$0	Good
MAIN STREET	Bridgewater	83	Routine Maintenance	$7,241	Fair
BEDFORD STREET	Bridgewater	95	No Immediate Repair	$0	Excellent
BEDFORD STREET	Bridgewater	100	No Immediate Repair	$75,789	Poor
BEDFORD STREET	Bridgewater	57	Rehabilitation	$666,444	Poor

Route 28 Communities – General Zoning




GENERAL ZONING
Industrial
Industrial
Commercial
Residential
Residential
WEST BRIDGEWATER
Rte 28
Commercial
Industrial
Residential
Residential
Industrial

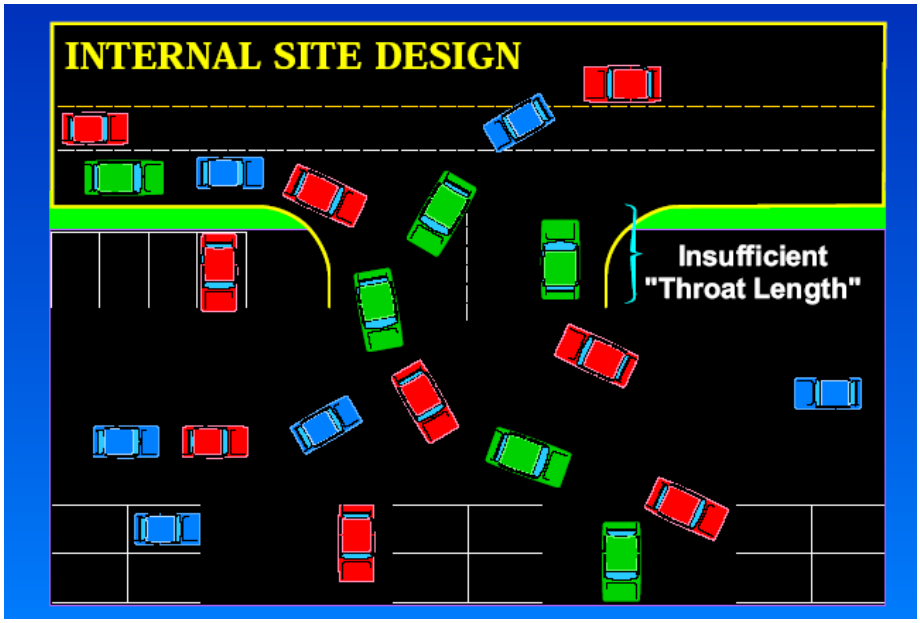

GENERAL ZONING
Industrial
Residential
Residential
Industrial
Commercial
Residential
Residential
Industrial
BRIDGEWATER
Rte 28
Industrial

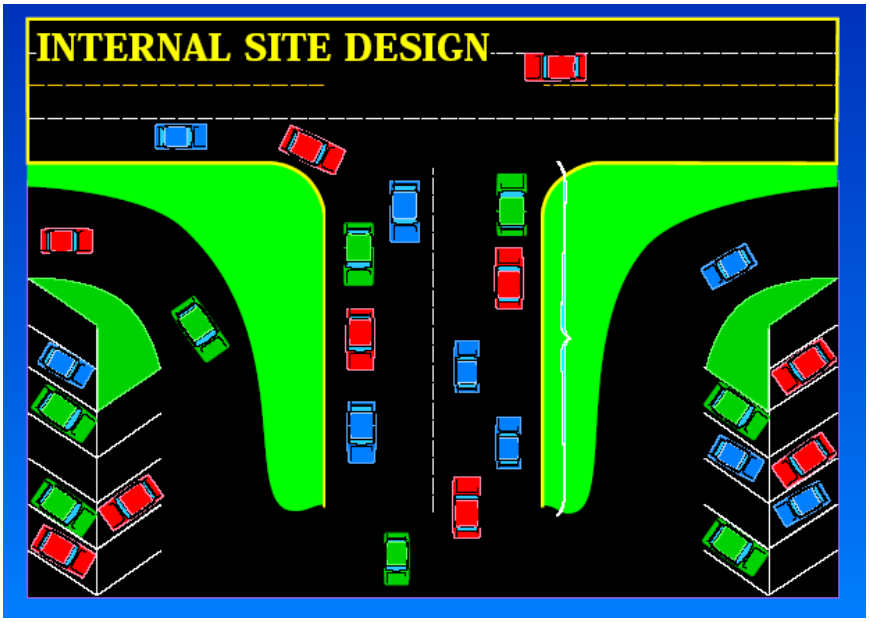
Access Management

"Access management is the practice of coordinating the location, number, spacing and design of access points to minimize site access conflicts and maximize the traffic capacity of a roadway."

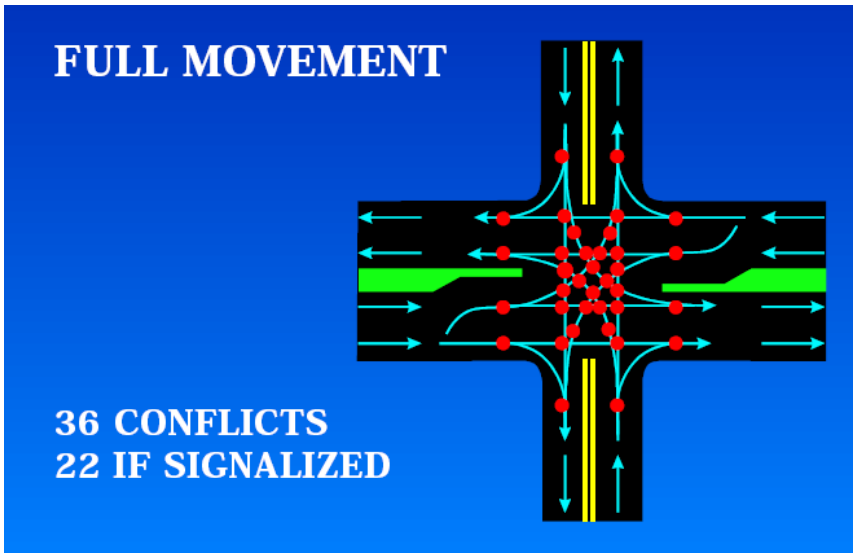
- Preserves Existing Capacity and Improves Capacity in Congested Areas
- Improves Safety

