

ROUTE 27 CORRIDOR TRAFFIC STUDY



SEPTEMBER, 2008

OLD COLONY PLANNING COUNCIL, BROCKTON, MA 02301

PREPARED UNDER EOTPW CONTRACT # 0052455





Acknowledgements

The preparation of this report has been financed in part through grants from the Federal Highway Administration and Federal Transit Administration, U.S. Department of Transportation, under Metropolitan Planning Program, Section 104(f) of Title 23, U.S. Code, under Contract 0052455.

The views and opinions of the Old Colony Planning Council expressed herein do not necessarily state or reflect those of the U. S. Department of Transportation.

This Planning Level Traffic Study was prepared by the following members of the Old Colony Planning Council staff under the direction of Pat Ciaramella, Executive Director, and the supervision of Charles Kilmer, Transportation Program Manager.

Report Preparation

Ray Guarino, Transportation Planner
rguarino@ocpcrpa.org

Data Collection and Analysis

Jed Cornock, Transportation Planner
jcornock@ocpcrpa.org

Bruce Hughes, Economic Development Specialist/Community Development Planner
bhughes@ocpcrpa.org

William McNulty, Transportation Planner
wmcnulty@ocpcrpa.org

Karen Winger, Transportation Planner
kwinger@ocpcrpa.org

Mapping and Graphics

Susan McGrath, GIS Coordinator
smcgrath@ocpcrpa.org



OLD COLONY METROPOLITAN PLANNING ORGANIZATION

James Harrington	Mayor, City of Brockton
Richard Quintal	Chairman, Board of Selectmen, Plymouth
Colleen Corona	Chairman, Board of Selectmen, Easton
Matthew Albanese	Board of Selectmen, West Bridgewater
Bernard Cohen	Secretary, EOTPW
Luisa Paiewonsky	Commissioner, MassHighway
Reinald Ledoux, Jr.	Administrator, BAT
Jeanmarie Kent Joyce	President, OCPC

JOINT TRANSPORTATION COMMITTEE

JTC OFFICERS

JTC Chairman	Noreen O’Toole
JTC Vice Chairman	Sid Kashi

JTC DELEGATES AND ALTERNATES

ABINGTON - <i>Delegate</i>	Kenan Connell
ABINGTON - <i>Alternate</i>	Bruce Hughes
AVON	Ed Sarni
BRIDGEWATER- <i>Delegate</i>	David Matton
BRIDGEWATER - <i>Alternate</i>	Robert Wood
BROCKTON - <i>Delegate</i>	Michael Thoreson
BROCKTON - <i>Alternate</i>	Elaine Czaja
EAST BRIDGEWATER - <i>Delegate</i>	John Haines
EAST BRIDGEWATER - <i>Alternate</i>	Richard O’Flaherty
EASTON - <i>Delegate</i>	Wayne P. Southworth
EASTON - <i>Alternate</i>	Maurice Goulet
HALIFAX	Troy Garron
HANSON	Noreen O’Toole
KINGSTON	Paul Basler
PEMBROKE	Eugene Fulmine
PLYMOUTH	Sid Kashi
PLYMPTON	Jim Mulcahy
STOUGHTON	Carin Klipp
WEST BRIDGEWATER	Tom Green
WHITMAN - <i>Delegate</i>	Daniel Salvucci

AGENCY REPRESENTATION

EOTPW	David Mohler
EOTPW	Wendy Stern
EOTPW	Joanne Weinstock
MHD District 5	Bernard McCourt
MHD District 5	Pamela Haznar
MHD District 5	Tim Kochan
BAT	Reinald Ledoux, Jr.
BAT	Kathy Riddell
DEP	Leah Weiss
FHWA	Paul Maloney
FHWA	Michael Chong
FTA	William Gordon
FTA	Donna Laidley
Brockton Traffic Commission	Captain John Gomes

OCPC TRANSPORTATION STAFF

Charles Kilmer	Transportation Program Manager
Caleb Cornock	Transportation Intern
Jed Cornock	Transportation Planner
Raymond Guarino	Transportation Planner
Susan McGrath	GIS Coordinator
William McNulty	Transportation Planner
Karen Winger	Transportation Planner



Old Colony Planning Council

OCPC OFFICERS

President	Jeanmarie Kent-Joyce
Secretary	Lee Hartmann
Treasurer	Robert Moran

COMMUNITY

ABINGTON
 AVON
 BRIDGEWATER
 BROCKTON
 EAST BRIDGEWATER
 EASTON
 HALIFAX
 HANSON
 KINGSTON
 PEMBROKE
 PLYMOUTH
 PLYMPTON
 STOUGHTON
 WEST BRIDGEWATER
 WHITMAN
 DELEGATE-AT-LARGE

DELEGATE

A. Stanley Littlefield
 Frank Staffier
 Anthony P. Anacki
 Robert G. Moran, Jr.
 Richard O’Flaherty
 Jeanmarie Kent-Joyce
 John G. Mather
 Robert Overholtzer
 Paul Basler
 Gerard Dempsey
 Lee Hartmann
 John Rantuccio
 Joseph Landolfi
 Eldon F. Moreira
 Fred Gilmetti
 Matthew Striggles

ALTERNATE

Robert Wing
 Charles Marinelli
 Preston Huckabee
 Steve Donahue
 Troy E. Garron
 Phillip Lindquist
 Brian Van Riper
 Valerie Massard
 James Mulcahy
 Robert E. Kuver
 Nancy Bresciani
 Daniel Salvucci

OCPC STAFF

Pasquale Ciaramella	Executive Director
Lila Burgess	Ombudsman Program Director
Jed Cornock	Transportation Planner
Hazel Gauley	Assistant Ombudsman Director
Raymond Guarino	Transportation Planner
Patrick Hamilton	AAA Administrator
Bruce G. Hughes	Economic Development/Community Planner
Charles Kilmer	Transportation Program Manager
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
James R. Watson	Comprehensive Planning Supervisor
Karen Winger	Transportation Planner
Caleb Cornock	Transportation Intern



Table of Contents

1.0 INTRODUCTION 1

 1.1 Study Purpose and Scope..... 1

 1.2 Methodology and Process..... 1

2.0 EXISTING CONDITIONS..... 2

 2.1 Jurisdiction, Road Classification, and Land Use 2

 2.2 Existing Traffic Volumes..... 7

 2.2.1 Average Daily Traffic (ADT)..... 7

 2.2.2 Peak Hour Intersection Turning Movement Counts (TMCs) 8

 2.3 Existing Traffic Operations..... 8

 2.4 Crash Analysis 14

 2.5 Spot Speed Studies..... 19

 2.6 Heavy Vehicle Traffic..... 20

 2.7 Pavement Conditions 22

 2.8 Community Goals and Visions 24

3.0 FUTURE ROUTE 27 CONDITIONS 29

 3.1 Planned Improvements..... 29

 3.1.1 Planned Improvements - Stoughton..... 29

 3.1.2 Planned Improvements - Brockton 35

 3.1.3 Planned Improvements - Whitman 39

 3.2 Traffic Forecasts 43

 3.3 Future Traffic Operations 43

4.0 RECOMMENDATIONS..... 46

 4.1 Overall Corridor Improvements..... 46

 4.2 Recommended Improvements - Stoughton..... 47

 4.3 Recommended Improvements - Brockton 49

 4.4 Recommended Improvements - Whitman 52

 4.5 Recommended Improvements – East Bridgewater..... 53

 4.6 Future Levels-of-Service with Recommended Improvements 53

5.0 Project Development and Funding..... 56

6.0 Appendices 59

Figures

Figure 1 Route 27 Study Area and Road Jurisdiction..... 3

Figure 2 Average Daily Traffic..... 9

Figure 3 Intersection Level-of-Service Analyses 15

Figure 4 Intersection Crash Rates 16

Figure 5 85th Percentile Speeds and Percent of Heavy Vehicles 21

Figure 6 Pavement Conditions..... 23

Figure 7 Planned and Recommended Improvement Projects 55



1.0 INTRODUCTION

1.1 *Study Purpose and Scope*

The Old Colony Planning Council (OCPC) has undertaken a comprehensive study of the Route 27 corridor in the communities of Stoughton, Brockton, Whitman, and East Bridgewater to identify traffic and transportation problems, and to develop feasible solutions that are in keeping with the visions of the future development, character, and land use patterns in the study area communities. The findings and recommendations in this report are intended to serve as a basis for including improvement projects in the Old Colony Metropolitan Planning Organization (MPO) Transportation Improvement Program (TIP), and Regional Transportation Plan (RTP).

The main tasks included in this study process include:

- Developing and maintaining a comprehensive public participation component, including forming of a study steering committee to oversee the study process.
- Documenting existing traffic and transportation conditions and identifying problems.
- Forecasting future conditions and identifying potential improvement projects, short term and long term, for the study area.

1.2 *Methodology and Process*

This study includes a review of existing traffic conditions (traffic volumes, intersection peak hour levels-of-service, speeds, and heavy vehicles), physical conditions (such as traffic control, lane use, signage, pavement conditions, intersection alignment), crash analyses, planned improvements, land use conditions, community goals and plans, zoning, and previous studies pertinent to the Route 27 corridor. In addition, traffic forecasts and level-of-service analyses for 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*. The traffic analyses were completed for the intersection peak hour operations using Highway Capacity Software (HCS) and SYNCHRO software (with SimTraffic.)

There are a number of key intersections within the corridor that are in close proximity. Although both HCS software and SYNCHRO both conform to the *Highway Capacity Manual* practices, SYNCHRO, along with SimTraffic, takes into account traffic back-ups, delays, and queues from an intersection that interfere with operations at other nearby intersections.

Signal Warrant analyses were performed in accordance with national standards as established in the *Manual On Uniform Traffic Control Devices 2003(MUTCD)* by the Federal Highway Administration (FHWA). Traffic data collection and crash analyses were completed in accordance with the procedures and techniques in the *Manual of Traffic Engineering Studies by the Institute of Traffic Engineers (ITE)*. Information on intersection crashes, right-of-way, highway width, functional classification, and jurisdiction were obtained from the Massachusetts Registry of Motor Vehicles, the



Massachusetts Highway Department (MassHighway), the Executive Office of Transportation and Public Works (EOTPW), the Federal Highway Administration (FHWA), and the Massachusetts Geographic Information System (MassGIS).

Public outreach was initiated through the establishment of an overall study steering committee and the identification of stakeholders. The public outreach effort enables a bottom-up approach to the planning process. Minutes of the steering committee meetings are included in the report appendix. Stakeholders were contacted through a direct mailing campaign and the general public was notified of the study through articles in the local newspapers in the study area communities. In addition to the steering committee meetings, individual stakeholder meetings were held to garner input and to disseminate information regarding the study to a number of stakeholders including the Brockton Area Transit (BAT), Massasoit Community College, Old Colony Comprehensive Economic Development Strategy Committee (CEDS), Mutual Bank in Whitman, MassHighway District 5, the Town of Stoughton, the City of Brockton, and the Town of Whitman. Periodic updates of the study's progress were provided to the Old Colony Joint Transportation Committee (JTC) and the Old Colony Metropolitan Planning Organization (MPO) over the course of the study. The findings and recommendations based on the input of the study steering committee and stakeholders are included in this final report.

2.0 EXISTING CONDITIONS

2.1 Jurisdiction, Road Classification, and Land Use

Route 27 is a two-lane state highway except for some four-lane segments in Stoughton and Brockton. The Route 27 corridor within the Old Colony Region runs southeast through Stoughton, Brockton, Whitman, East Bridgewater, Hanson, Pembroke, and Kingston. This study includes approximately 15.85 miles of the Route 27 corridor in the communities of Stoughton, Brockton, Whitman, and East Bridgewater. Figure 1 shows the geographic scope of the study and the road jurisdiction.

Jurisdiction refers to the agency in charge of maintaining the road. Route 27 is alternately under both state and municipal jurisdiction. Road classification indicates funding eligibility. Route 27 is classified as a principal urban arterial in all the study area communities, except for approximately 0.38 miles in downtown Brockton where it is classified as a minor arterial on Commercial Street, from Crescent Street to Court Street. Its principal and minor urban arterial classification indicates that it is eligible for both state and federal funding.

ROUTE 27 CORRIDOR STUDY ~ 2005 ORTHO & 2007 ROADS BY JURISDICTION



FIGURE 1

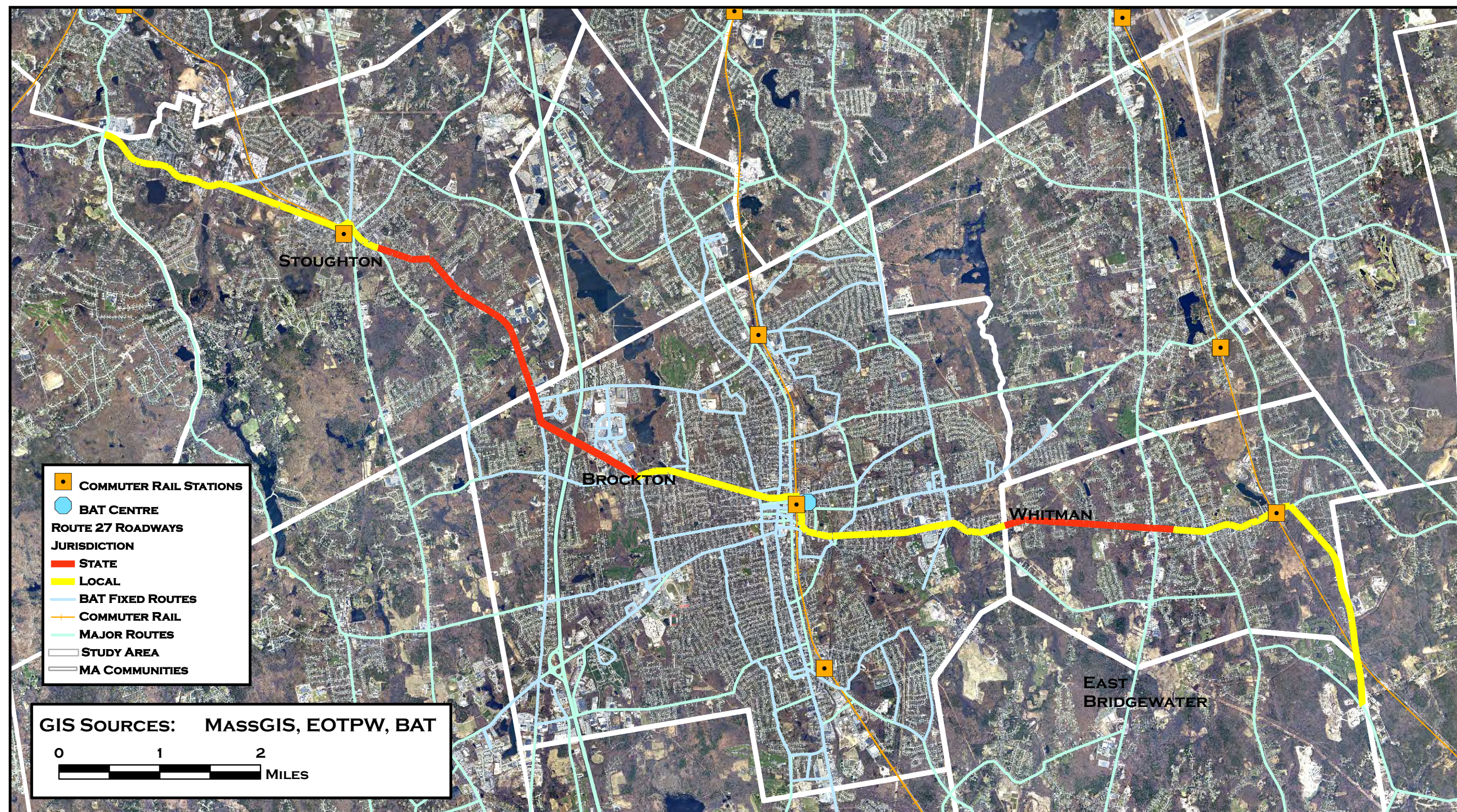




Figure 1 shows that Route 27 is under local jurisdiction within the Stoughton, Brockton, and Whitman centers. Route 27 is under Stoughton jurisdiction from the Sharon Town Line east through Stoughton center to the Park Street/Sumner Street intersection. State jurisdiction of the road begins at this intersection and continues east along Park Street, Pearl Street, and Reynolds Memorial Highway to Pleasant Street, where it is under Brockton jurisdiction. Brockton jurisdiction continues along Pleasant Street, through the Brockton downtown to the Whitman Town Line, where it comes under state jurisdiction. State jurisdiction extends east from the Brockton/Whitman Town Line to the Temple Street/West Street intersection. Whitman jurisdiction on Route 27 begins at the West Street intersection and continues through Whitman center to the East Bridgewater Town Line. Route 27 is under East Bridgewater jurisdiction to the Route 14 intersection, which is the terminus for the geographic scope of this study.

Figure 1 shows that Route 27 provides connections for regional access to Route 138 and Route 139 at Stoughton center. In Brockton, it provides access to Route 24, via Reynolds Memorial Highway, for access to Interstate Route 93 to Boston and Interstate Route 95 to points north and west. It also connects to Route 28 and Route 123 in Brockton Downtown. Route 27 provides access to the Massasoit Community College campus via Crescent Street in the east portion of Brockton. In Whitman, Route 27 intersects Route 18 and, although it does not intersect Route 58 directly, access to Route 58 is easily achieved via Raynor Avenue or South Avenue.