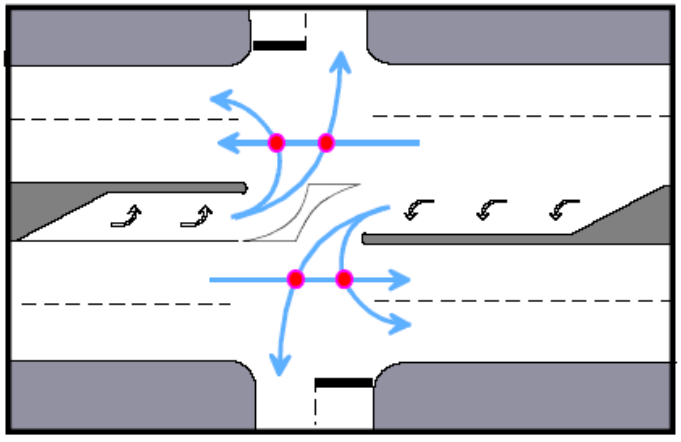
Access Management Applications





Access Management Applications





4

MAJOR Conflicts

TABLE 2-5 Summary of Research on the Effects of Access Management Techniques *(13)*

Treatment	Effects
1. Add continuous TWLTL	• 35% reduction in total crashes • 30% decrease in delay • 30% increase in capacity
2. Add nontraversable median	• ~~35~~≥55% reduction in total crashes • ≥30% decrease in delay • ≥30% increase in capacity
3. Replace TWLTL with a nontraversable Median	• 15%-57% reduction in crashes on 4-lane roads • 25%-50% reduction in crashes on 6-lane roads
4. Add a left-turn bay	• 25% to 50% reduction in crashes on 4-lane roads • up to 75% reduction in total crashes at unsignalized access • 25% increase in capacity
5. Type of left-turn improvement a) painted b) separator or raised divider	• 32% reduction in total crashes • 67% reduction in total crashes
6. Add right-turn bay	• 20% reduction in total crashes • Limit right-turn interference with platooned flow, increased capacity
7. Increase driveway speed from 5 mph to 10 mph	• 50% reduction in delay per maneuver; less exposure time to following vehicles
8. Visual cue at driveways, driveway illumination	• 42% reduction in crashes
9. Prohibition of on-street parking	• 30% increase in traffic flow • 20%-40% reduction in crashes
10. Long signal spacing with limited access	• 42% reduction in total vehicle-hours of travel • 59% reduction in delay • 57,500 gallons fuel saved per mile per year

Access location, building location and site circulation and parking are highly related. The building footprint and location have a major influence on parking and site circulation and in turn on the access location. Conversely, identification of a specific access location will materially affect how the site may be laid out – especially for small sites.

Poor site access and circulation design is detrimental to both the public and investment in the highway system and the private investment in the developed property adjacent to the highway. Site plan review by a traffic engineer competent in site access and circulation design can uncover problems in the planning stage when they can be resolved. Problems discovered after the development has occurred may be mitigated only at considerable cost. **Moreover, a developer owner and consultant involved with a site development which has circulation problems which result in a death or injury have a very high risk for lost claims.**

What are the Consequences of Poor Site Access and Circulation Design?	Notes
• Inadequate access capacity • On-site congestion • Congestion on the public street system • High crash experience on the public street • High crash experience on-site • Pedestrian-auto crashes • Limited flexibility to adjust the design or operation to changed conditions • Loss of customers • Unstable land use • Decrease in property value • Decreased tax revenues	

Figure A1Existing Peak Hour Turning Movements
Route 28 Traffic Study
(not to scale) AM Peak (PM Peak)

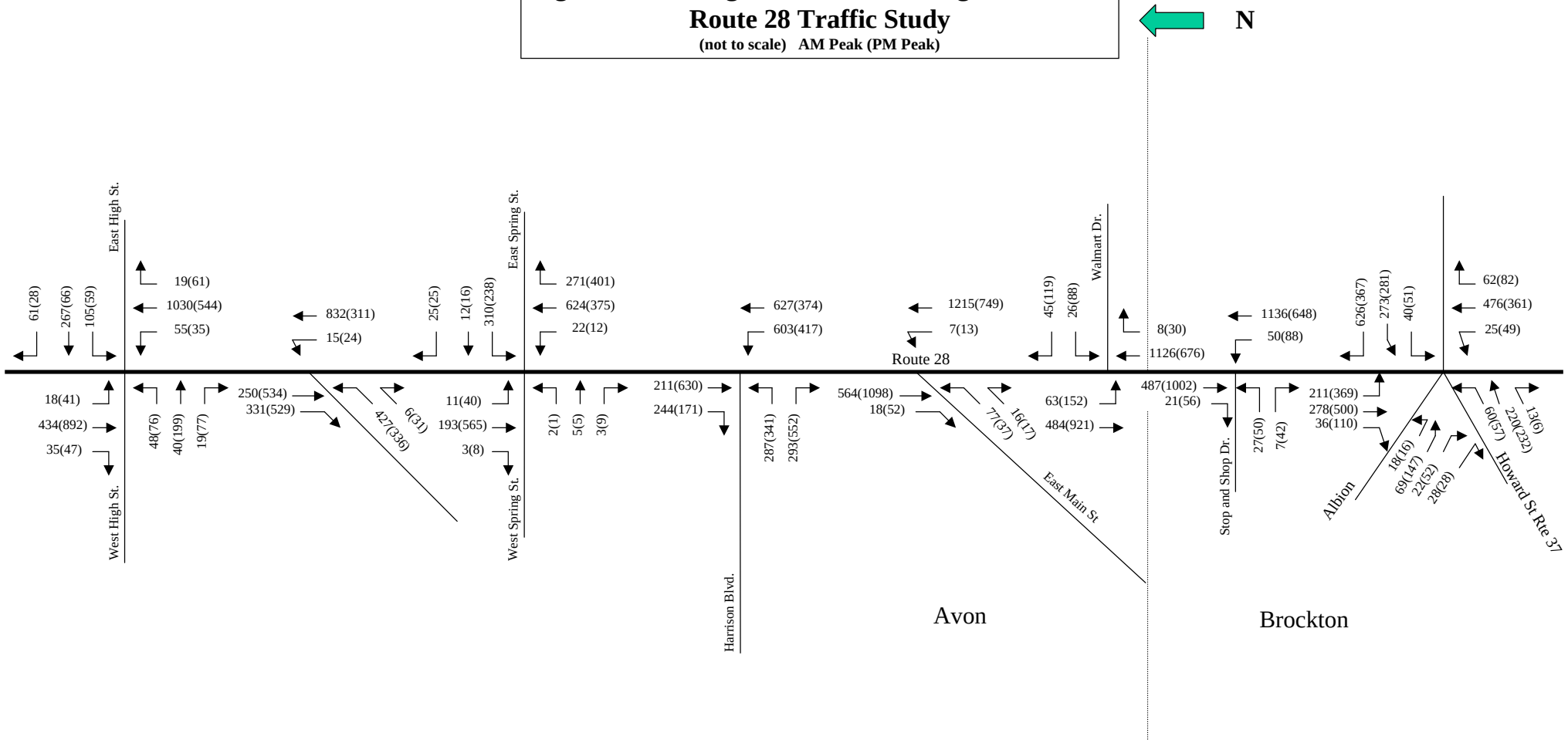
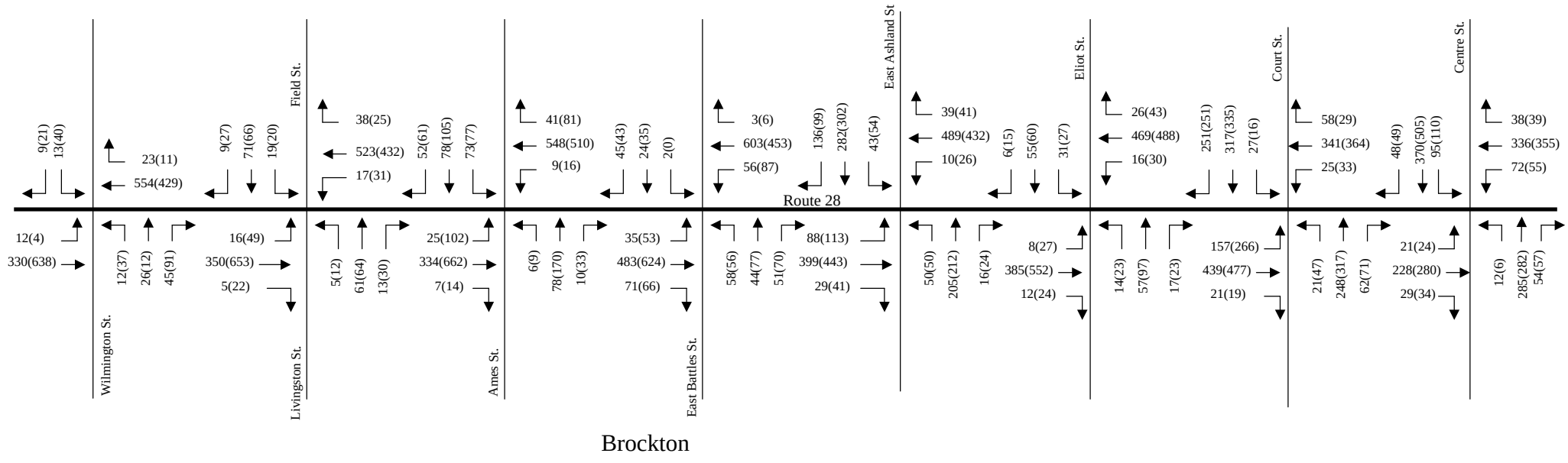


Figure A2 Existing Peak Hour Turning Movements
Route 28 Traffic Study
(not to scale) AM Peak (PM Peak)