The land use along Route 27 is varied and includes the downtowns of Stoughton, Brockton, and Whitman with dense patterns of development. Route 27 also passes by commuter rail stations in Stoughton, Brockton Downtown (commuter rail station and the Brockton Area Transit Intermodal Centre), and in Whitman (the commuter rail station east of the Whitman Downtown). Strip mall commercial areas have developed alongside Route 27 at the Brockton/Stoughton Line near the Oak Street intersection, and in the vicinity of the Home Depot on Crescent east of Brockton Downtown. Route 27, via Reynolds Memorial Highway, provides direct access to the Westgate Mall in Brockton, which is in close proximity to Route 24. Route 27 is residential in character west of Stoughton Square on Canton Street, east of Stoughton Square along Park Street, along Pleasant Street in Brockton, and in Whitman from the Brockton City Line to Whitman Center.

Route 27 in Stoughton at the Sharon Town Line is named Central Street east to the Canton Street/Central Street/Tosca Drive intersection. This section of Route 27 provides two lanes of travel, one lane for each direction of travel. There are no shoulders provided on either side of the road. Central Street, as Route 27, does not have adequate sight distances at intersections and crossings, due mainly to both horizontal and vertical alignment, especially in the area of the West Street intersection, the Island Street intersection, and the Canton Street/Tosca Drive intersection. In addition, the alignment at these locations cannot adequately accommodate tractor trailers making turns, which results in trucks encroaching in other lanes.



Route 27 follows Canton Street from the Central Street/Canton Street/Tosca Drive intersection to the town center. Utility poles are set at the curb within close proximity (about three feet) to passing traffic, which poses a lane departure hazard. The posted speed limit varies between 25 miles per hour and 40 miles per hour westbound and 30 miles per hour to 35 miles per hour eastbound. Canton Street, as Route 27, is mostly residential in character with a sidewalk provided on one side of the road.

Route 27 connects to Route 138 and Route 139 at the center of Stoughton. There are four travel lanes, two in each direction, through Stoughton center with traffic turning and weaving northbound and southbound to access Route 138, Route 139, and Route 27. In addition, traffic is also entering the center from side streets and curb cuts within the center. Route 27 provides access to the MBTA Stoughton Commuter Rail Station, which is located on Railroad Avenue just off of Stoughton center. An identified issue in this area is the at-grade rail crossing across Route 27 where the MBTA train will back up onto Route 27, blocking traffic, when stopped at the Stoughton Station.

Route 27 continues east from Stoughton center as Park Street to the Brockton City Line where it becomes North Pearl Street. Park Street is mostly residential and provides two lanes of travel with eight foot shoulders on both sides of the road. The speed limit on Park Street is posted at 40 miles per hour and a sidewalk is provided on one side of the road. The land use transitions to commercial on Park Street just north of the Brockton City Line where the road widens to four lanes of travel. Park Street continues on to North Pearl Street in Brockton. Route 27, from there, then follows Reynolds Memorial Highway southeast of the Pearl Street/Reynolds Memorial Highway intersection. Reynolds Memorial Highway is a four lane limited access facility with a narrow raised median. Reynolds Memorial Highway provides access to Route 24 via on and off ramps, and also provides an entrance to the Westgate Mall at a signalized four-way intersection with Christys Drive. The speed limit on Reynolds Memorial Highway is posted at 45 miles per hour, and eight foot shoulders are provided on both sides of the road.

Reynolds Memorial Highway ends at its intersection with Pleasant Street. Route 27 continues east on Pleasant Street from Reynolds Memorial Highway to its intersection with Main Street and Court Street in the Brockton Downtown. Pleasant Street provides two lanes of travel with sidewalks on both sides of the road. Utility poles are located close to the travel way, due to a lack of shoulders, creating potential hazards for lane departure crashes. Pleasant Street is in a densely settled residential area with numerous driveways and side streets. Some of the side streets contain heavy traffic that turns onto Pleasant Street or crosses through traffic. In addition, pedestrian traffic is significant in this densely settled area.

Route 27 continues east from Main Street as Court Street, which passes under the Railroad viaduct in downtown Brockton. This viaduct was built in the late 1800s before bridge height was an issue for moving freight via truck, and the viaduct is currently 13 feet and 6 inches high at its highest point, which is insufficient for many of today's heavy vehicles. Court Street intersects both Main Street and Route 28 (Montello Street), two heavily traveled corridors in the Brockton area. Route 27 turns onto Commercial Street,



adjacent to the Brockton Area Transit (BAT) Intermodal Centre and the Brockton MBTA Commuter Rail Station. Commercial Street intersects Route 123 (Centre Street) an important east-west corridor in the Brockton region. Sidewalks are provided throughout the Brockton downtown on Pleasant Street, Court Street, and Commercial Street, with textured crosswalks provided across Commercial Street between the BAT Intermodal Centre and the Brockton MBTA Commuter Rail Station.

Commercial Street intersects Crescent Street where Route 27 continues east along Crescent Street providing a four-lane cross section to the Crescent Street/Lyman Street intersection. Crescent Street provides sidewalks on both sides of the road. Crescent Street narrows to two lanes with no shoulders east of the Lyman Street intersection. The land use along Crescent Street in this area is commercial in nature with strip malls and a Home Depot home improvement store. Route 27 forms a four-way intersection with the Massasoit Community College entrance and Quincy Street. Quincy Street is a heavily traveled north south road between Route 123 and Route 27 in Brockton, and Massasoit Community College is a commuter college that currently serves 7,500 full and part-time students.

Crescent Street (Route 27) is called Temple Street in Whitman, which provides two lanes of traffic, sidewalks on both sides of the road, and eight foot shoulders on both sides of the road. The speed limit is posted at 40 miles per hour at the Brockton City Line, 35 miles per hour as Temple Street approaches the Route 18 intersection, and 35 and 25 miles per hour as Route 27 approaches Whitman Center. Temple Street (Route 27) intersects Bedford Street (Route 18), which is an important north-south regional route. The land uses vary along Temple Street with a mix of commercial and residential uses.

Route 27 intersects Washington Street at Whitman Center. This intersection is a four-way stop controlled intersection with a flashing red beacon. Whitman downtown is characterized by office, parking, and commercial uses. Within Whitman center, there is parking allowed on both sides of Route 27.

Temple Street (Route 27) is called South Avenue east of Washington Street and the Whitman downtown. The posted speed limit on South Avenue varies between 25 and 35 miles per hour between the Whitman downtown and the South Avenue/Pleasant Street/Franklin Street intersection. The Whitman MBTA Commuter Rail Station is located within this section of Route 27 on South Avenue. South Avenue provides two lanes of travel and Route 27 continues on as Franklin Street southeast of the South Avenue/Pleasant Street/Franklin Street intersection. Franklin Street (Route 27) is a two lane highway that intersects Route 14 in East Bridgewater. The speed limit on Franklin Street is posted at 35 miles per hour. Route 14 provides an alternative to Route 27 from Hanson and East Bridgewater west through Whitman that connects back to Route 27 Crescent Street in Brockton.



2.2 Existing Traffic Volumes

2.2.1 Average Daily Traffic (ADT)

Automatic traffic recorders were utilized to determine the average daily traffic (ADT) at specific locations on Route 27 and on key intersecting roads. The traffic recorders were installed for a minimum 48-hour period and recorded traffic in both directions in one-hour intervals. The traffic recorders were programmed to record vehicle speeds and the number of heavy vehicles in the traffic stream, as well as the traffic volumes. The traffic recorders were installed at 50 locations within the study area. Figure 2 shows the average daily traffic (24-hour traffic total for both directions of travel) for the Route 27 study area. The automatic traffic recorder counts are included in the appendix to this report.

As shown in Figure 2, the ADT varies on Route 27, depending upon the community and the land use. The ADT on Route 27 (Central Street) in Stoughton at the Sharon Town Line is 20,942 vehicles per day (VPD). The volumes are higher in Stoughton in the vicinity of Island Street and Central Street at 23,352 VPD and 23,892 VPD. Route 27 east of Central Street, continues as Canton Street as it approached Stoughton Center. The ADT on Route 27 (Canton Street) is significantly less with 11,102 VPD west of the School Street intersection and 9,817 VPD between School Street and Stoughton Center. East of Stoughton Center, the ADT is 18,000 VPD, and slightly lower at 14,597 between Sumner Street and Prospect Street. The ADT is at 18,175 and 20,253 VPD west of Turnpike Street, and remains over 20,000 VPD on Route 27 at the Stoughton/Brockton Line.

Route 27 (Reynolds Memorial Highway) in Brockton has the highest volumes in the corridor with 24,000 VPD west of the Route 24 interchange and 36,100 VPD east of the Route 24 interchange, in the vicinity of the Westgate Mall. Route 27 (Pleasant Street) in Brockton has 21,445 VPD in the vicinity of West Street; however, closer to the Brockton Downtown it has 16,382 VPD. The ADT on Route 27 through Brockton Downtown varies with 12,043 VPD on Route 27 (Court Street) between Main Street and Route 28 (Montello Street) and 16,146 VPD east of Route 28 (Montello Street). The ADT is 10,237 and 11,400 VPD on Route 27 (Commercial Street) north and south of Route 123 (Centre Street) respectively, and is higher at 18,236 VPD as Route 27 becomes Crescent Street. The ADT is at the 18,000 VPD level on Route 27 (Crescent Street) except for the section between Summer Street and Lyman Street, where it drops to 10,945 VPD, and between Route 14 and the Quincy Street/Massasoit Community College intersection where it jumps to 21,237 VPD.

In Whitman, the ADT on Route 27 (Temple Street) is at 9,246 VPD at the Brockton/Whitman Line, and at 13,173 VPD just west of Route 18. The traffic remains at 13,200 VPD east of Route 18; however, it is at 10,145 VPD east of West Street and at 9,375 VPD west of Whitman Center. East of Whitman Center, Route 27 (South Avenue) is at 10,619 VPD and 11,862 VPD, and jumps up to 14,148 in the vicinity of the MBTA Commuter Rail Station. Route 27 (South Avenue) is at 11,111 VPD west of the Pleasant Street/South Avenue/Franklin Street intersection, and much lower at 5,269 VPD and 5,000 VPD east of the intersection.



2.2.2 Peak Hour Intersection Turning Movement Counts (TMCs)

Manual turning movement counts were conducted at 50 key intersections (signalized and un-signalized) within the corridor during the morning and afternoon (7:00 AM to 9:00 AM and 4:00 PM to 6:00 PM) to determine the peak hours of operation. The turning movement counts include a count of pedestrians and heavy vehicles entering intersections as well as passenger cars. The turning movement counts are included in the appendix to this report.

2.3 Existing Traffic Operations

Level-of-service analyses (LOS) were completed for the study area intersections to determine the operating conditions 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:

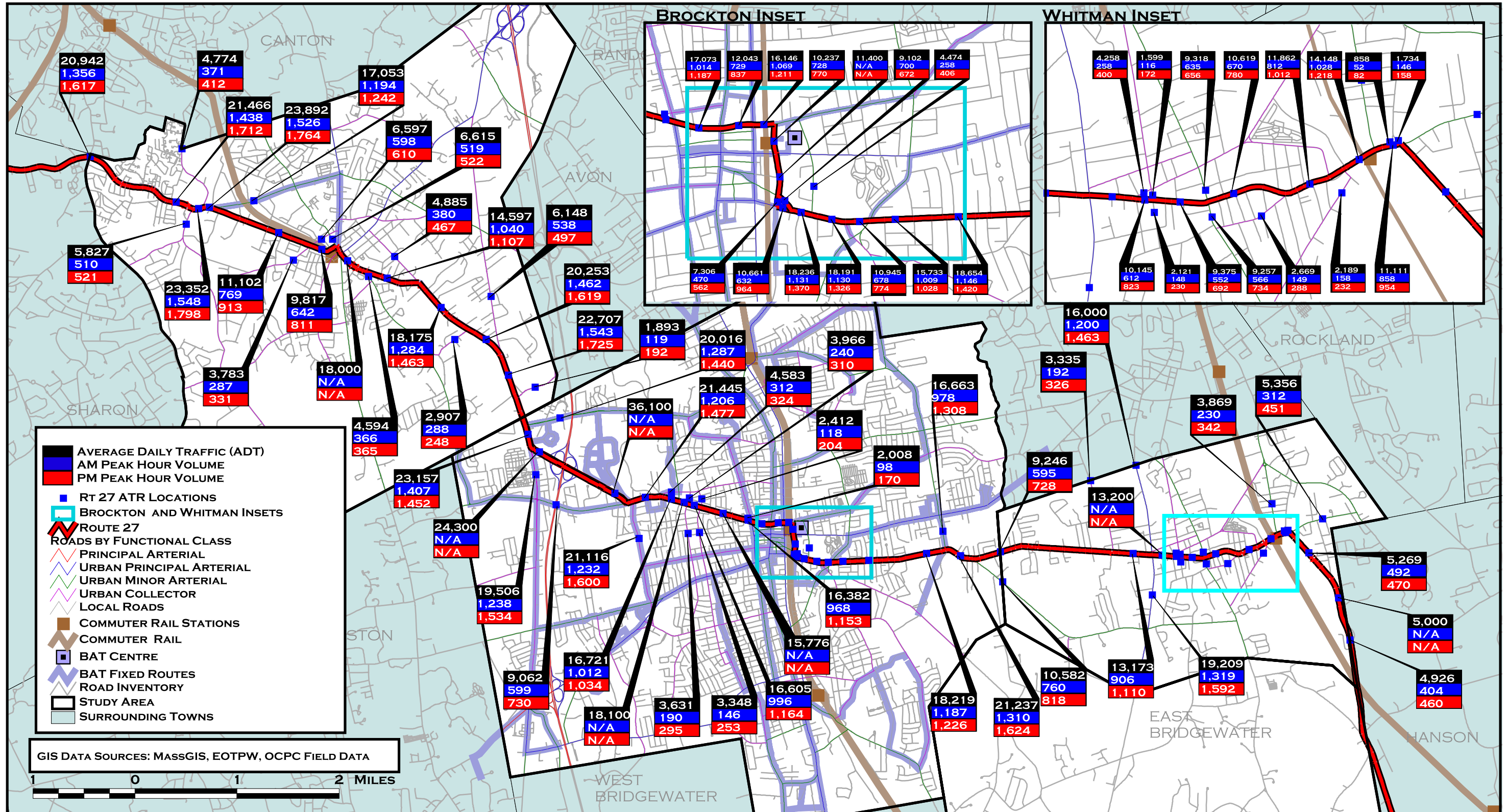
- LOS "A" represents free flow. Individual users are virtually unaffected by the presence of others in the traffic stream.
- LOS "B" is in the range of stable flow, but the presence of other users in the traffic stream begins to be noticeable. Freedom to select desired speeds is still relatively unaffected.
- 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.

ROUTE 27 CORRIDOR STUDY

ADT &
AM/PM PEAK HOUR VOLUMES



FIGURE 2





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 study area corridors, time delay, average stop delay, and average travel speed are used as measures of operational effectiveness to which levels-of-service are assigned. Table 1 shows the delay criteria for each level-of-service for both un-signalized and signalized intersections.

Table 1 Level-of-Service Criteria Average Delay in Seconds

Level-of-Service	Stop Sign	Traffic Signal
A	0 to 10	0 to 10
B	>10 to 15	>10 to 20
C	>15 to 25	>20 to 35
D	>25 to 35	>35 to 55
E	>35 to 50	>55 to 80
F	>50	>80

Table 2 shows the signalized and un-signalized levels-of-service for the Route 27 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 2008 Intersection Levels-of-Service

ID	Community	Intersection	Traffic Control	AM LOS	PM LOS
1	Stoughton	Central Street (Route 27) & West Street	Stop Sign	F	F
2	Stoughton	Central Street (Route 27) & Island Street	Stop Sign	F	F
3	Stoughton	Canton Street (Route 27) & Central Street/Tosca Drive	Stop Sign	F	F
4	Stoughton	Canton Street (Route 27) & School Street/School Avenue	Stop Sign	F	F
5	Stoughton	Stoughton Center (Northern End)	Signal	B	F
6	Stoughton	Stoughton Center (Southern End)	Signal	E	E
7	Stoughton	Park Street (Route 27) & Sumner Street	Stop Sign	F	F
8	Stoughton	Park Street (Route 27) & Prospect Street	Stop Sign	E	F
9	Stoughton	Park Street (Route 27) & Ash Street	Stop Sign	D	F
10	Stoughton	Park Street (Route 27) & Turnpike Street	Stop Sign	F	F
11	Stoughton	Park Street (Route 27) & South Street	Stop Sign	F	F
12	Stoughton	Park Street (Route 27) & R and K Plaza	Signal	C	C
13	Brockton	North Pearl Street (Route 27) & Oak Street	Signal	C	C
14	Brockton	North Pearl Street (Route 27) & Good Samaritan Hospital	Signal	A	B
15	Brockton	North Pearl Street (Route 27) & Reynolds Memorial Highway (Route 27)	Signal	C	D
16	Brockton	Reynolds Memorial Highway (Route 27) & Westgate Drive/Christys Drive	Signal	C	D
17	Brockton	Reynolds Memorial Highway (Route 27) & Pleasant Street	Signal	C	E
18	Brockton	Pleasant Street (Route 27) & West Street	Signal	E	F
19	Brockton	Pleasant Street (Route 27) & Prospect Street	Stop Sign	F	F
20	Brockton	Pleasant Street (Route 27) & BelairStreet/Moraine Street	Signal	C	E
21	Brockton	Pleasant Street (Route 27) & Ash Street	Stop Sign	F	F



Table 2 Existing 2008 Intersection Levels-of-Service (continued)