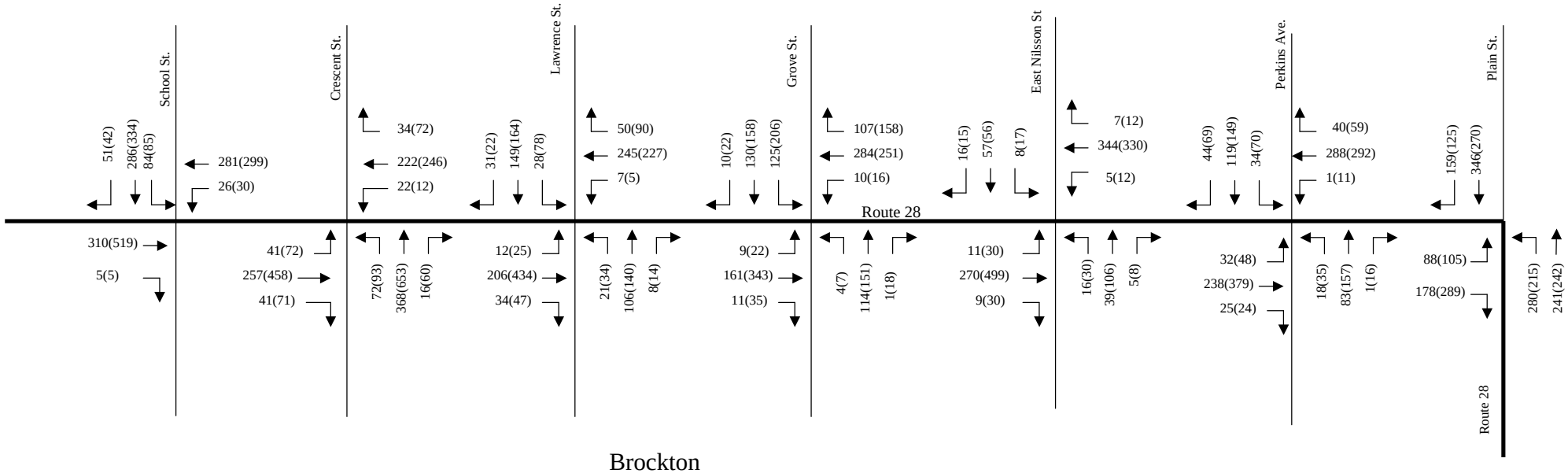
N



Brockton

Figure A3 Existing Peak Hour Turning Movements
Route 28 Traffic Study
(not to scale) AM Peak (PM Peak)

N



Brockton

Figure A4 Existing Peak Hour Turning Movements
Route 28 Traffic Study

(not to scale) AM Peak (PM Peak)

N

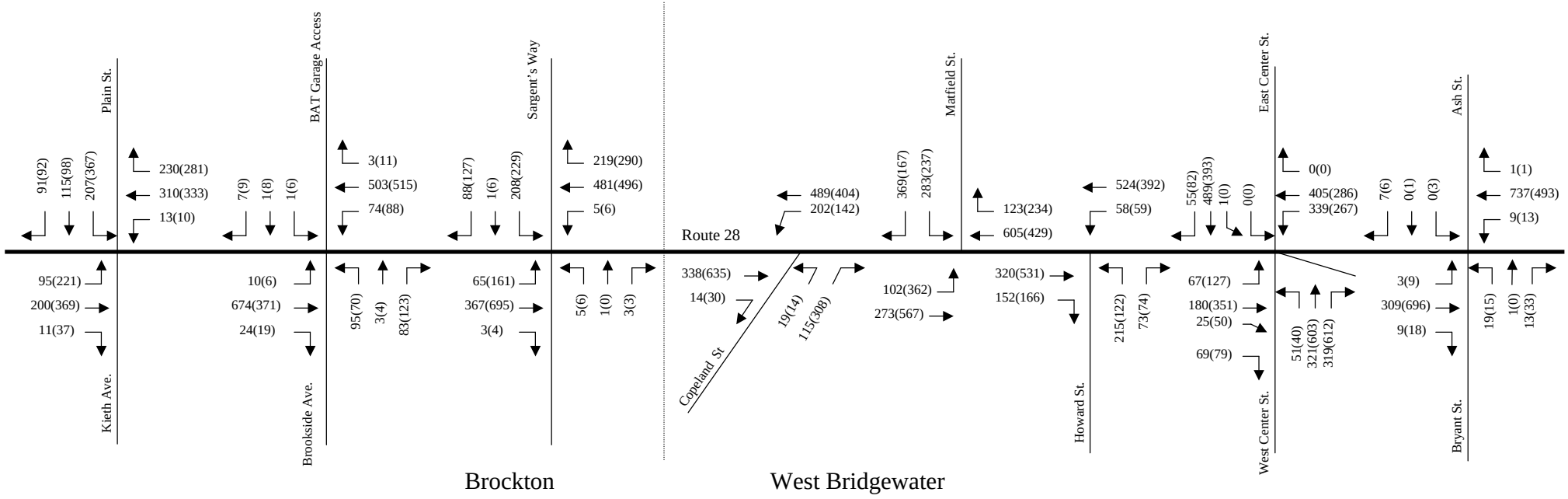
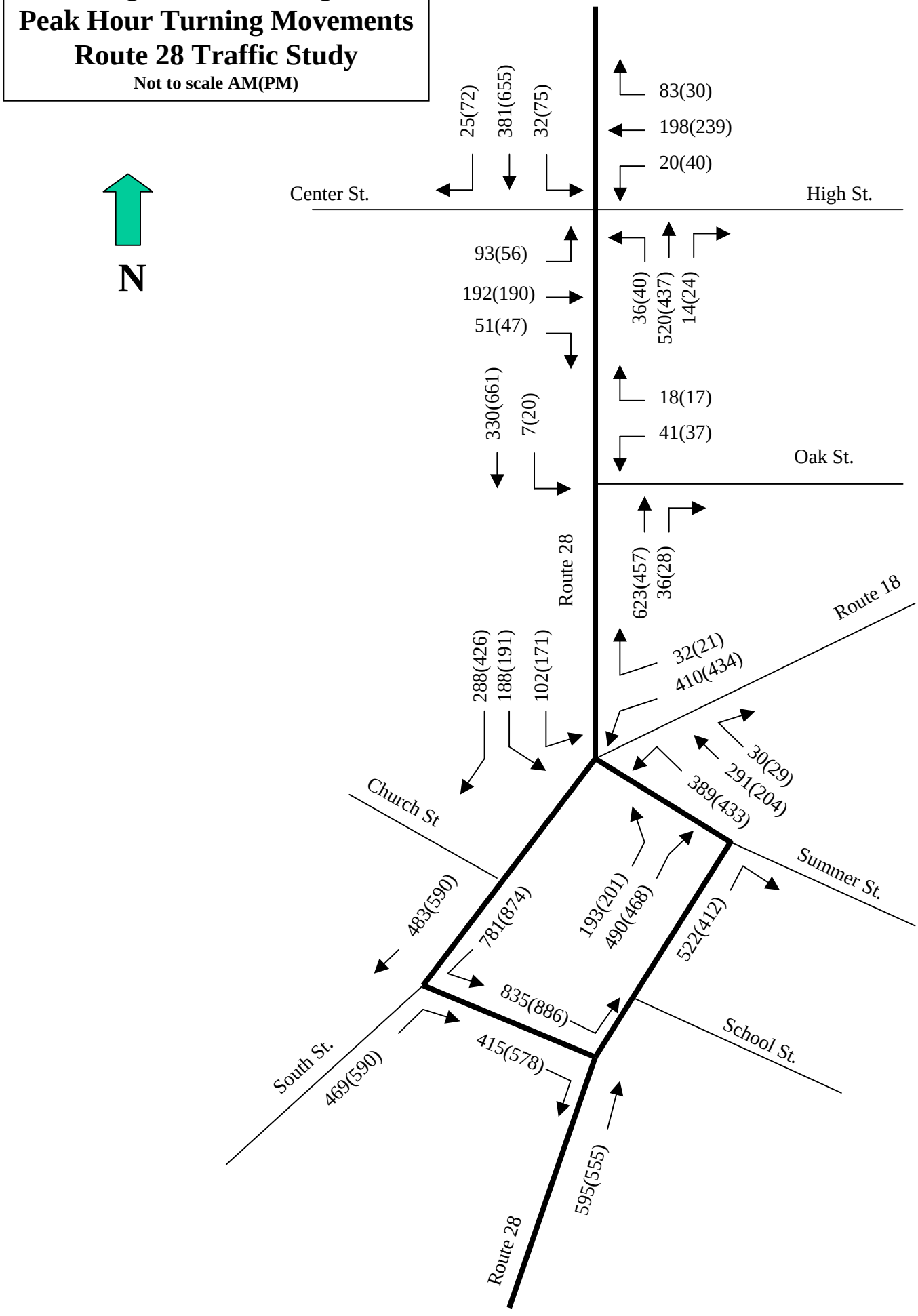