ID	Community	Intersection	Traffic Control	AM LOS	PM LOS
22	Brockton	Pleasant Street (Route 27) & Belmont Avenue/Augusta Avenue	Stop Sign	F	F
23	Brockton	Pleasant Street (Route 27) & Spring Street	Stop Sign	C	F
24	Brockton	Pleasant Street (Route 27) at Warren Avenue	Signal	C	C
25	Brockton	Pleasant Street (Route 27) & Main Street/Court Street	Signal	C	B
26	Brockton	Court Street (Rte 27) & Montello Street (Route 28)	Signal	C	C
27	Brockton	Court Street (Route 27) & Commercial Street	Signal	B	B
28	Brockton	Commercial Street (Route 27) & Centre Street (Route 123)	Signal	B	C
29	Brockton	Commercial Street (Route 27) & School Street	Signal	B	B
30	Brockton	Commercial Street (Route 27) & Crescent Street (Route 27)	Signal	B	B
31	Brockton	Crescent Street (Route 27) & Plymouth Street	Stop Sign	F	F
32	Brockton	Crescent Street (Route 27) & Summer Street	Signal	B	B
33	Brockton	Crescent Street (Route 27) & Lyman Street	Signal	C	F
34	Brockton	Crescent Street (Route 27) & Wendell Avenue/Crescent Avenue	Signal	B	B
35	Brockton	Crescent Street (Route 27) & Home Depot Shopping Plaza	Signal	C	C
36	Brockton	Crescent Street (Route 27) & Quincy Street/Massasoit Community College	Signal	F	F
37	Brockton	Crescent Street (Route 27) & Alger Street (Route 14)	Signal	D	B
38	Whitman	Temple Street (Route 27) & High Street	Signal	C	F
39	Whitman	Temple Street (Route 27) & Bedford Street (Route 18)	Signal	B	C
40	Whitman	Temple Street (Route 27) & West Street	Stop Sign	C	F
41	Whitman	Temple Street (Route 27) & Beulah Street	Stop Sign	C	D
42	Whitman	Temple Street (Route 27) at Washington Street (Whitman Center)	Stop Sign	F	F
43	Whitman	South Avenue (Route 27) & Broad Street	Stop Sign	B	D
44	Whitman	South Avenue (Route 27) & Park Avenue	Stop Sign	C	F
45	Whitman	South Avenue (Route 27) & Commercial Street	Stop Sign	C	E
46	Whitman	South Avenue (Route 27) & Raynor Avenue	Stop Sign	D	F
47	Whitman	South Avenue (Route 27) & Pleasant Street	Stop Sign	B	B
48	Whitman	South Avenue (Route 27)/Pleasant Street & Franklin Street (Route 27)	Stop Sign	C	F
49	Whitman	Franklin Street (Route 27) at Winter Street	Stop Sign	A	B
50	E. Bridgewater	Franklin Street (Route 27) at Route 14	Signal	B	C



Table 2 shows that 25 out of the 50 study area intersections experience LOS “E” or “F” conditions during the morning peak hour, afternoon peak hour, or during both peak hours. All the Stoughton intersections experience LOS “E” or “F” conditions, except for the Park Street Route 27/R and K Plaza intersection. All of these “E” and “F” intersections in Stoughton are stop sign controlled, except for the two intersections in Stoughton center, which are signal controlled. These stop sign controlled intersections in Stoughton have poor alignment, poor sight lines, and long delays on the side street approaches to Route 27. The traffic flow on Route 27 during the peak hours is so heavy in both directions that there are very few gaps sufficient for the side street left turns to enter the main stream traffic on Route 27 safely or without very long delays. Subsequently, side street traffic often forces its way into the main flow on Route 27, forcing Route 27 traffic to slow down, or worse, causing crashes. The critical movement from Route 27, vehicles turning left into the side streets, also lacks sufficient gaps in the Route 27 through traffic. These left turns block traffic behind them on Route 27 if there is no room for vehicles behind them to perform a bypass maneuver.

In addition to poor alignment, road curvature, and steep grades, the intersections of Route 27 (Central Street) at West Street, Route 27 (Central Street) at Island Street, and Route 27 (Central Street) at Canton Street and Tosca Drive in Stoughton are within close proximity of each other so that delays at any one of these intersections during the morning or afternoon peak impacts the other intersections.

Stoughton Square has its own unique problems. Although the signals have been recently updated, along with timing and phasing, new signage, textured cross-walks, turning prohibitions, and pavement markings, the entering traffic volumes are so heavy that vehicles back up from one signal to the other inside the town center, despite coordination between the two signals in the center. Further problems exist due to the internal weaving on both the northbound and southbound sides. The LOS at the northern intersection (Route 27/Pearl Street/Route 138) is LOS “B” during the morning peak and LOS “F” during the afternoon peak. The LOS at the southern most intersection (Route 27/Route 138/Pleasant Street) is LOS “E” during the morning peak hour and LOS “E” during the afternoon peak hour.

Heavy peak traffic flows along Route 27 in Brockton create the same problem as on Route 27 in Stoughton; a lack of sufficient gaps within the major traffic flow on Route 27 for critical movements at un-signalized intersections. This occurs along Route 27 (Pleasant Street) between West Street and Brockton downtown at a number of un-signalized intersections: Route 27 (Pleasant Street)/Prospect Street, Route 27 (Pleasant Street)/Ash Street, Route 27 (Pleasant Street)/Augusta Street/Belmont Avenue, and Route 27 (Pleasant Street)/Spring Street. It also occurs along Route 27 (Crescent Street) east of the Brockton downtown at the Route 27 (Crescent Street)/Plymouth Street intersection. In addition, Brockton has a number of signalized intersections that experience LOS “E” or “F” peak hour operating conditions within the Route 27 corridor. Signalized intersections with LOS “E” or “F” conditions (failed conditions) during the peak hour in Brockton include Route 27 (Reynolds Memorial Highway)/Pleasant Street, Route 27 (Pleasant Street)/West Street, Route 27 (Pleasant Street)/Belair Street/Moraine Street,



Route 27 (Crescent Street)/Lyman Street, and Route 27 (Crescent Street)/Quincy Street/Massasoit Boulevard. The morning and afternoon peak hour levels-of-service, under existing conditions (2008) for the study area intersections are shown in Figure 3.

2.4 Crash Analysis

Crash data for the study area intersections was obtained from the Massachusetts Highway Department (MassHighway) for the latest available three-year period (2004, 2005, and 2006). The data, which is made available to MassHighway from the Massachusetts Registry of Motor Vehicles (RMV), was tabulated and analyzed in accordance with the standard practices published by the Institute of Transportation Engineers (ITE) 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; and,
- To identify needs in pedestrian and bicycle safety and certain actions causing crashes that can be prevented through driver and/or public education.

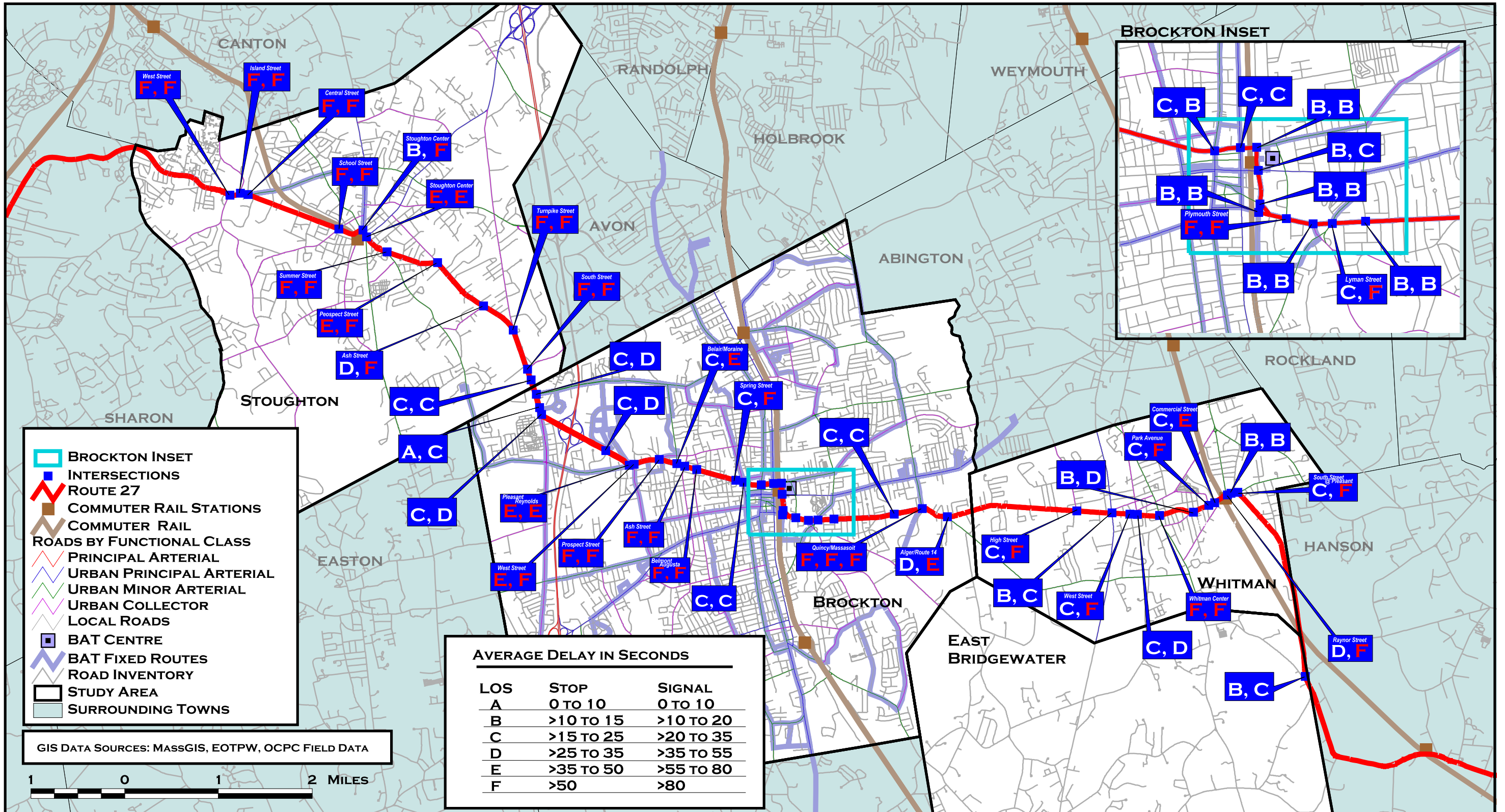
The crash rate is a good indicator of the frequency of crashes at intersections. The crash rate helps measure the crash exposure at an intersection. It is based on the number of crashes per million entering vehicles (MEV). The number of crashes often increases as traffic volumes increase. Traffic growth 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 crashes. Crash rates for the study area intersections are shown in Figure 4.

ROUTE 27 CORRIDOR STUDY

INTERSECTION PEAK HOUR
LEVEL OF SERVICE (AM, PM)



FIGURE 3

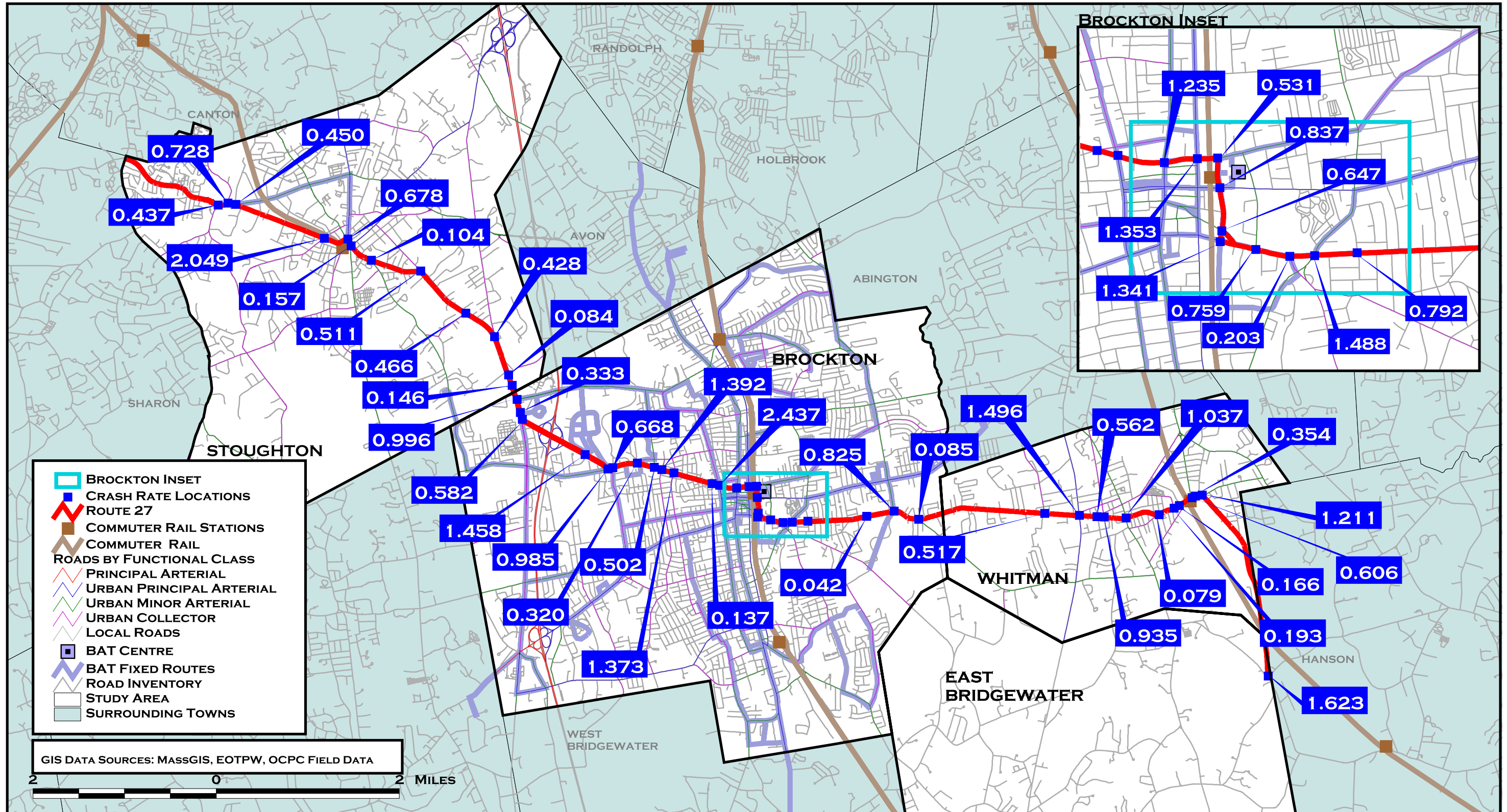


ROUTE 27 CORRIDOR STUDY

INTERSECTION CRASH RATE
(PER MEV)



FIGURE 4



GIS DATA SOURCES: MASSGIS, EOTPW, OCPD FIELD DATA

2 0 2 MILES



OLD COLONY PLANNING COUNCIL

70 SCHOOL STREET

BROCKTON, MA 02301

SEPTEMBER, 2008



Table 3 – Crashes and Crash Rates (per Million Entering Vehicles, MEV)

Community	Intersection	Traffic Control	Number of Crashes	Crash Rate	Injury Crashes	Fatal	EOTPW Top 200?	OCPC Top 100?
Brockton	Reynolds Memorial Highway (Route 27) & Westgate Drive/Christys Drive	Signal	58	1.458	25 (43%)	0	No	Yes
Brockton	Pleasant Street (Route 27) at Warren Avenue	Signal	58	2.437	21 (36%)	0	Yes	Yes
Brockton	Crescent Street (Route 27) & Lyman Street	Signal	51	1.488	26 (53%)	1	Yes	Yes
Whitman	Temple Street (Route 27) & Bedford Street (Route 18)	Signal	48	1.496	6 (13%)	0	No	Yes
Brockton	Reynolds Memorial Highway (Route 27) & Pleasant Street	Signal	38	0.985	13 (37%)	1	No	Yes
Brockton	Court Street (Route 27) & Montello Street (Route 28)	Signal	37	1.353	16 (43%)	0	Yes	Yes
Stoughton	Canton Street (Route 27) & School Street/School Avenue	Stop	36	2.049	11 (44%)	0	No	Yes
Brockton	Pleasant Street (Route 27) & Main Street/Court Street	Signal	34	1.235	19 (56%)	0	Yes	Yes
Brockton	North Pearl Street (Route 27) & Oak Street	Signal	33	0.996	17 (52%)	0	No	Yes
Brockton	Crescent Street (Route 27) & Quincy Street/Massasoit	Signal	32	0.974	14 (44%)	0	No	Yes
Brockton	Pleasant Street (Route 27) & West Street	Signal	31	0.668	8 (26%)	0	Yes	Yes
Brockton	Pleasant Street (Route 27) & Ash Street	Stop	29	1.392	13 (45%)	0	No	No
Brockton	Pleasant Street (Route 27) & Belmont Avenue/Augusta Avenue	Stop	27	1.373	11 (41%)	0	No	Yes
Brockton	Commercial Street (Route 27) & Crescent Street (Route 27)	Signal	26	1.341	8 (31%)	0	No	Yes
Brockton	North Pearl Street (Route 27) & Reynolds Memorial Highway (Route 27)	Signal	23	0.562	9 (39%)	0	No	Yes
Stoughton	Central Street (Route 27) & Island Street	Stop	21	0.728	5 (24%)	0	No	Yes
Brockton	Commercial Street (Route 27) & Centre Street (Route 123)	Signal	21	0.837	8 (38%)	0	No	No
Stoughton	Stoughton Center (Northern End)	Signal	20	0.678	2 (11%)	0	No	No
Brockton	Crescent Street (Rte 27) & Plymouth Street	Stop	20	0.759	11 (55%)	0	No	No
Whitman	Temple Street (Route 27) at Washington Street (Whitman Center)	Stop	20	1.037	2 (10%)	0	No	No

MassHighway District 5 Average crash rate for signalized intersections is 0.84.

MassHighway District 5 Average crash rate for un-signalized intersections is 0.59.