Figure A5 Existing
Peak Hour Turning Movements
Route 28 Traffic Study
Not to scale AM(PM)



FigureA6 Existing
Peak Hour Turning Movements
Route 28 Traffic Study
Not to scale AM(PM)

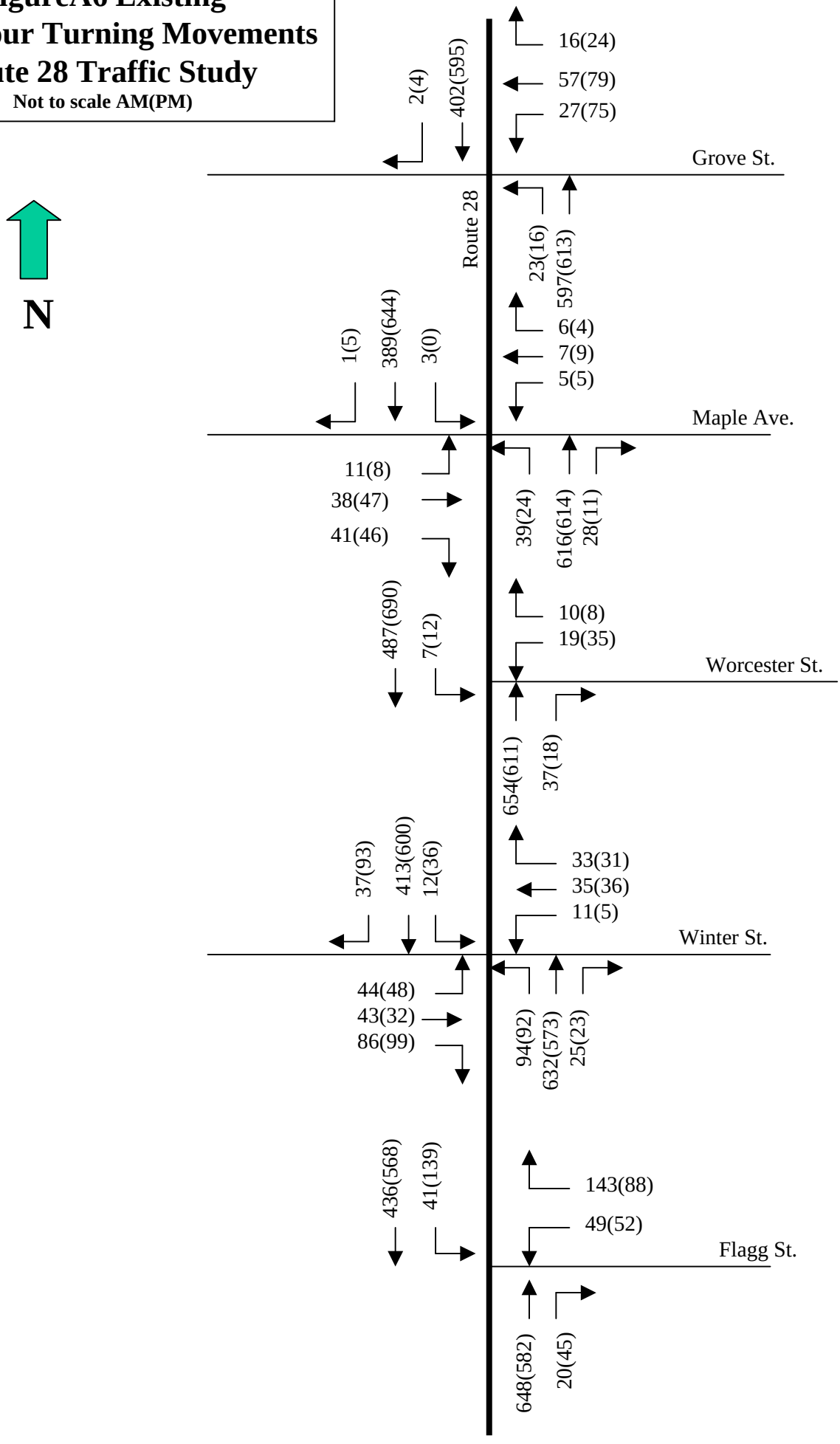


Figure A7 FUTURE
2010 Peak Hour Turning Movements
Route 28 Traffic Study

(not to scale) AM Peak (PM Peak)

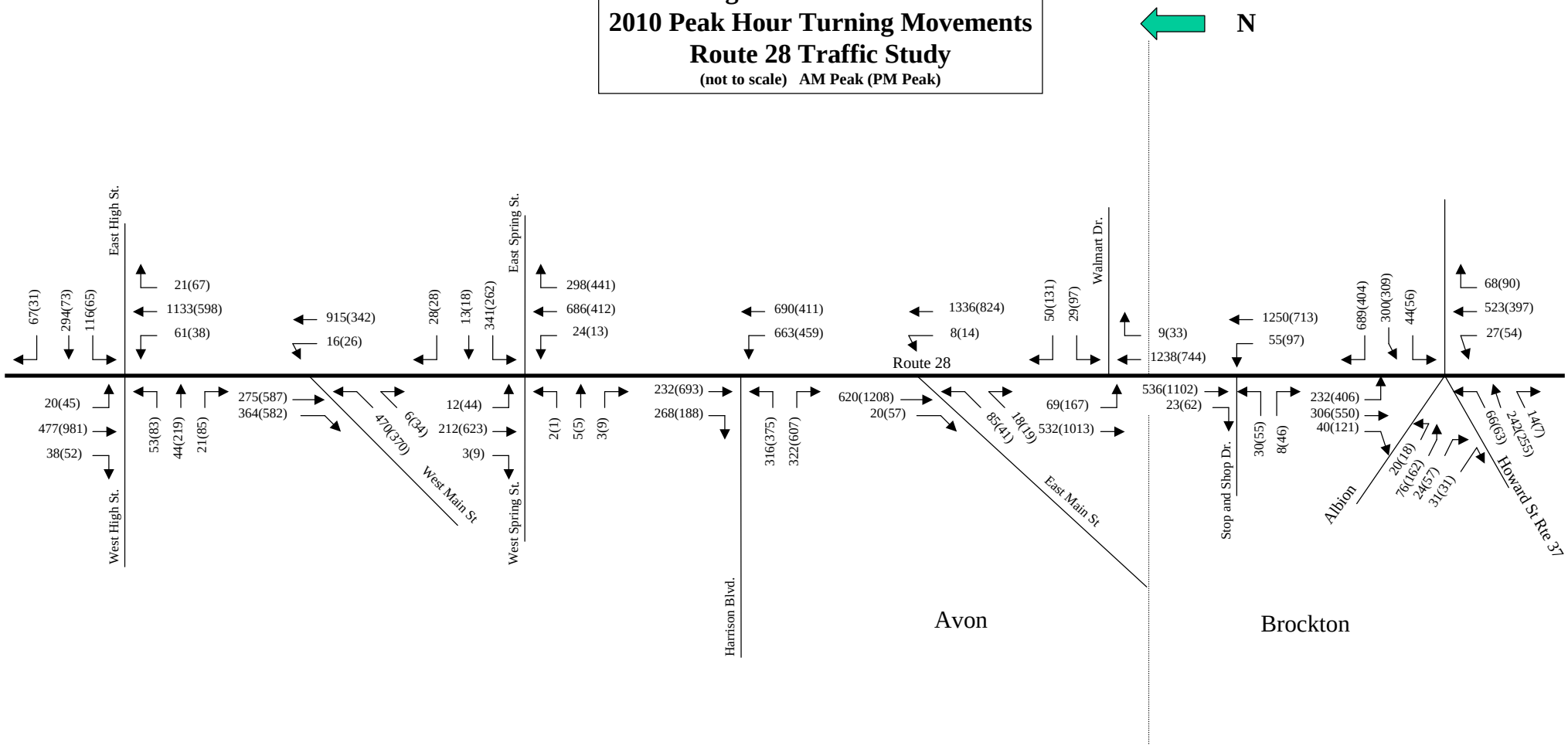


Figure A8 FUTURE
2010 Peak Hour Turning Movements
Route 28 Traffic Study
(not to scale) AM Peak (PM Peak)

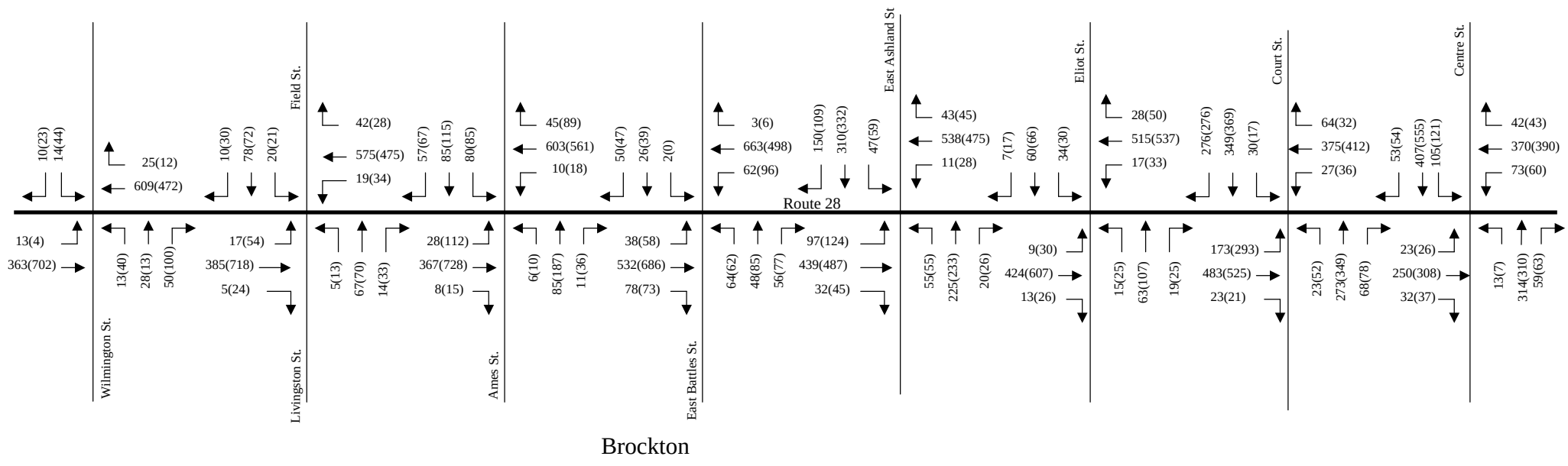
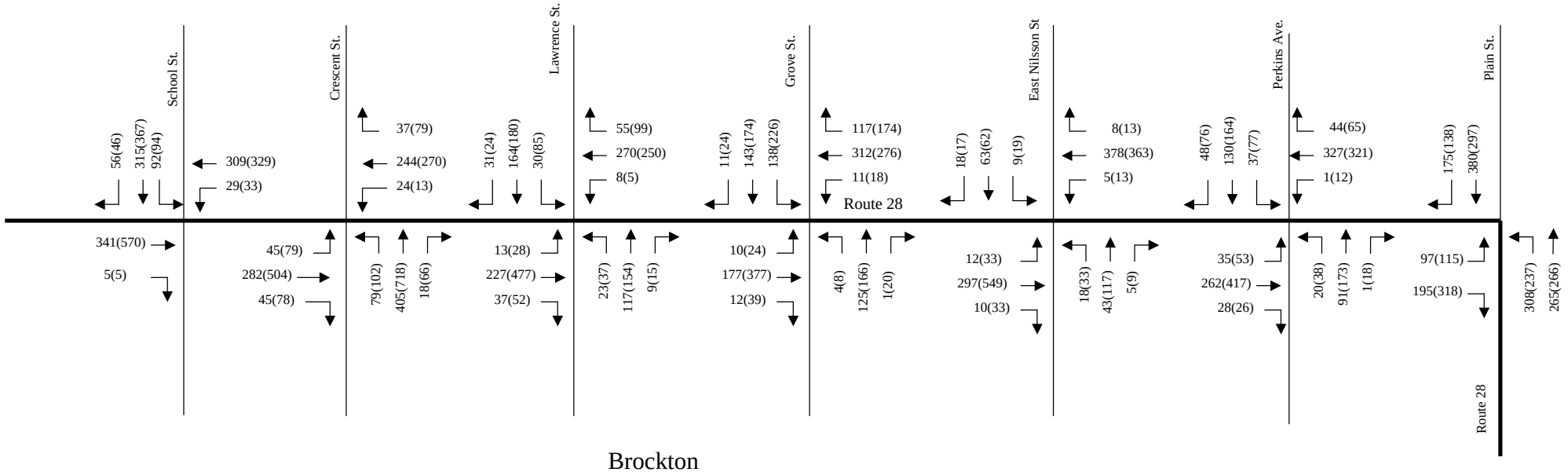


Figure A9 FUTURE
2010 Peak Hour Turning Movements
Route 28 Traffic Study
(not to scale) AM Peak (PM Peak)



Brockton

Figure A10 FUTURE
2010 Peak Hour Turning Movements
Route 28 Traffic Study

(not to scale) AM Peak (PM Peak)