Table 3 Crashes and Crash Rates (continued)

Community	Intersection	Traffic Control	Number of Crashes	Crash Rate	Injury Crashes	Fatal	EOTPW Top 200?	OCPC Top 100?
Whitman	South Avenue (Route 27)/Pleasant Street & Franklin Street (Route 27)	Stop	18	1.211	7 (39%)	0	No	No
Brockton	Crescent Street (Route 27) & Wendell Avenue/Crescent Avenue	Signal	17	0.792	6 (35%)	0	No	No
Stoughton	Canton Street (Route 27) & Central Street/Tosca Drive	Stop	15	0.450	2 (13%)	0	No	No
Stoughton	Central Street (Route 27) & West Street	Stop	12	0.437	3 (33%)	0	No	No
Stoughton	Park Street (Route 27) & Ash Street	Stop	12	0.466	1 (8%)	0	No	No
Brockton	Pleasant Street (Route 27) & Belair Street/Moraine Street	Signal	12	0.502	3 (25%)	0	No	No
Whitman	Temple Street (Route 27) & Beulah Street	Stop	12	0.935	5 (42%)	0	No	No
Stoughton	Park Street (Route 27) & Turnpike Street	Stop	11	0.428	3 (27%)	0	No	No
Brockton	North Pearl Street (Route 27) at Good Samaritan Hospital	Signal	11	0.333	4 (36%)	0	No	No
Brockton	Commercial Street (Route 27) & School Street	Signal	11	0.647	7 (64%)	0	No	No
Whitman	South Avenue (Route 27) & Raynor Avenue	Stop	11	0.606	2 (18%)	0	No	No
Stoughton	Park Street (Route 27) & Prospect Street	Stop	10	0.511	3 (30%)	0	No	No
Brockton	Court Street (Route 27) & Commercial Street	Signal	10	0.531	0 (0%)	0	No	No
Whitman	Temple Street (Route 27) & High Street	Signal	10	0.517	2 (20%)	0	No	No
Brockton	Pleasant Street (Route 27) & Prospect Street	Stop	8	0.320	2 (25%)	0	No	No
Whitman	Temple Street (Route 27) & West Street	Stop	8	0.562	4 (50%)	0	No	No
Stoughton	Stoughton Center (Southern End)	Signal	5	0.157	0 (0%)	0	No	No
Stoughton	Park Street (Route 27) & R and K Plaza (TJ Maxx)/Burger King	Signal	5	0.146	0 (0%)	0	No	No
Brockton	Crescent Street (Route 27) & Summer Street	Signal	5	0.203	3 (60%)	0	No	No
Whitman	South Avenue (Route 27) & Pleasant Street	Stop	5	0.354	1 (20%)	0	No	No
Stoughton	Park Street (Route 27) & Sumner Street	Stop	3	0.104	2 (67%)	0	No	No
Brockton	Pleasant Street (Route 27) & Spring Street	Stop	3	0.137	1 (33%)	0	No	No
Whitman	South Avenue (Route 27) & Park Avenue	Stop	3	0.192	0 (0%)	0	No	No
Whitman	South Avenue (Route 27) & Commercial Street	Stop	3	0.166	2 (67%)	0	No	No
Whitman	Franklin Street (Route 27) & Winter Street	Stop	3	0.202	3 (100%)	0	No	No
Stoughton	Park Street (Route 27) & South Street	Stop	2	0.084	2 (100%)	0	No	No
Brockton	Crescent Street (Route 27) & Alger Street (Route 14)	Signal	2	0.085	0 (0%)	0	No	No
Brockton	Crescent Street (Route 27) & Home Depot Shopping Plaza	Signal	1	0.042	0 (0%)	0	No	No
Whitman	South Avenue (Route 27) & Broad Street	Stop	1	0.079	0 (0%)	0	No	No

As shown in Table 3, the intersections of Route 27 (Reynolds Memorial Highway) at Westgate Mall/Christys Drive and Route 27 (Pleasant Street) at Warren Avenue, both in Brockton, experienced the most crashes in the three year period with 58 crashes each.



The Route 27 (Pleasant Street)/Warren Avenue intersection had the highest crash rate with 2.437 crashes per million entering vehicles. There were five intersections in the study area that are included on EOTPW's Top 200 Hazardous Intersection list, including: Route 27 (Pleasant Street) at Warren Avenue, Route 27 (Crescent Street) at Lyman Street, Route 27 (Court Street) at Route 28 (Montello Street), Route 27 (Pleasant Street) at Main Street, and Route 27 (Pleasant Street) at West Street. Sixteen of the study area intersections are included on the OCPC Top 100 Hazardous Intersection list. The average crash rate for MassHighway District 5 is 0.59 MEV for un-signalized intersections and 0.84 MEV for signalized intersections. The Massachusetts statewide average is 0.66 MEV for un-signalized intersections and 0.87 MEV for signalized intersections. A rate higher than the district average is used as an indicator that safety improvements should be considered to reduce crashes at an intersection location. Other criteria used as indications that improvements are necessary include inclusion on EOTPW's Top 200 Hazardous Intersection List and the OCPC Region's Top 100 Hazardous Intersection List, as well as the percentage of injury crashes and the overall number of crashes.

2.5 Spot Speed Studies

OCPC staff measured vehicle speeds under prevailing conditions at specific locations on Route 27. These speed studies were conducted using automatic traffic recorders, which also record vehicle classification to identify the percentage of heavy vehicles in the traffic flow. Spot speed data collection occurs over the course of a 24 to 48 hour period during a weekday. The use of automatic recorders allows for non-peak as well as peak hour data collection. Figure 5 summarizes the speed data collected for the Route 27 corridor, as well as the percentage of heavy vehicles in the traffic flow. The 85th percentile speed is the speed at or below in which 85 percent of all vehicles were traveling at the time of the study. It is used in the Massachusetts Highway Department's guidelines as one of the criteria to determine the posted speed limit on a road.

As shown in Figure 5, the 85th percentile speed on Route 27 west of Central Street in Stoughton is 40 miles per hour (mph). East of Central Street, the 85th percentile speeds are lower, 37 mph, as Route 27 is more residential in character closer to Stoughton Square. The posted speed limit is 35 mph west of Central Street and 30 and 40 mph on Canton Street (30 mph eastbound toward Stoughton Center and 40 mph westbound away from Stoughton Center).

East of Stoughton Center, the 85th percentile speeds are at 42 mph and 46 mph, and remain high to the Brockton City Line. The posted speed limit varies on this section of Route 27. It is posted at 35 mph between Stoughton Center and Prospect Street and 40 mph between Prospect Street and the Brockton City Line. The speeds on Route 27 east of the Oak Street intersection are at 38 mph due to signalization and higher traffic volumes. The land uses along this section of Route 27 is commercial in nature with more vehicles entering and exiting driveways along the road that also slow down through traffic on Route 27. The speed limit on Reynolds Memorial Highway is 45 mph. This section of Route 27, which connects to the Route 24 Ramps, has limited access and four lanes of travel, which encourages increased speeds.



The 85th percentile speeds on Route 27 (Pleasant Street) vary between 34 and 37 mph between Reynolds Memorial Highway and the Brockton Downtown. The land use along this section of Route 27 is residential with a number of busy side streets that have traffic entering and exiting the Route 27 corridor.

East of the Brockton Downtown, the 85th Percentile speed on Route 27 (Commercial Street) is at 28 mph, adjacent to the Brockton Area Transit (BAT) Intermodal Centre. This section of Route 27 (Commercial Street) experiences heavy pedestrian traffic due to people crossing the street for access between the downtown area and the BAT Intermodal Centre. On Route 27 (Crescent Street), the 85th Percentile speeds vary between 31 and 37 mph. The posted speed limit is 30 mph on Route 27 (Crescent Street), from Commercial Street to Quincy Street, and 40 mph at the Whitman Town line.

The 85th Percentile speeds are higher on Route 27 in Whitman at 46 and 47 mph between the Brockton City Line and Route 18. The speed limit is posted at 35 and 40 mph in this section of Route 27. The 85th percentile speed varies between 35 and 37 mph west of Whitman Center, and the speed limit is posted at 35 mph. East of the center, the 85th percentile speed is lower at 26 mph. Route 27 just east of Whitman Center experiences parking maneuvers and pedestrian traffic, which conflict with through traffic. The 85th percentile speeds vary between 35 and 38 mph in the vicinity of the Whitman MBTA Commuter Rail Station between the Route 27 (South Avenue)/Broad Street intersection and the Route 27 (South Avenue)/Pleasant Street/Franklin Street intersection. The speed limit in this section is posted at 25 mph. Route 27 (Franklin Street) has an 85th percentile speed of 45 mph south of South Avenue.

2.6 Heavy Vehicle Traffic

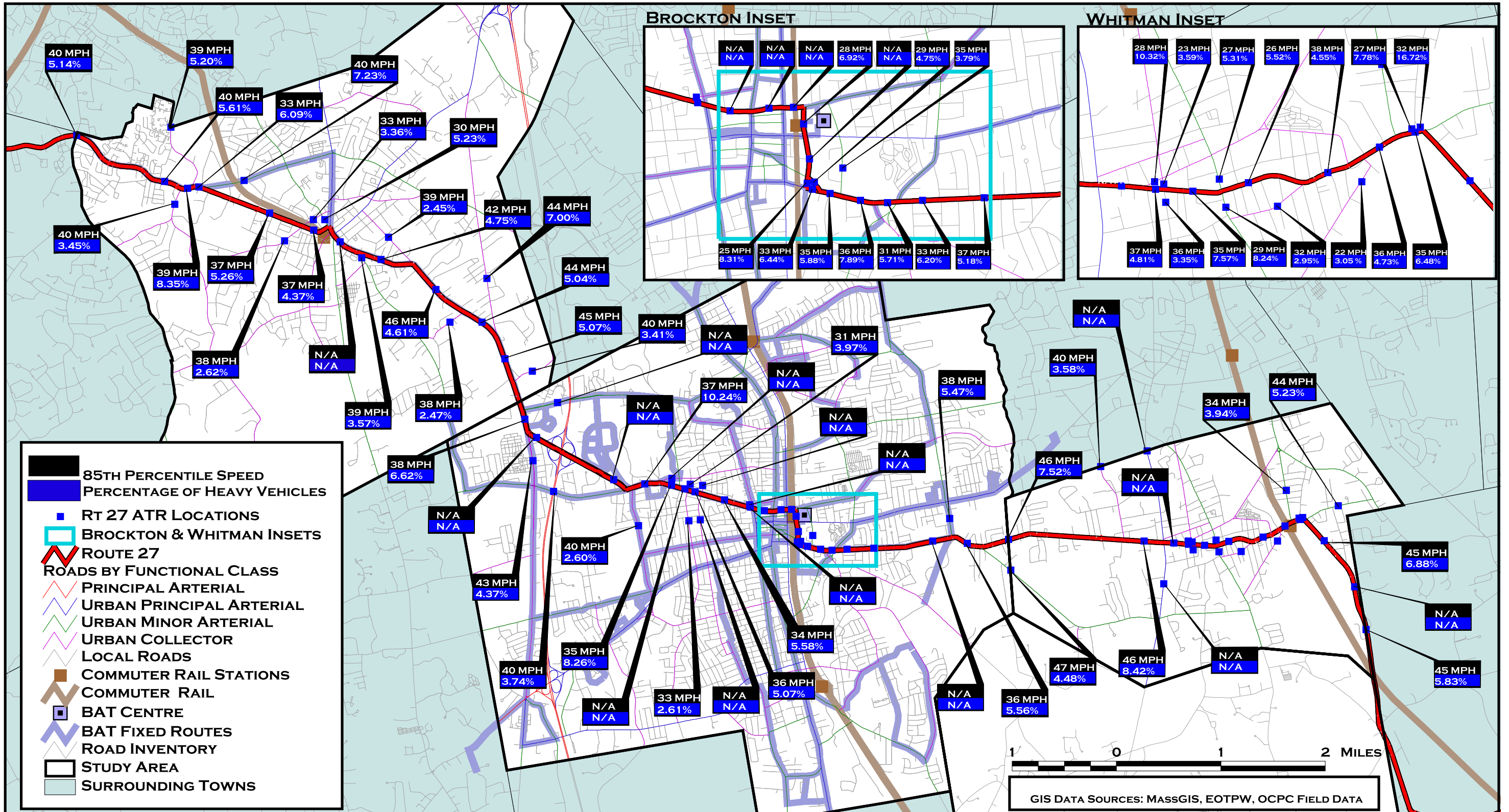
Figure 5 shows the percentage of heavy vehicles within the traffic flow along the Route 27 corridor, as well as the 85th percentile speeds. In Stoughton, the percentage of heavy vehicles in the traffic flow fluctuates at around 5 percent, except for the segment between West Street and Island Street, where the percentage reaches 8.35 percent. In Brockton, the percentage of heavy vehicles on Route 27 is 6.62 percent east of Oak Street, and 10.24 percent and 8.26 percent east of West Street. Route 27 (Crescent Street) has a percentage of heavy vehicle traffic that ranges from 5.18 to 7.89 percent. In Whitman, between the Brockton City Line and Route 18, the percentage of heavy vehicles varies between 7.52 and 8.42 percent.

ROUTE 27 CORRIDOR STUDY

85TH PERCENTILE SPEEDS & PERCENTAGE OF HEAVY VEHICLES



FIGURE 5





2.7 Pavement Conditions

OCPC uses *Road Manager* software to maintain a region-wide Pavement Management System (PMS). *Road Manager* 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, which is an index derived from an evaluation of pavement distress factors, average daily traffic, and roadway classification. The PCI is based on a scale of 1 to 100, with 100 indicating a flawless road surface. 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. Roads with scores below 65 need base rehabilitation or reconstruction and overlay.

OCPC surveyed the Route 27 corridor to determine the pavement conditions in September 2008. The road was segmented for analysis purposes. Figure 6 shows the results of the survey and the road condition for each segment as determined by *Road Manager*. As shown in Figure 6, Route 27 (Central Street) is in Excellent and Good condition from the Sharon Town Line to the Central Street/Tosca Drive/Canton Street intersection. Route 27 (Canton Street) is in Fair condition from Central Street to Stoddard Street. The remainder of Route 27 in Stoughton, through Stoughton Center to the Brockton City Line, is in Excellent condition.

Route 27 (North Pearl Street) in Brockton is in Good condition, as shown in Figure 4, and Route 27 (Reynolds Memorial Highway) is in Fair condition. A segment of Route 27 (Pleasant Street), from Reynolds Memorial Highway to Lenox Street, is in Good condition; however, most of Pleasant Street to Warren Avenue is in Poor condition. Route 27 (Pleasant Street) from Warren Avenue to Main Street is in Good condition, and Route 27 (Court Street) from Main Street to Commercial Street is in Fair to Poor condition. Brockton Area Transit has recently repaved Route 27 (Commercial Street) adjacent to the BAT Intermodal Centre; however, the remainder of Commercial Street from Route 123 to Crescent Street is in Poor condition. Route 27 (Crescent Street) is in Fair condition from Commercial Street to Wendell Avenue and Good condition from Wendell Avenue to Christos Way. Route 27 (Crescent Street) from Christos Way to the Whitman Town Line is in Fair to Poor condition.

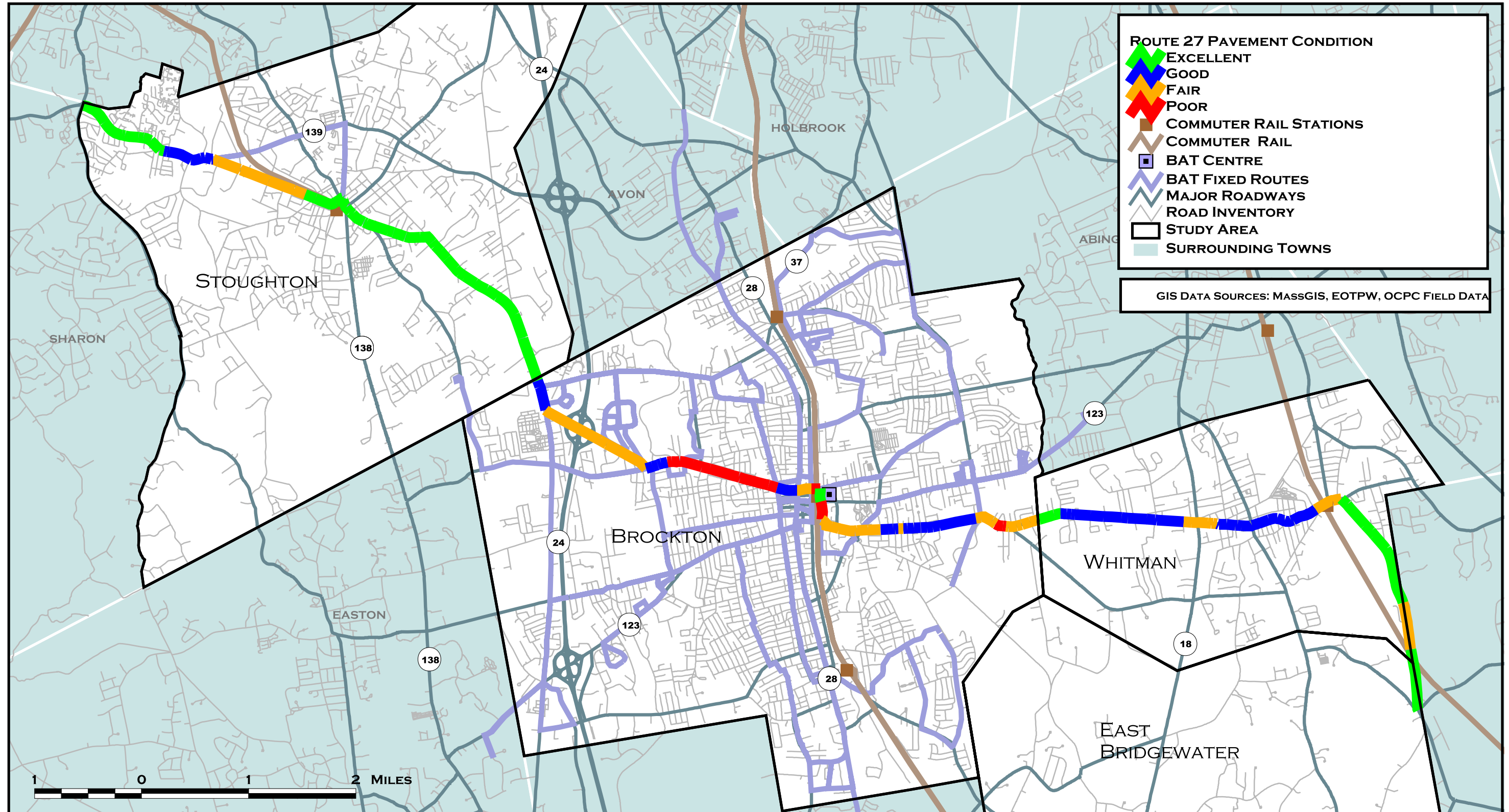
Route 27 (Temple Street) in Whitman is in Excellent condition from the Brockton City Line to Mansion Lane; from this point to Churchill Avenue, it is in Good condition. The road is in Fair condition from Churchill Avenue, as it crosses Route 18, to West Street; from West Street through Whitman Center to Commercial Street, the pavement is in Good condition. Route 27 (South Avenue) is in Fair condition from Commercial Street to the Route 27 (South Avenue)/Pleasant Street/Franklin Street intersection, and in Excellent condition from this intersection to Route 14 in East Bridgewater, except for a

ROUTE 27 CORRIDOR STUDY

PAVEMENT CONDITION INDEX



FIGURE 6



GIS DATA SOURCES: MASSGIS, EOTPW, OCPC FIELD DATA





section between the Whitman-Hanson Regional High School and the MBTA Commuter Rail tracks, which is in Fair condition.

2.8 Community Goals and Visions

Reviews of planning studies, including master plans and community development plans, for each of the Route 27 communities were completed in order to discern the vision that each of the communities has for future development patterns within the corridor. Reviews of the existing zoning in each of the towns were also completed to determine if the zoning is consistent as Route 27 transitions from one community to the next.

Stoughton

The zoning along the Route 27 corridor in Stoughton varies and includes Residential zones, Industrial zones, Business zones, and a Central Business District zone. The Route 27 (Central Street) corridor from the Sharon Town Line to Mill Street is zoned Residential. The northern side of the road is Industrial east to the Route 27 (Central Street)/Canton Street/Tosca Drive intersection. The Route 27 (Canton Street) corridor is Residential to Southworth Court where it becomes Industrial on the north side to Drake Avenue. Route 27 (Canton Street) is zoned intermittently Industrial and Residential from Drake Avenue east to the town center, which is zoned Central Business District. As Route 27 continues southeast from the town center as Park Street, it is zoned mostly Residential with intermittent Business and Industrial zones. Route 27 (Park Street) is zoned Industrial and Business from Turnpike Street south to the Brockton City Line.

In 2006, the Town of Stoughton amended its zoning laws to include the Stoughton Center Mixed-Use Overlay District (SCMUOD). This district applies to the town center and includes the Central Business District zone and portions of Residential zones, Industrial zones and General Business zones. The purpose of the overlay district is not to restrict the rights of landowners based on the underlying district; however, if a developer chooses to use the SCMUOD for development purposes, then the development must conform to the overlay by-law. Specific architectural design guidelines have been established for use within the overlay district, along with mixed use guidelines. The SCMUOD encourages the shared use of parking within the downtown; however, parking spaces for single use are not considered as providing the required spaces for any other use, except when it can be clearly demonstrated that the need for parking occurs at different times. It is required that a shared parking agreement be submitted to the town as part of any special permit request.

The SCMUOD was established for the following purposes:

- To maintain the cultural and architectural integrity of the center;
- To promote a range and balance of residential and commercial uses in the center;
- To promote efficient use of land within the town;
- To facilitate integrated physical design and synergies between activities;
- To facilitate an increase in the variety of housing stock available in the center;
- To enhance the vitality in the center during both day and night time;



- To promote a pedestrian-friendly living and working environment that encourages transit use and bicycling;
- To facilitate economic development of the center while remaining consistent with the established design guidelines and sensitive to environmental impacts;
- To encourage building reuse and appropriate infill development;
- To promote innovative and sustainable building and site design.

The Metropolitan Area Planning Council (MAPC) assisted Stoughton in developing the *2004 Stoughton Community Development Plan* (CDP). The purpose of that plan was to enable Stoughton to address future growth and development by creating visions, goals, and strategies in four topic areas: natural resources and open space, housing, economic development, and transportation. The Stoughton Board of Selectmen appointed a Community Development Plan Committee, which coordinated the CDP efforts and hosted five Community Development Plan public workshops to gather public input. Some of the key recommendations of the plan included:

- Based on the recommendations of the participants at the final plan forum, the town should commit to a set of Smart Growth Principles, and should hire a municipal planner to oversee continued planning and implementation of the Community Development Plan.
- Promote cluster development as a means of protecting significant portions of a property proposed for development. The town could promote cluster through a variety of means, including density bonuses for developers willing to use cluster, or through requiring that all subdivisions over a specified acreage or number of lots (i.e., “major developments”) be developed through cluster subdivision.
- In the town center, establish or reinvigorate a public-private downtown partnership to guide and coordinate revitalization efforts.
- In the town center, execute plans to improve streets and sidewalks, and help businesses improve the appearance of their properties.
- Revise downtown zoning to guide the design of new buildings, stimulate re-development, and increase housing by allowing mixed use development.
- Develop short-term management strategies for downtown parking while exploring the feasibility of increasing parking spaces.
- Improve the mix of commercial and cultural activities to attract shoppers and visitors in the downtown by encouraging businesses and activities consistent with the vision for a more active specialty retail district.
- Promote higher quality redevelopment of highway commercial strips through design standards and review.
- Promote orderly development of the commercial and industrial area near Route 24 by planning for future uses and roadway and infrastructure improvements.
- Create a new neighborhood commercial zone sensitive to surrounding residential uses, and rezone specific commercial and industrial districts for uses more compatible with their surroundings.

The Town of Stoughton participated in the *Route 138 Corridor Study*, conducted by the Central Transportation Planning Staff in 2002. The study recommended a series of



improvements to enhance safety and traffic flow in the Route 138 corridor in Stoughton, Canton, and Milton, including Stoughton Square. The study concluded that the town should work to implement traffic and pedestrian improvements in Stoughton Square, one of the areas cited as a major traffic concern during the CDP forums. Stoughton has received a Public Works and Economic Development (PWED) grant to implement traffic and pedestrian improvements in Stoughton Square. The purpose of the improvements was to provide public incentives for private redevelopment of Stoughton Square. Although the improvements have been implemented to date, the town has currently contracted a consultant to maximize signal coordination and the channeling of downtown traffic.

Based upon the input received at the public forums, it was recommended that Stoughton should concentrate on mitigation efforts to lessen impacts on residential areas of the town as the abutting commercial and industrial areas continue to develop. Specific zoning amendments were recommended in the plan to mitigate traffic impacts on residential areas. These included rezoning the Route 27 (Canton Street) Industrial area (west of the town center) for office use, and rezoning the Industrial area on Route 27 (Park Street), east of the town center, for uses more in scale with the prevailing residential zones in that corridor.

Brockton

Brockton is currently in the process of updating its master plan. As part of the planning process, the city has held visioning sessions that have been summarized in the draft report *Plan Brockton 2008: A Draft for Discussion*. The purpose of Plan Brockton 2008 sessions is to facilitate a planning process that sets a common vision for the future of the City of Brockton that is shared by the city's residents and its public officials. The vision thus far has evolved from two meetings held in the fall of 2007. The report includes a series of broad vision statements, an assessment of the city's primary strengths and challenges, and a number of planning goals and objectives applicable to various aspects of public policy. It is anticipated that the vision and recommendations included will provide a foundation for the master planning process that will be initiated in 2008.

The planning sessions resulted in the development of the following broad-range goal for transportation: To develop an integrated transportation network that improves and expands easy movement within and beyond the city, linking rail, buses, cars, cyclists, and pedestrians. At the same time, pursue public policies that minimize greenhouse gases, reduce per capita energy consumption, and maximize the use of renewable energy.

The following objectives were developed as a means to reach the transportation goal:

- Provide convenient movement of goods and services as well as individuals.
- Strive to become a pedestrian friendly downtown recognizing the importance of a holistic transportation strategy that improves access to and from the downtown for all modes, including cars.



- Develop a transportation ring that ties the downtown development with development at sub-cores and established neighborhood centers, utilizing the existing streets and boulevards as the corridors to create the ring.
- Improve connections between bus routes and job centers.
- Facilitate transportation alternatives such as expanded bus service to offset a growing number of cars per household and reduce single occupancy vehicle commuting.
- Offset demand for downtown parking with fast and frequent downtown shuttle service.
- Promote foot traffic with better sidewalks and walking trails with connected trails along the Salisbury and Trout Brooks.
- Establish biking trails throughout the city to alleviate traffic congestion, improve safety, and promote access to public areas.
- Encourage developers and investors to make on-site provision for bicycles and improvements to broken and incomplete sidewalks and crosswalks.

Whitman

Route 27 in Whitman, just east of the Brockton City Line, is zoned for General Business and Highway Business. A General Residence zone on Route 27 extends east from the vicinity of Oakwood Avenue, where the Business zone ends, to Churchill Avenue, where the Highway Business zone picks up again around the intersection of Route 18. Route 27 is zoned for Residential from Route 18 east to East Avenue, where the General Business District zone for the downtown is in effect. The downtown General Business District extends along Route 27 (South Avenue) east to Franklin Street. Both sides are zoned General Business in this section except for the north side of Route 27 from Colebrook to the railroad tracks, which is zoned Industrial, and for the south side of Route 27 from the railroad tracks to Franklin Street, which is zoned Limited Industrial. Route 27 (Franklin Street) is zoned Residential from South Street southeast to the Hanson Town Line.

In 2005, the Town of Whitman amended its zoning to include a Mixed-Use Overlay District. This district is in effect within the General Business zone, which includes Route 27 in the center of the town and Route 27 eastward to Franklin Street. This overlay district allows residential uses in developments within the business zone and it also allows the conversion of upper floors in existing commercial buildings to residential units.

The land use along Route 27 in Whitman is a mix of residential, commercial, and industrial uses. The industrial uses are clustered around the railroad, in the vicinity of the MBTA Commuter Rail Station. The commercial uses are sparsely spread out along the corridor and exist in clusters at the Route 27/Route 18 intersection and the Whitman center. The land use throughout the Route 27 corridor in Whitman is mostly characterized by residential uses.

According to the *2004 Town of Whitman Master Plan*, Whitman's population is expected to increase by 7.6 percent between 2000 and 2020. The age distribution of the population is such that Whitman's elderly population is expected to grow significantly, and the



number of school age children is expected to remain high, which will magnify the needs for both the youngest and oldest segments of the town's population. Employment in the town is expected to increase slowly between 2000 and 2020. Growth in the area has shifted from historic activities such as manufacturing to retail and service oriented activities. New development has been focused mainly in communities with direct highway access. Sprawl has not become a major issue in Whitman due to its location, lack of direct highway access, and small geographic size.

The 2004 Master Plan process included visioning sessions to survey residents in order to garner an overall vision and specific improvements in the town. The visioning component identified a number of values important to the town's residents:

- The "small town" feel, compactness, and traditional downtown.
- The diversity of the people.
- The Town Park and open spaces.
- The opportunities for walking and recreation.

In addition, some issues that the people perceived as negative included:

- Unattractive signage along the highways and roads.
- Poor town tree maintenance.
- Too many used car lots along highways.

Some of the objectives of the plan included:

- Improved commercial signage.
- Developing a multi-use trail system and improve the sidewalk network.
- Controlling strip commercial development along highways.
- Lessening the impact of traffic on local roads.
- Studying the expansion of the Brockton Area Transit (BAT) service to Whitman.
- Improving parking in the downtown.
- Expanding parking at the MBTA Commuter Rail Station.
- Implementing a pavement management system.
- Resolving the delay and congestion problems at the town center, signalize the Route 27 (Temple Street)/Washington Street/South Street intersection and the Washington Street West Street intersection.

The 2004 *Whitman Master Plan* was supplemented by the *Whitman Community Development Plan*, which was completed by OCPC for the town. The *Whitman Community Development Plan* added to the master plan objectives including:

- Consider revising the General Business District to include mixed development and increasing density around the town center.
- Encourage higher densities around the MBTA Commuter Rail Station by creating a Transit Oriented Development District (TOD).



3.0 FUTURE ROUTE 27 CONDITIONS

3.1 *Planned Improvements*

3.1.1 *Planned Improvements - Stoughton*

Route 27 (Central Street) at West Street

The Route 27 (Central Street)/West Street intersection is a “T” type intersection. This intersection is stop sign controlled on the northbound West Street approach. The existing morning and afternoon peak hour LOS is “F” with extremely long delays and queues on the northbound West Street approach. The volumes on Route 27 (Central Street) during the peak hours are such that the gaps within the traffic stream are insufficient for a vehicle to safely maneuver a left turn from West Street to Route 27 or left from Route 27 to West Street. This intersection is about 550 feet west from the Route 27/Island Street intersection. The Island Street intersection is about 450 feet west from the Route 27 (Canton Street)/Central Street/Tosca Drive intersection. Back-ups and delays from turning movements in and out of these three non-signalized intersections impacts traffic progression overall on Route 27 due to the close proximity of these intersections to one another.



The Route 27 (Central Street)/West Street intersection looking east showing the approximately 110 foot long crosswalk and faded pavement island on the West Street approach.



Although West Street is approximately 24-feet wide, it widens out as it approaches Route 27, which makes for a distance of approximately 110 feet from the stop line to the opposite curb. Consequently, the crosswalk distance for pedestrians is 110 from this point to the Hansen Elementary School at the opposite side of the street. A painted traffic island on the West Street approach channels traffic, which creates a separate left turn and right turn lane on West Street and a separate lane for Central Street westbound left turn traffic entering West Street and Central Street eastbound right turn traffic entering West Street. This painted island increases turning movement conflicts at the intersection.

The West Street intersection, along with the Route 27 (Central Street)/Island Street intersection and the Route 27 (Central Street)/Canton Street/Tosca Drive intersection, was the subject of the *Traffic Impact and Access Study for the Woodbridge Crossing* residential development, prepared by Greenman-Pederson, Inc. in 2006. The plans for Woodbridge Crossing, which was a proposed 192 unit apartment development contained in 7 buildings, called for one of the development driveways to be built directly opposite of West Street, thereby making the Route 27/West Street intersection a four-way signalized intersection. The plans called for two other site drives, one off of Island Street and one off of Mill Street. The Hansen Elementary School is located on at the southwest corner of the West Street/Route 27 intersection. Access to the school is provided via two drives, one off of Central Street and the other off of West Street. *The Traffic Impact and Access Study for Woodbridge Crossing* cited concerns from residents regarding school access and safety. The study recommended that modifications to the school property be investigated and evaluated as part of the Woodbridge Crossing project, although no specific mitigation was offered.

Route 27 (Central Street) at Island Street

The Route 27 (Central Street)/Island Street intersection is located 500 feet east of West Street. This intersection operates at LOS “F” during the morning and afternoon peak hours. This intersection has poor alignment that limits sight distances for turning movements. A faded painted island in the Island Street approach is designed to channel vehicle movements; however, this island increases conflicting movements at the intersection.



The Route 27 (Central Street)/Island Street intersection looking east, showing the faded pavement island on the Island Street approach.

The traffic study for Woodbridge Crossing recommended geometric improvements to the Route 27 (Central Street)/Island Street intersection that included; the widening of Route 27 eastbound to add an exclusive left turn lane, widening Route 27 westbound to provide a through lane and channeled right turn lane, widening Island Street to provide an exclusive left turn lane and channeled right turn lane, and widening Island Street between the proposed site driveway and Route 27 from 20 to 24 feet.

Route 27 at Central Street/Canton Street/Tosca Drive

The Route 27 (Central Street)/Canton Street/Tosca Drive intersection is a poorly aligned, unconventional four-way intersection. The intersection has stop signs on the Canton Street westbound approach, the Central Street southwest approach, and the Tosca Drive southbound approach. This intersection operates under failed forced flow conditions, LOS “F” conditions, during the morning and afternoon peak hours. There are long queues on the Central Street and Canton Street approaches during the peak hour. The study for the Woodbridge Crossing development stated that the development would have little impact on this intersection, and therefore did not offer mitigation for developmental impacts, except to say that that geometric and signalization improvements would be investigated and evaluated.



The Route 27 (Canton Street)/Central Street/Tosca Drive intersection looking east from Central Street.

Route 27 (Canton Street) at School Street/School Avenue

This intersection has been the subject of a number of traffic studies including a *Traffic Signal Warrant Analysis Study* completed by OCPC in September 2005 and a *Functional Operation and Design Report* completed by Edwards and Kelcey (E&K) in 2000. The deficiencies cited in these studies include poor intersection alignment and poor sight distance. This intersection has a high crash rate (2.049 crashes per MEV) and it is subject to failed operating conditions (LOS “F”) in the morning and afternoon peak hours. Although this intersection operates mainly as conventional four-way intersection, with stop signs on the School Street approaches, it is actually a five-way intersection, with School Avenue intersecting from the southeast. The turning movements in and out of School Avenue add greatly to the congestion, driver confusion, and crash exposure for vehicles at the intersection.

The *OCPC Traffic Signal Warrant Analysis Study* and the E&K *Functional Operation and Design Report* concluded that this intersection satisfies the *Manual on Uniform Traffic Control Devices* (MUTCD) warrants for signalization and recommended geometric improvements and full signalization of this intersection. The E&K report also recommended realigning School Avenue to be perpendicular to School Street. This project proposal is currently listed in the *2009-2012 Old Colony Transportation*



Improvement Program as a project requiring MassHighway's Project Review Committee approval.