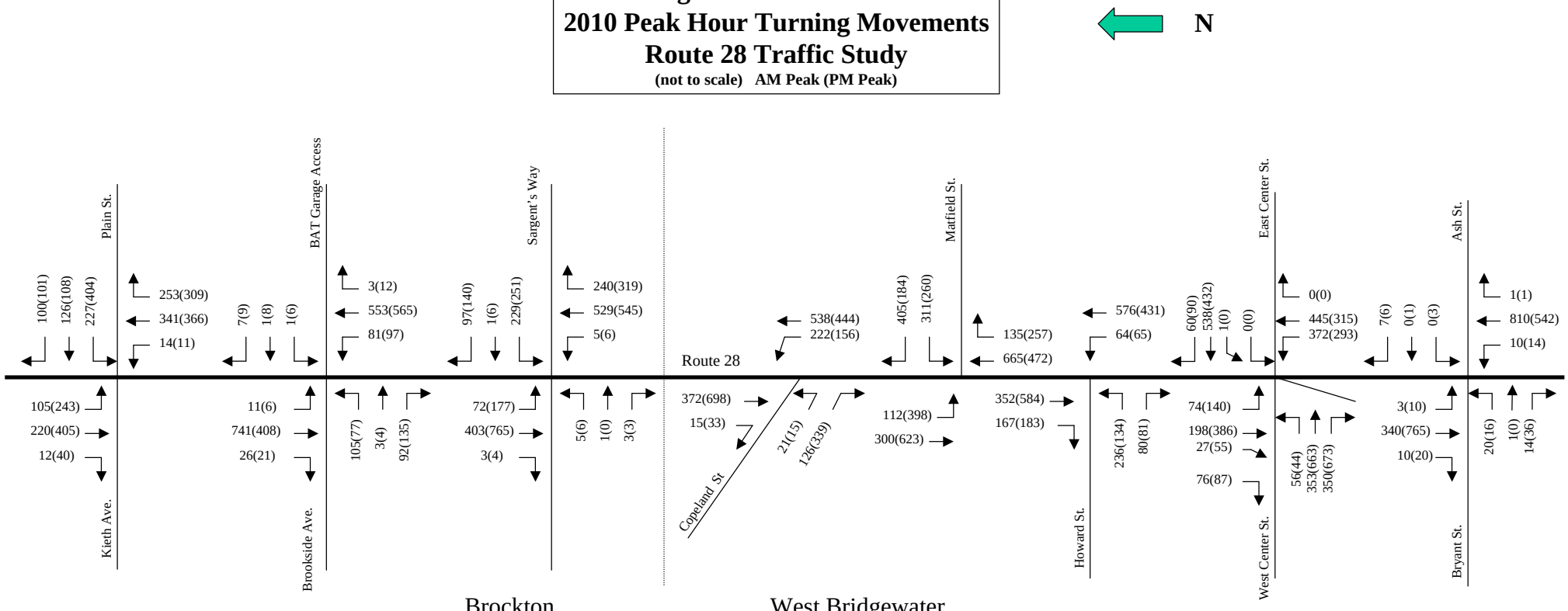


Figure A11 FUTURE
2010 Peak Hour Turning Movements
Route 28 Traffic Study
Not to scale AM(PM)

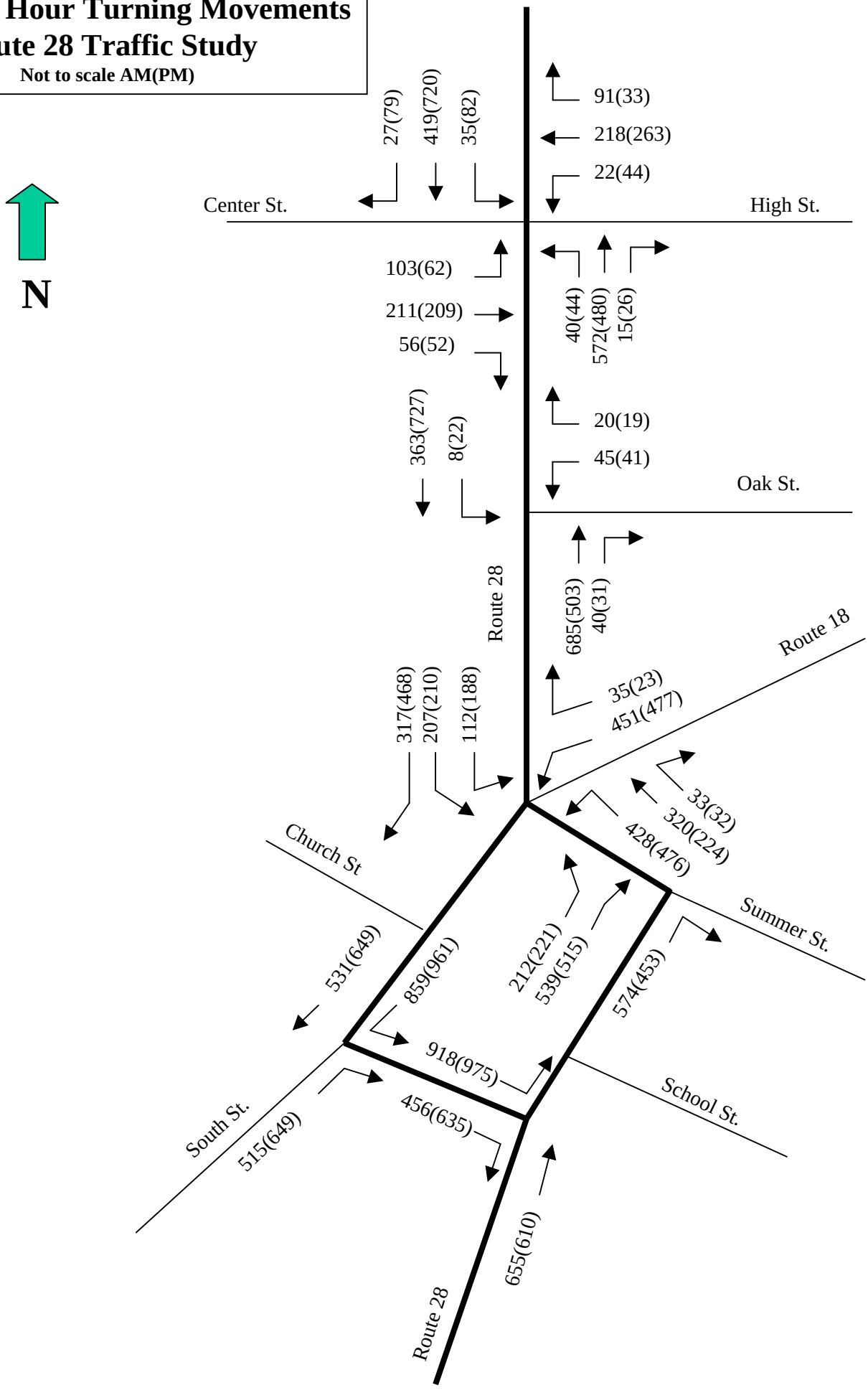


Figure A12 FUTURE
2010 Peak Hour Turning Movements
Route 28 Traffic Study
Not to scale AM(PM)