The Route 27 (Canton Street)/School Street/School Avenue intersection looking northwest from School Avenue.

An additional improvement at this intersection could include the dead-ending of School Avenue. The Route 27 (Canton Street)/School Street intersection would become a conventional four-way intersection with the elimination of access to and from the fifth School Avenue leg, thereby eliminating a great deal of vehicle conflicts and confusion caused by vehicles turning in and out of this street. Access to School Avenue would still be available via Summer Street.

Stoughton Square

Improvements recently completed in Stoughton Square include improved signal timing and phasing, roadway alignment, channelization, right turn restrictions from side streets, and bump-outs and pedestrian crosswalks. These improvements have improved vehicle flow and traffic safety, and have come about based on the conclusions and recommendations from the *Route 138 Corridor Study*, conducted by the Central Transportation Planning Staff in 2002, and the *Functional Design Report Improvements to Stoughton Center* by Bayside Engineering completed in 2003 for a Public Works Economic Development (PWED) grant for the town.



Stoughton Square looking northbound showing pedestrian bump-outs, crosswalks, and upgraded traffic signals.

These improvements to Stoughton Square have enhanced pedestrian amenities, improved traffic flow, and have created a more pedestrian friendly environment. Nevertheless, traffic progression remains problematic through the center with LOS “E” during the morning and afternoon peak hours at the southern end of the square and LOS “F” during the afternoon peak hour at the northern end.

Other concepts that have been discussed and considered for improving traffic flow in Stoughton Square include the rerouting of Route 27 around the center via Turnpike Street to Central Street, or through Stoughton Square north onto Washington Street, currently Route 138, to Central Street. It is expected that both alternatives would reroute left turns at the northern end of Stoughton Square that currently follow Route 27 via Porter Street and Canton Street, thereby removing a large amount of left turn conflicts.

An additional concept proposed during the Stoughton stakeholder meeting suggested creating a bypass road to channel through traffic around the square. One proposal consists of the extension of Capen Street, which is to the east of the square, from Pleasant Street (Route 139) to Washington Street (Route 138). This concept would require right of way takings. The other concept, which is to the west of the square, would parallel the railroad tracks from the intersection of Porter Street and Canton Street south to Wyman Street. These concepts are included in the appendix to this report.



3.1.2 Planned Improvements - Brockton

Route 27 (Reynolds Memorial Highway) at Christy's Drive and Westgate Mall

Route 27 (Reynolds Memorial Highway) provides access from Route 24 to the Westgate Mall from the Route 24 Exit 18 interchange in Brockton. The Route 27 (Reynolds Memorial Highway)/Westgate Mall/Christy's Drive intersection provides the main access to the Westgate Mall. This intersection is a four-way signal controlled intersection with the eastbound and westbound Reynolds Memorial Highway approaches consisting of two through lanes, and exclusive left turn lane, and a channelized right turn lane. The northbound Christy's Drive approach has a left turn lane and a channelized right turn lane. Through traffic from Christy's Drive into the mall is not currently allowed. The Westgate Drive approach consists of a stop controlled approach from the east and a stop controlled approach from the south that converge 50 to 100 feet east of Reynolds Memorial Highway into a signalized approach that has two left turn lanes and a channelized right turn. This configuration does not provide any storage for vehicles exiting the mall, which back up into the Westgate Drive stop controlled intersections. This alignment, along with poor directional signage for vehicles entering the mall, creates complex vehicle movements for vehicles entering and exiting the mall within a confined area. In addition, extensive vehicle queuing on the Reynolds Memorial Highway eastbound left turn lane results in vehicles backing up beyond the storage lane and into the travel lane. This increases the potential for vehicles on Reynolds Memorial Highway eastbound rear-ending vehicles waiting to turn left into the mall.

An evaluation of the intersection, by the engineering consultant firm MDM Transportation Consultants, Inc. completed for the City of Brockton, concluded that there were several significant defects. The *Technical Memorandum of June 8, 2007 for The Route 27 (Reynolds Memorial Highway)/Westgate Mall/Christy's Drive Intersection*, by MDM, cited poor intersection geometry and inefficient traffic signal timing. These defects at the intersection result in extensive vehicle queuing, numerous vehicle conflict points, driver confusion, and a higher than average crash rate.

The MDM technical memorandum includes a number of conceptual improvements including extending the Reynolds Memorial Highway eastbound left turn storage lane (for vehicles turning left into the mall) back to 200 feet, eliminating the right turn channelization on westbound Reynolds Memorial Highway approach into the mall, optimizing signal timing, adding directional signs on Westgate Drive into the mall, reconstructing the Westgate Mall approach to allow for more storage, and making Westgate Drive a one way south of the intersection. The conceptual plans are included in the appendix to this report.

The City of Brockton, the Westgate Mall, MassHighway, and stakeholders are currently working on developing and implementing short term improvements at this intersection that involve redesigning and relocating the intersection islands, along with other associated signage, striping and traffic flow improvements.



Route 27 (Reynolds Memorial Highway)/Westgate Mall/Christy's Drive intersection looking south west from Westgate Drive showing numerous vehicle conflicts.

Route 27 (Reynolds Memorial Highway) at Pleasant Street and Route 27 (Pleasant Street) at West Street

Route 27 (Reynolds Memorial Highway) intersects with Pleasant Street to create a signalized "T" type intersection. Pleasant Street is oriented east-west with the Reynolds Memorial Highway leg skewed to the northwest. Route 27 continues along Pleasant Street eastward toward Brockton Downtown. The Reynolds Memorial Highway approach consists of two left turn lanes, to accommodate the heavy left turn volumes from Reynolds Memorial Highway to Pleasant Street, and a channelized right turn lane. The Pleasant Street eastbound approach consists of a shared through left turn lane. The Route 27 (Pleasant Street) westbound approach consists of two right turn lanes to Reynolds Memorial Highway and a single westbound through lane.

The Route 27 (Reynolds Memorial Highway)/Pleasant Street intersection is located approximately 250 feet west of the Route 27 (Pleasant Street)/West Street intersection in Brockton. The Route 27 (Pleasant Street)/West Street intersection is a "T" type intersection with heavy volumes on the east and west Route 27 approaches as well as the northbound West Street approach. This intersection operates at LOS "E" during the morning peak hour and LOS "F" during the afternoon peak hour. In addition, Westgate Drive, which services the Westgate Mall, intersects on the north side of Route 27



between West Street and Reynolds Memorial Highway. Access to Westgate Drive from the West Street northbound approach is a “dog-leg” movement to the left.

The reconstruction of the two intersections, Route 27 (Reynolds Memorial Highway) at Pleasant Street and Route 27 (Pleasant Street) at West Street, is currently programmed in the *Old Colony 2009-2012 Transportation Improvement Program (TIP)*. This project involves combining these two “T” type signalized intersections into one four-way intersection. It also involves relocating Westgate Drive north, from its intersection with Pleasant Street, to create a new Westgate Drive/Route 27 (Reynolds Memorial Highway) signalized intersection. This project is currently at the 100 percent design stage with construction expected to begin in the spring of 2009. A preliminary design is included in the appendix to this report.



The Route 27 (Reynolds Memorial Highway)/Pleasant Street intersection looking east toward the Route 27 (Pleasant Street)/West Street intersection.

Route 27 (Pleasant Street) at Belair Street and Moraine Street

The reconstruction of this intersection is currently underway. The purpose of the proposed project is to improve traffic operations and safety at the intersection. Belair Street and Moraine Street, which make up the north and south leg of this four-way intersection, are currently off-set, making north-south through movement a “dog-leg” movement to the left. This project consists of realigning these approaches and upgrading the traffic signal. The project will also include reconstructing sidewalks, removing and



resetting existing granite curbing, installing granite curbing, constructing concrete wheel chair ramps, adding pedestrian pushbuttons, installing loop detectors, installing traffic signs, and adding new pavement markings. The construction began in the spring of 2008 and is expected to be complete by the spring of 2009.

Reconstruction of Route 27 (Pleasant Street)

The rehabilitation, resurfacing, and related improvements of Route 27 (Pleasant Street) are included in the *Old Colony TIP 2009-2012* as a regional priority. This project consists of roadway and intersection improvements along Pleasant Street from the intersection with West Street easterly to the intersection with North Main Street, Main Street and Court Street (approx. 6,211 feet). The proposed roadway, geometric, and traffic control improvements are intended to improve vehicular, bicyclist, and pedestrian safety as well as vehicular capacity and traffic operations within the project limits. The proposed design of Pleasant Street will require, but is not limited to: cold plane and overlaying; isolated full-depth pavement widening, removing and resetting of granite curb or installation of new granite curb; sidewalk installation or reconstruction; installation of fully actuated and coordinated traffic signal systems; reconstruction of existing traffic signals; and improved signing and pavement markings.

This project is currently at the 25 percent design stage with construction expected to begin in 2010.

Project specifics include:

- Widening travel lanes to 12 feet with five foot shoulders and seven foot sidewalks on both sides of Pleasant Street. Wheelchair ramps will be constructed in conformance with ADA guidelines with new crosswalks at each intersection at the minor street approaches. The project includes new pavement markings and signage warning motorists of intersecting side streets and pedestrian crossings.
- Prospect Street intersection improvements include realigning Prospect Street to be perpendicular to Pleasant Street, which will reduce the expanse of pavement at the intersection. The curbing on Elmwood Street, which currently intersects Prospect Street at Pleasant Street, will be revised and pavement markings will be added to reinforce the stop sign control for vehicles entering Prospect Street southbound to Pleasant Street. This revision will also give the City of Brockton an area for improved landscaping elements.
- The intersection of Route 27 (Pleasant Street)/Ash Street/North Ash Street will be reconstructed and a traffic signal installed. An exclusive left turn lane will be added to the Pleasant Street eastbound and westbound approaches with a protected and permissive lead phase. This signal will operate under a coordinated closed loop system with the signals at Pleasant Street/Belair Street/Moraine Street and Pleasant Street/Augusta Avenue/Belmont Avenue.
- The installation of a traffic signal is proposed for the Pleasant Street/Augusta Street/Belmont Avenue intersection with a simple two phase operation and actuated pedestrian phase. The signal will be coordinated through a closed loop system with



the Pleasant Street/Moraine Street intersection and the Pleasant Street/Ash Street/North Ash Street intersection.

- This project proposes minor curb modifications, improved lane markings, and improved signage at the Pleasant Street/Spring Street intersection. The Spring Street southbound approach will consist of an exclusive right turn lane and a shared through/left turn lane. Improved signage will reinforce the one-way restriction on Spring Street southbound.
- This project includes box widening of the Pleasant Street/Warren Avenue intersection, and the upgrading of traffic signals. The Pleasant Street westbound left turn lane will be protected via a painted island on the eastbound approach, and the eastbound exclusive right turn lane will be moved further south and a traffic island will be added to this right turn lane.
- This project includes the improvement of signal heads and phasing at the Pleasant Street/Main Street/Court Street intersection to add protected phasing on Main Street and Pleasant Street utilizing turn arrow signal heads. A full upgrade of this intersection may be considered depending upon funding.

This project is estimated to cost \$4,000,000, will use both federal and state funding (STP, CMAQ, and potentially HSIP), and will require some permanent right-of-way takings as Pleasant Street existing right of way layout is 50 feet within the project limits.

A full upgrade of the Route 27 (Pleasant Street)/Main Street/Court Street intersection might be planned depending upon the design and funding status of the Brockton Downtown Central Area Improvement project. In 1999, the *Brockton Area Traffic Study* was completed by OCPC and Rizzo Associates. This study considered changing Brockton's one-way system back to a two-way system to stimulate economic development in the city center.

The study encompassed 20 intersections including the Route 27 (Pleasant Street)/Main Street/Court Street intersection. The recommendations included changing the one-way system on Main Street and Warren Avenue, between Belmont Street and Pleasant Street, and changing the one-way system on Spring Street to a two-way system between Main Street and Pleasant Street. This would impact three intersections in the Route 27 corridor through Brockton Downtown including Route 27 (Pleasant Street) at Warren Avenue, Route 27 (Pleasant Street) at Main Street, and the Route 27 (Pleasant Street)/Spring Street intersection. The total cost of the project is estimated at \$8.5 million dollars. The project funding for design and construction is expected to come from a federal SAFETEA-LU earmark (\$2.0 million federal dollars and \$500,000 state dollars) and the Massachusetts state Bond Bill Chapter 235 Acts of 2000 (\$6.5 million).

3.1.3 Planned Improvements - Whitman

Whitman Town Center

The intersection of Route 27 (Temple Street)/South Avenue and Washington Street at Whitman Center had been the subject of the *Whitman Downtown Traffic Analysis Study* completed by OCPC in January 2002 for the Town of Whitman. This project was undertaken to examine traffic conditions around the town center of Whitman and



specifically to study safety and efficiency of existing traffic controls at two key intersections; the Route 27 (Temple Street)/South Avenue/Washington Street intersection, and the Washington Street/Park Avenue/West Street intersection. It was completed in response to a request from the Town of Whitman, which had expressed concern about downtown traffic to the Town Council. The objective of the study was to analyze existing traffic conditions and traffic control devices, and to evaluate alternatives to existing control devices. The study concluded the following regarding existing traffic conditions at the Route 27 (Temple Street)/South Avenue/Washington Street intersection:

- Washington Street south of Route 27 (northbound traffic) is either at or above capacity during peak travel times.
- Delays on all four approaches are excessive.
- All approaches receive a failing level of service.

Based on the study analyses, this intersection satisfies the minimum warrants required in the *Manual on Uniform Traffic Control Devices* (MUTCD) for signalization. However, mere satisfaction of one or more warrants does not mean that signals should be installed; rather it means that signals could be installed.

The *Whitman Circulation Study*, which was undertaken by (OCPC) in 2003 to analyze the overall transportation circulation system in the Town of Whitman, reiterated the findings and conclusions in the *Whitman Downtown Traffic Analysis Study*, regarding the installation of traffic signals at Whitman Center to relieve congestion.

OCPC held two stakeholder meetings in Whitman in its public outreach process for this Route 27 Corridor Study, one with the Mutual Bank located at the Corner of Route 27 (Temple Street) and Washington Street on March 18, 2008, and one at the Whitman Town Hall on May 21, 2008. There were a number of issues discussed at these meetings; however, the overwhelming consensus among the participants was that the small town character and pedestrian friendly environment in Whitman Center should take precedence over the installation of traffic signals at the town center, and that signalization is not desired. Issues cited by stake holders at these meetings concerning Whitman Center include:

- Improve alternative transportation, including the establishment of Transportation Oriented Development (TOD), to reduce downtown trips, increase pedestrian activity, and improve economic viability.
- Institute traffic calming measures to enhance the pedestrian friendly environment.
- Preserve Whitman's community character.
- Expand parking for Whitman's MBTA Commuter Rail Station.



Route 27 (Temple Street)/South Avenue/Washington Street intersection at Whitman Center looking north from the Washington Street approach.

Route 27 (South Avenue) at Pleasant Street/Franklin Street

This intersection had been the subject of a traffic study (technical memorandum) completed by OCPC at the request of the town in January 2008. The town had cited safety concerns at the intersection due to the number and severity of crashes. The study included traffic counts (daily counts and peak hour intersection turning movement counts); peak hour level-of-service operations analyses, crash data analyses, all-way stop, and signal warrant analyses.

The Old Colony Planning Council identified a number of potential recommendations for safety and operational improvements, based on the LOS analyses and the warrant analyses. Improvement options were divided into short-term, interim, less expensive projects, and long-term projects that require reconstruction and high levels of funding. These included:

- Add flashing beacons (red for the stop controlled approaches and yellow for the approaches with the right of way), to emphasize the existing traffic controls, along with improved pavement markings to properly channel vehicles, show lane use, and emphasize the stop control on the northbound and southbound approaches.
- The intersection satisfies the MUTCD warrant for installing a stop sign (all-way stop) on all four approaches; however, the LOS analyses show that the Franklin Street



northbound approach and Pleasant Street southbound approach will experience LOS 'F' conditions during the afternoon peak hour with the four-way stop control.

- Install traffic signals at this location, and reconstruct and re-align to reduce or eliminate the intersection skew for safe, efficient traffic flow. The warrant analyses showed that this intersection satisfies the warrants for signal operation in conformance with the MUTCD. A traffic signal installation project, with reconstruction and re-alignment, will bring higher costs and a longer period of implementation in order to obtain programming of federal and state funds.
- Safety enhancements at the intersection should include improvements in sight distances, upgrades in pavement markings, and upgrades in signing for proper speeds and advance warning for traffic. These improvements will be needed with all recommended options (all-way stop, traffic signal.)
- It was recommended that immediate and strict enforcement of the posted speed limits be implemented in an effort to reduce approach speeds.

The town has decided to move forward with adding flashing beacons (red for the stop controlled approaches and yellow for the approaches with the right of way), to emphasize the existing traffic controls. OCPC is available to the town for future needs to monitor the crash experience and peak hour congestion to discern the effects of these improvements.



South Avenue/Franklin Street/Pleasant Street intersection looking north from the Franklin Street approach.



3.2 *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 Old Colony Region shows that there has been rapid traffic growth in some corridors and little or no growth on other highways. Those areas showing traffic growth reflect the impact of retail development within specific highway corridors. An annual growth rate of 1.02 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. This average annual growth rate is based on the average growth rate calculated in the *Old Colony Planning Council Traffic Volumes Report 2007*.

3.3 *Future Traffic Operations*

Level-of-service analyses (LOS) were completed for the study area intersections to determine the operating conditions that are expected to occur during the morning and afternoon peak hours under future operating conditions. Table 4 shows the signalized and un-signalized LOS for the Route 27 study area intersections for future peak hour conditions. Congestion at intersections in Table 4 (LOS “E” and “F”) is shown in shaded blocks.

Level-of-service analyses (LOS) were completed for those study area intersections with planned improvements in place to determine the impact of planned improvements on future peak hour LOS. Table 5 shows the improvements in levels-of-service due to recommendations for study area intersection made prior to the Route 27 Corridor Study.

Table 5 shows increases in peak LOS at the study area intersections for 2013 with improvements in place over 2013 with no improvements, except for the Route 27 (South Avenue)/Pleasant Street & Franklin Street (Route 27) intersection. The planned improvements for this intersection include adding a flashing red and yellow beacon. This intersection will remain un-signalized under future 2013 conditions with improvements; therefore, changes in LOS will not occur, although the flashing beacon will improve motorist awareness of the stop control, which is expected to cut down on cross-movement type crashes.

**Table 4 Future 2013 Intersection Levels-of-Service**

ID	Community	Intersection	Traffic Control	AM LOS	PM LOS
1	Stoughton	Central Street (Route 27) & West Street	Stop Sign	F	F
2	Stoughton	Central Street (Route 27) & Island Street	Stop Sign	F	F
3	Stoughton	Canton Street (Route 27) & Central Street/Tosca Drive	Stop Sign	F	F
4	Stoughton	Canton St (Route 27) & School St/School Avenue	Stop Sign	F	F
5	Stoughton	Stoughton Center (Northern End)	Signal	B	F
6	Stoughton	Stoughton Center (Southern End)	Signal	E	E
7	Stoughton	Park Street (Route 27) & Sumner Street	Stop Sign	F	F
8	Stoughton	Park Street (Route 27) & Prospect Street	Stop Sign	E	F
9	Stoughton	Park Street (Route 27) & Ash Street	Stop Sign	D	F
10	Stoughton	Park Street (Route 27) & Turnpike Street	Stop Sign	F	F
11	Stoughton	Park Street (Route 27) & South Street	Stop Sign	F	F
12	Stoughton	Park Street (Route 27) & R and K Plaza	Signal	C	C
13	Brockton	North Pearl Street (Route 27) & Oak Street	Signal	C	C
14	Brockton	North Pearl St (Route 27) at Good Samaritan	Signal	A	B
15	Brockton	North Pearl Street (Route 27) & Reynolds Memorial Highway (Route 27)	Signal	C	D
16	Brockton	Reynolds Memorial Highway (Route 27) & Westgate Drive/Christys Drive	Signal	C	D
17	Brockton	Reynolds Memorial Highway (Route 27) & Pleasant Street	Signal	C	E
18	Brockton	Pleasant Street (Route 27) & West Street	Signal	E	F
19	Brockton	Pleasant Street (Route 27) & Prospect Street	Stop Sign	F	F
20	Brockton	Pleasant Street (Route 27) & Belair/Moraine Street	Signal	C	E
21	Brockton	Pleasant Street (Route 27) & Ash Street	Stop Sign	F	F
22	Brockton	Pleasant Street (Route 27) & Belmont Avenue/Augusta Avenue	Stop Sign	F	F
23	Brockton	Pleasant Street (Route 27) & Spring Street	Stop Sign	C	F
24	Brockton	Pleasant Street (Route 27) at Warren Street	Signal	C	C
25	Brockton	Pleasant St (Route 27) & Main Street/Court Street	Signal	C	B
26	Brockton	Court St (Route 27) & Montello Street (Route 28)	Signal	C	C
27	Brockton	Court Street (Route 27) & Commercial Street	Signal	B	B
28	Brockton	Commercial Street (Route 27) & Centre Street (Route 123)	Signal	B	C
29	Brockton	Commercial Street (Route 27) & School Street	Signal	B	B
30	Brockton	Commercial Street (Route 27) & Crescent Street (Route 27)	Signal	B	B
31	Brockton	Crescent Street (Route 27) & Plymouth Street	Stop Sign	F	F



Table 4 Future 2013 Intersection Levels-of-Service

ID	Community	Intersection	Traffic Control	AM LOS	PM LOS
32	Brockton	Crescent Street (Route 27) & Summer Street	Signal	B	B
33	Brockton	Crescent Street (Route 27) & Lyman Street	Signal	C	F
34	Brockton	Crescent Street (Route 27) & Wendell Avenue/Crescent Avenue	Signal	B	B
35	Brockton	Crescent Street (Route 27) & Home Depot Shopping Plaza	Signal	C	C
36	Brockton	Crescent Street (Route 27) & Quincy Street/Massasoit	Signal	F	F
37	Brockton	Crescent Street (Route 27) & Alger Street (Route 14)	Signal	D	B
38	Whitman	Temple Street (Route 27) & High Street	Signal	C	F
39	Whitman	Temple Street (Route 27) & Bedford Street (Route 18)	Signal	B	C
40	Whitman	Temple Street (Route 27) & West Street	Stop Sign	C	F
41	Whitman	Temple Street (Route 27) & Beulah Street	Stop Sign	C	D
42	Whitman	Temple Street (Route 27) at Washington Street - Whitman Center	Stop Sign	F	F
43	Whitman	South Avenue (Route 27) & Broad Street	Stop Sign	B	D
44	Whitman	South Avenue (Route 27) & Park Avenue	Stop Sign	C	F
45	Whitman	South Avenue (Route 27) & Commercial Street	Stop Sign	C	E
46	Whitman	South Avenue (Route 27) & Raynor Avenue	Stop Sign	D	F
47	Whitman	South Avenue (Route 27) & Pleasant Street	Stop Sign	B	B
48	Whitman	South Avenue (Route 27)/Pleasant St & Franklin Street (Route 27)	Stop Sign	C	F
49	Whitman	Franklin Street Route 27 at Winter Street	Stop Sign	A	B
50	E Bridgewater	Franklin Street Route 27 at Route 14	Signal	B	C

Two intersections in Table 5 in Stoughton will become signalized under 2013 conditions with improvements, which will improve the LOS from failing to acceptable levels. The LOS at the signalized Reynolds Memorial Highway (Route 27) & Westgate Drive/Christys Drive intersection in Brockton will remain the same from 2013 with no improvements to 2013 LOS conditions, because the improvements to this intersection mainly include reconfiguring the Westgate Mall approach, which currently causes motorist confusion and cross-movement crashes.



Table 5 Future 2013 Intersection Levels-of-Service with Planned Improvements

ID	Community	Intersection	2013 AM LOS	2013 PM LOS	2013 AM LOS With Improvements	2013 PM LOS With Improvements
1	Stoughton	Central Street (Route 27) & West Street	F	F	D	D
4	Stoughton	Canton St (Route 27) & School St/School Ave	F	F	B	B
16	Brockton	Reynolds Memorial Highway (Route 27) & Westgate Drive/Christys Drive	C	D	C	D
17	Brockton	Reynolds Memorial Highway (Route 27) & Pleasant Street	C	E	C	C
18	Brockton	Pleasant Street (Route 27) & West Street	E	F	C	C
20	Brockton	Pleasant Street (Route 27) & Belair/Moraine St	C	E	C	C
21	Brockton	Pleasant Street (Route 27) & Ash Street	F	F	A	C
22	Brockton	Pleasant Street (Route 27) & Belmont Avenue/Augusta Avenue	F	F	A	B
48	Whitman	Route 27 (South Avenue)/Pleasant St & Franklin Street (Route 27)	C	F	C	F

Two signalized intersections in Brockton; Route 27 (Reynolds Memorial Highway)/Pleasant Street, and Route 27 (Pleasant Street) at West Street, will be merged into one four-way signalized intersection. The LOS will be improved from LOS “E” and “F” to LOS “C” at this location. The signalized Route 27 (Pleasant Street)/Belair/Moraine Street intersection will improve from LOS “C” and “E” to LOS “C” and “C” for the morning and afternoon peak hours with the improved alignment slated for this intersection. Two un-signalized intersections within the Route 27 (Pleasant Street) corridor; the Route 27 (Pleasant Street)Ash Street intersection and the Route 27 (Pleasant Street)Belmont Street/Augusta Street intersection will improve from failed LOS “F” peak hour conditions to acceptable levels at LOS “A”, “B”, and “C” with the installation of traffic signals under 2013 with improvements scenario.

4.0 RECOMMENDATIONS

4.1 Overall Corridor Improvements

As previously described, road improvements are planned at a number of specific locations within the Route 27 corridor. However, there is no plan to improve the overall safety, physical conditions, and traffic operations for the entire corridor for motor vehicle traffic and other users. The study area communities should work together with state agencies and private developers to implement-short term and long-term improvements that address the cumulative impacts of growth along the Route 27 corridor.



The following overall improvements were identified in regards to traffic, pedestrian, and bicyclist safety and operation in the Route 27 corridor:

Short term improvements:

- Pavement marking revision and re-striping along the Route 27 corridor (centerlines, fog lines, side street stop lines.)
- New and revised signing upgraded to meet MUTCD reflectivity standards.
- Replace missing speed limit signs.
- Roadway sweeping.
- Improve lighting along the road and at intersections.
- Clear vegetation to improve sight distances at intersections and driveways, and to provide recovery areas for lane departures.
- Relocate and or remove fixed objects (utility poles, trees, etc.) that are too close to travel lanes and present lane departure hazards.
- Install post mounted curve delineators and chevrons.
- Enhance speed management by providing immediate and strict speed enforcement.
- Traffic signal updates and modifications (improvements to equipment, coordination, and timing and phasing.)
- Lane use revisions.

Long term improvements:

- Rehabilitate, repave, and/or reconstruct the Route 27 corridor.
- Implement construction and/or operational improvements, such as adding or expanding shoulders, straightening dangerous curves, and realigning and improving hazardous intersections.
- Realign intersections and remove obstacles to improve sight distances at intersections.
- Request that OCPC routinely monitor traffic conditions on Route 27 as part of its regional growth monitoring efforts.
- Study area communities should continue to participate in the Joint Transportation Committee and Metropolitan Planning Organization.
- Continue to utilize pavement management system.
- Construct, reconstruct, and replace sidewalks in conformance with the Americans with Disabilities Act.

4.2 Recommended Improvements - Stoughton

Route 27 Central Street at West Street

As previously stated, West Street widens out as it approaches Route 27, which makes for a distance of approximately 110 feet across West Street from curb to curb. Consequently, the crosswalk distance for pedestrians is 110 across West Street to the Hansen Elementary School. Currently, a painted traffic island on the West Street approach channels traffic, which creates a separate left turn and right turn lane on West Street and a separate lane for Central Street westbound left turn traffic entering West Street and Central Street eastbound right turn traffic entering West Street. This painted island increases turning movement conflicts at the intersection and offers no refuge for



pedestrians crossing the 110 feet from curb to curb across West Street. The mitigation for the Woodbridge Crossing development called for the installation of signals at this intersection. It is recommended, along with the installation of signals, that a refuge island be installed along with pedestrian control actuation to enhance pedestrian safety at this intersection. A signal warrant for this intersection is included in the appendix to this report.

Route 27 (Central Street) at Canton Street/Tosca Drive

As previously stated in this report, the traffic study for the Woodbridge Crossing development recommended a number of improvements for mitigation of impacts to intersections within the Route 27 corridor; however, it did not address the need for safety improvements and improvements to relieve congestion at the Route 27 (Central Street)/Canton Street/Tosca Drive intersection. Signalization of the Route 27 (Central Street)/Canton Street/Tosca Drive intersection, will improve safety and increase the LOS from “F” to “D”. The signal will also create gaps in the through traffic for vehicles accessing Island Street and West Street from Route 27. The signal warrant analysis for this intersection is included in the appendix to this report

Route 27 (Canton Street) at School Street/School Avenue

As previously stated, an improvement project for the Route 27 (Canton Street)/School Street/School Avenue intersection is currently listed in the *2009-2012 Old Colony Transportation Improvement Program* as a project requiring MassHighway’s Project Review Committee approval. This project includes realigning the intersection and installing traffic signals. An additional improvement to this proposal could include the dead-ending of School Avenue at this intersection. This would remove the fifth leg of the intersection and make the intersection a conventional four-way, thereby removing turning movement conflicts and vehicles hug-up inside the intersection during the peak hours that are seeking access to and from this fifth leg. Access to School Avenue would still be available via Summer Street.

Route 27 at the Stoughton MBTA Commuter Rail Station

The commuter rail station presents an important amenity to the town, offering alternative transportation; however, the train also stops on the at-grade track across Railroad Avenue and Route 27 in Stoughton Center. This blocks traffic, which adds to the congestion especially during the morning and afternoon peak hours. In addition, pedestrians are also crossing the tracks on Route 27 and Railroad Avenue putting them in danger of being hit by trains. Redesigning the station and moving the platforms would eliminate this hazard and help improve traffic flow during the peak hours.

Route 27 (Park Street) from Sumner Street to South Street

This section of Route 27 experiences heavy volumes, especially during the morning and afternoon peak hours, as well as high speeds. Route 27 in the vicinity of Sumner Street, just east of the downtown, is residential in nature; however, as Route 27 approaches the Brockton City Line, there are more retail and commercial uses along the side of the road. A major problem along this section of Route 27 is that the flow of Route 27 traffic contains few sufficient gaps that allow side street traffic to enter the main street flow



safely. The result is poor or failed LOS for side street intersections. The installation of a traffic signal is an option that can ameliorate the situation where few sufficient gaps are available for entrance to and from the side streets. Signal warrant analyses were conducted for the five study area intersections in this section of Route 27 (Park Street) in Stoughton. Table 6 summarizes the warrant analyses, which are included in the appendix to this report.

Table 6 Warrant Analysis Route 27 (Park Street) Intersections - Stoughton

ID	Community	Intersection	Signal Warrant	2013 LOS	2013 LOS	2013 AM LOS With Signal	2013 PM LOS With Signal
7	Stoughton	Park Street (Route 27) & Sumner Street	Satisfied	F	F	C	F
8	Stoughton	Park Street (Route 27) & Prospect Street	Satisfied	E	F	B	B
9	Stoughton	Park Street (Route 27) & Ash Street	Satisfied	D	F	A	C
10	Stoughton	Park Street (Route 27) & Turnpike Street	Satisfied	F	F	B	D
11	Stoughton	Park Street (Route 27) & South Street	Not Satisfied	F	F	Not applicable	Not applicable

4.3 Recommended Improvements - Brockton

Route 27 (Reynolds Memorial Highway) at Christy’s Drive and Westgate Mall

Although the City of Brockton, the Westgate Mall, and MassHighway, are currently working on developing and implementing short term improvements at this intersection, which mostly involve improvements to intersection islands at the Mall approach, there are other necessary improvements that need to be addressed. The Christy’s Drive eastbound approach does not have a straight through movement into the Westgate Mall. Currently, vehicle movements from Christy’s Drive must turn left or right onto Route 27 (Reynolds Memorial Highway.) Further, the southbound left turn storage lane on Route 27 (Reynolds Memorial Highway) is not long enough and is consistently back beyond the storage lane into the travel lane, especially during weekday peak hours and the Saturday and Sunday peak hours, due to heavy movement into the mall.

Route 27 (Commercial Street) from Centre Street to Perkins Street

Route 27 (Commercial Street) has recently been repaved next to the BAT Intermodal Centre; however, the section from Centre Street to Perkins remains in poor condition. In addition to the need for repaving this section, there is also a need for re-striping lanes and crosswalks and fixing pedestrian signals. Some of these pedestrian signals failed during testing by staff in the field. This section has significant pedestrian traffic because the US Post Office, the BAT Intermodal Centre, and the MBTA Commuter Rail Station are all located on Commercial Street.

*Route 27 (Crescent Street) Perkins Street to Summer Street*

Re-striping is recommended for this section of Route 27 to improve traffic and pedestrian safety and channelize traffic in the vicinity of the Plouffe School. It is recommended that the Plouffe School partner with the Safe Routes to School program with Mass Rides in order to improve pedestrian safety and to cut down on vehicle trips to and from the school. A signal warrant analysis, conducted in conformance with the *Manual On Uniform Traffic Control Devices (MUTCD)*, for the Route 27 Crescent Street/Plymouth Street intersection shows that a traffic signal is warranted for this intersection. A signal at this intersection would improve safety and overall LOS, which is currently at LOS “F” conditions, to LOS “C” and “D” in the morning and afternoon peak hours, respectively.

Route 27 (Crescent Street) at Summer Street

Although the existing and future peak hour levels-of-service are at acceptable levels, and the crash analysis shows that the number and crash rate are below average, an opportunity exists at this location to greatly improve the alignment and cut down on conflicts for turning vehicles. Currently, the driveway to the Plouffe Elementary school is in close proximity where vehicles turning in and out of the school interfere with traffic operation at the intersection. This driveway could be moved approximately 50 feet to the east directly opposite Summer Street to create a conventional four-way intersection. Currently, the driveway does not come under the control of the signal at the intersection. The signal equipment should be upgraded to include the school drive in the timing and phasing of signal operations.

Crescent Street Route 27 at Quincy Street and Massasoit Boulevard

This intersection represents a major bottleneck within the Route 27 corridor. The average daily traffic volumes are high on Quincy Street as well as on Route 27 (Crescent Street). The peak hour turning movement volumes at this intersection are also high, with existing LOS (“F”) forced flow operations during the morning peak hour, the afternoon peak hour, and the mid-day peak. The northbound approach from Massasoit Community College does not have high daily volumes; however, the volumes during the peak hours to and from the college, especially the morning and mid-day peak, are high and the intersection operates under failed LOS (“F”) conditions. The mid-day peak hour is characterized with extremely long delays and queues that have traffic backed up along the Massasoit Boulevard back into the campus, blocking egress to the school’s parking lots. The morning and afternoon peak hours experience heavy volumes on the Route 27 and Quincy Street approaches to the intersection. These heavy turning movement volumes lead to LOS “F” operations.

In addition to forced flow traffic operations, this intersection experiences a higher than average crash rate. The crashes at this intersection are overwhelmingly of the cross-movement type, and a high percentage of the crashes involve personal injury (44 percent.) There were 17 cross-movement crashes, 8 rear-end crashes, one head-on, crash, one crash involving a pedestrian, one ran off the road crash, and four crashes with the types of crash not reported within the three year study period. The high incident of cross-movement crashes is of concern because cross-movement crashes lead to higher incidences of personal injury and fatalities.



Although no improvements are currently planned for the intersection of Route 27 (Crescent Street)/Quincy Street/Massasoit Boulevard, the administration of Massasoit College expressed an interest in participating in the study Route 27 Corridor Study process and identifying safety and congestion related improvements at its main entrance at Route 27. The college was identified as a study stakeholder during the public outreach, and volunteered to participate in the study committee. A stakeholders meeting was held on June 10, 2008 at Massasoit Community College where administrator's identified safety and operational concerns at this intersection for pedestrians and bicyclists, as well as for motor vehicles. The College has been traditionally a commuter school, and the campus was established as an automobile oriented development; however, more recently, the administration has recognized the need and advantages for reducing vehicle traffic to and from the campus, and has partnered with MassRides to establish demand management strategies. In addition, the administration identified the need for establishing emergency entrances and exits to and from the campus, and recognized the need for enhanced pedestrian and bicycle access (and safety) as viable alternative commuter modes.

Despite the efforts to reduce vehicle trips, the intersection of Route 27 (Crescent Street)/Quincy Street/Massasoit Boulevard remains problematic in regards to safety and peak hour operations. Several issues and improvement initiatives were discussed at the June stakeholder meeting. Possible short term and long term fixes were discussed. These include:

Upgrading the traffic signals to include protected phases for critical movements, re-stripe faded pavement markings. Currently, the traffic signal operates on a fixed 80 second cycle, with no protected phases for left turning vehicles. The traffic signal is currently coordinated with the traffic signals upstream at the Home Depot intersection and the Caffrey Towers apartments. Currently, heavy volumes cause long delays for motorists waiting to turn left on all the approaches, so that they either fail to yield the right of way to on-coming traffic, or they take the turn within an insufficient gap between on-coming vehicles. Lead/lag split phasing could be used without adding storage lanes to provide left-turn protected phasing. The Massasoit administration also discussed upgrading the signals to include pre-emption by emergency vehicles.

Employ signal coordination between the Quincy Street/Route 27 (Crescent Street)/Massasoit Boulevard intersection and the Route 123 (Centre Street)/Quincy Street intersection. At the stakeholder meeting, it was noted that the queues on Quincy Street at the Route 123 (Centre Street) intersection have been observed backing up to the Route 27 (Crescent Street)/Quincy Street/Massasoit Boulevard intersection, causing delays at Massasoit Drive. Coordinating the signals will clear traffic upstream of the Massasoit Boulevard and enhance operation at the Massasoit intersection.



Widen the approaches at the Route 27 (Crescent Street)/Quincy Drive/Massasoit Boulevard intersection, upgrade traffic signals, signal timing, and signal phasing. Improve pedestrian phasing and actuation, and add sidewalks to Route 27 and Massasoit Boulevard.

Reconstructing the intersection to widen the approaches and adding left turn and or right turn storage lanes and sidewalks where warranted would be part of a long term improvement project that would require right-of-way takings. Currently, the right-of-way on Crescent Street varies between 50 and 55 feet, which might not be sufficient for a four-lane cross-section plus sidewalks on both sides of the road without right-of-way takings.

According to volume 12 of the National Cooperative Highway Research Program (*NCHRP Report 500: A Guide for Reducing Collisions at Signalized Intersections*), the objective of reducing the frequency and severity of intersection conflicts at signalized intersection, can be met using the following proven strategies:

- Employ multiphase signal operation.
- Optimize clearance intervals.
- Employ signal coordination.
- Employ emergency vehicle preemption.

The participants in the Massasoit Community College stakeholder meeting were in agreement that operation and safety improvements at this intersection are priorities for the Route 27 corridor and the future of Massasoit Community College. The improvements discussed for this intersection at the meeting paralleled the strategies outlined in Volume 12 of the NCHRP Report 500 Series, to meet the objectives of improvements at signalized intersections. In addition, Massasoit Community College would also add improvements for safe efficient pedestrian and bicycle access through the intersection.

4.4 Recommended Improvements - Whitman

Route 27 (Temple Street) at Route 18 (Bedford Street)

It is recommended that OCPC monitor the intersection of Route 27 at Route 18 as the phased plan for the development of Southfield (South Weymouth Naval Air Station) is implemented, and work with stakeholders to identify and implement necessary improvements.

Whitman Center

Although a number of previous studies that focused on traffic operations in the center recommended installing traffic signals at the Route 27 (Temple Street)/South Avenue/Washington Street intersection, the overwhelming consensus among Whitman stakeholders was that the small town character and pedestrian traffic were the priorities in which the town should focus their efforts. The stakeholders at OCPC's public outreach meetings in Whitman emphasized the fact that at this four-way stop, although at LOS "F" during the morning and afternoon peak hours, the queues move sufficiently as most motorists are familiar with the intersection, and signalization was not required. In addition, there are alternative routes around the center, such as Route 14, that most



motorists are aware. The stakeholders in Whitman were in consensus for the need to enhance alternative modes by encouraging Transit Oriented Development (TOD) to support the economic viability of the town center, maintain the small town character, and reduce traffic congestion within the center.

Route 27 (South Avenue)/Pleasant Street/Franklin Street

It is recommended that the town move forward with their plans for adding flashing beacons (red for the stop controlled approaches and yellow for the approaches with the right of way), to emphasize the existing traffic controls at this intersection. It is also recommended that OCPC monitor the crash experience and peak hour congestion to discern the effects of these improvements. This intersection was the focus of a previous study conducted by OCPC. The intersection satisfies MUTCD warrants for a traffic signal. Other options discussed in the study include the construction of a roundabout at this location. The town has decided to pursue the installation of flashing beacons.

4.5 Recommended Improvements – East Bridgewater

Route 27 at Route 14

This intersection was recently reconstructed and a traffic signal was installed; however, it is recommended that OCPC continue to monitor traffic congestion and safety at this location to measure the performance of recent improvements.

4.6 Future Levels-of-Service with Recommended Improvements

Table 7 shows the improvements in levels-of-service expected due to improvements recommended specifically in this study.

Table 7 Future 2013 Intersection LOS with Recommendations

ID	Community	Intersection	2013 AM LOS	2013 PM LOS	2013 AM LOS With Recommended Improvements	2013 PM LOS With Recommended Improvements
1	Stoughton	Central Street (Route 27) & West Street	F	F	D	D
3	Stoughton	Route 27 (Canton Street) & Central Street/Tosca Drive	F	F	D	D
31	Brockton	Route 27 (Crescent Street) & Plymouth Street	F	F	B	B
33	Brockton	Route 27 (Crescent Street) & Summer Street/Ploufe School	B	B	B	C
36	Brockton	Route 27 (Crescent Street) & Quincy Street/Massasoit Drive	F	F	C	D

Table 7 shows increases in LOS for year 2013 at the un-signalized Route 27 (Canton Street) & Central Street/Tosca Drive intersection from failed conditions, LOS “F” under un-signalized conditions, to acceptable levels, LOS “D” with signalization. Improvements at the signalized Route 27 (Crescent Street)/Summer Street consist of the re-alignment of the Ploufe School Drive opposite Summer Street to form a conventional four-way intersection. This change does not result in improvement of the LOS, in fact



the LOS decreases from LOS “B” to “C” in the afternoon peak. The realignment of this intersection will impact turning movement conflicts and is not reflected in the LOS results.

Recommended improvement to the Route 27 (Crescent Street)/Quincy Street/Massasoit Boulevard intersection include widening the approaches, adding left turn and right turn storage lanes to the Massasoit Boulevard northbound approach, adding a left turn storage lane to the Route 27 westbound approach, and adding protected phases to the signal phasing. Table 7 shows that these recommended improvements will increase the LOS from failed LOS “F” conditions to acceptable LOS “C” and “D” conditions for the morning and afternoon peak hours. All planned and recommended improvements are summarized in Table 8 and shown in Figure 7 for the Route 27 corridor.

Table 8 Route 27 Corridor Planned and Recommended Improvement Projects

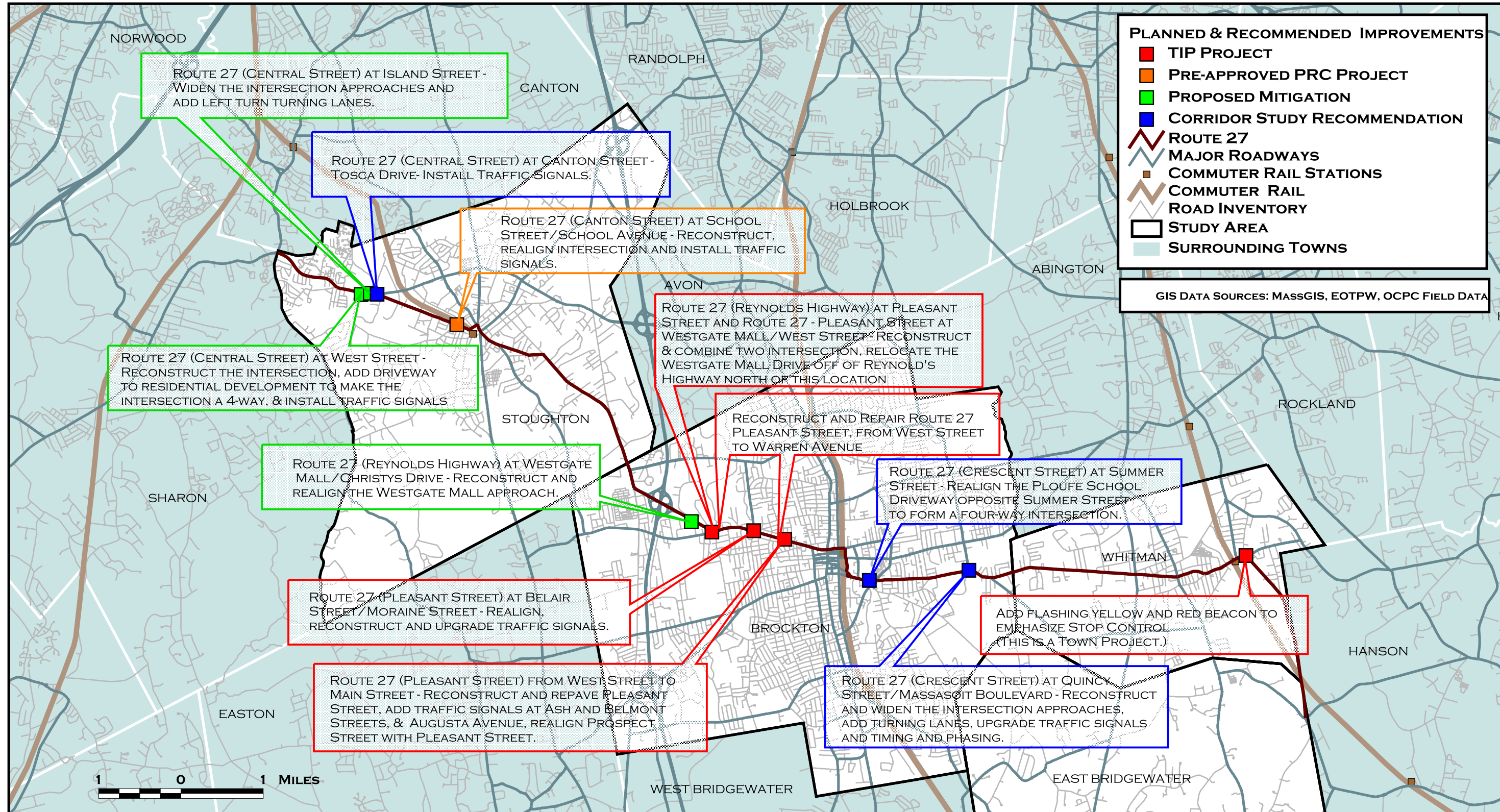
Community	Improvement Status	Location and Description	Jurisdiction
Stoughton	Recommended mitigation for Woodbridge Commons	Route 27 (Central Street) at West Street – Reconstruct to add driveway (making the intersection a four-way) and adding traffic signals. Add refuge island for pedestrian safety.	Stoughton
Stoughton	Recommended mitigation for Woodbridge Commons	Route 27 (Central Street) at Island Street – Widen eastbound to add an exclusive left turn lane, widen Route 27 westbound to provide a through lane and channeled right turn lane, widen Island Street to provide an exclusive left turn lane and channeled right turn land, and widen Island Street between the proposed site driveway and Route 27 from 20 to 24 feet.	Stoughton
Stoughton	Route 27 Corridor Study Recommendation	Route 27 (Central Street) at Canton Street and Tosca Drive – Install Traffic Signals.	Stoughton
Stoughton	TIP project requiring project review approval	Route 27 (Canton Street) at School Street and School Avenue – realign intersection and install traffic signals.	Stoughton
Stoughton	Route 27 Corridor Study Recommendation	Route 27 (Park Street) From Sumner Street to South Street - The installation of a traffic signal is an option that can improve safety and ameliorate the situation where few sufficient gaps are available for entrance to and from the side streets. Four intersections along Park Street satisfy the MUTCD signal warrant: Park Street at Sumner Street, Park Street at Prospect Street, Park Street at Ash Street, and Park Street at Turnpike Street.	Stoughton
Brockton	Recommended mitigation for proposed movie theater at mall	Route 27 (Reynolds Memorial Highway) at Westgate Mall – Reconstruct and realign Westgate Mall Drive.	Brockton
Brockton	TIP project at 100% design	Route 27 (Reynolds Memorial Highway) at Pleasant Street and Route 27 (Pleasant Street at West Street) – Reconstruct, realign, and combine both intersections. Relocate Westgate Mall entrance off of Reynolds Memorial Highway.	Brockton

ROUTE 27 CORRIDOR STUDY

PLANNED & RECOMMENDED IMPROVEMENTS



FIGURE 7





**Table 8 Route 27 Corridor Planned and Recommended Improvement Projects
(continued)**

Community	Improvement Status	Location and Description	Jurisdiction
Brockton	Under Construction	Route 27 (Pleasant Street) at Belair and Moraine Streets – Reconstruct and realign Belair and Moraine Streets, upgrade traffic signals.	Brockton
Brockton	TIP project at 25 % design	Route 27 (Pleasant Street) from West Street to Main Street – Reconstruct and repave Route 27, realign Prospect Street intersection with Route 27, install traffic signals at Route 27/Ash Street intersection and Route 27/Belmont Street/Augusta Avenue intersection.	Brockton
Brockton	Route 27 Corridor Study Recommendation	Route 27 (Crescent Street) at Plymouth Street – Install Traffic Signals with pedestrian actuation.	Brockton
Brockton	Route 27 Corridor Study Recommendation	Route 27 (Crescent Street) at Summer Street – Realign the Plouffe School Drive opposite Summer Street to create a four way intersection.	Brockton
Brockton	Route 27 Corridor Study Recommendation	Route 27 (Crescent Street) at Quincy Street/Massasoit Drive – Widen approached, add left turn storage lanes, add sidewalks, and upgrade traffic signal, timing and phasing.	Brockton
Whitman	Town project planned for implementation	Route 27 (South Avenue) at Pleasant Street and Franklin Street – Add flashing yellow and red beacons to emphasize stop control.	Whitman

5.0 Project Development and Funding

The implementation of projects includes taking transportation improvements from the concept stage through to design and construction. Funding is an essential element in ensuring the implementation of recommended improvements. The *MassHighway Project Development and Design Guide* explains the project development process in Massachusetts and design standards for transportation projects. The MassHighway project development process consists of eight steps:

- I. Problem/Need/Opportunity Identification (A Project Need form is submitted to MassHighway)
- II. Planning (A project planning report is completed)
- III. Project Initiation (A Project Initiation Form is submitted to MassHighway)
 - Identification of Appropriate Funding
 - Definition of Appropriate Next Steps
 - Project Review Committee Action
- VI. Environmental Design and ROW Process (Includes Plans, Specifications, and Estimates, P, S, & E)
 - Environmental Studies and Permits
 - Right-of-Way Plans
 - Permits
- V. Programming (Old Colony and State Transportation Improvement Program, TIP)
 - Programming of Funds
- VI. Procurement (Construction bids and contractor selection)
- VII. Construction



VIII. Project Assessment

On sections of roadway owned and maintained by the municipality, they typically initiate a project by completing and submitting the Project Need Form (available in the Appendix), as well as providing for project planning and design. Similarly, for state owned facilities, the Massachusetts Highway Department initiates projects and provides planning and design on their section of roads.

Many funding options are available for project construction, and are outlined below. Note that some funding programs, such as the Congestion Mitigation and Air Quality (CMAQ) Program, are for specific types of projects that meet specific criteria, while other programs such as Chapter 90 can be utilized on a much broader range of projects. Federal aid eligible regional transportation needs have outpaced available funding in the Transportation Improvement Program (TIP) for the past several years. All projects on the TIP go through a comprehensive evaluation process to determine priority for funding; therefore, the programming of the TIP is a competitive process. In general, the process to fund a project through the TIP may take at least five years. Therefore, due to this limitation of TIP funding, communities are encouraged to seek alternate funding avenues for their high priority projects. Examples of such options include using Chapter 90 funds, developer mitigation, or public/private partnerships with local stakeholders.

Funding Programs

- **Capital Improvement Program (CIP) and Local Funding** has historically been utilized to help provide the design and engineering of highway projects.
- **Exactions (Developer Mitigation Agreements)** Communities have increasingly turned to exactions as a means to meet new infrastructure and public service needs. Cities and towns use developer exactions as a strategy to offset the burdens of new development on the community. Exactions contribute to regional equity by ensuring that a new development pays a fair share of the public costs that they generate. Exactions consist of a developer's payment of funds to offset the cost of necessary construction, design, or maintenance of public infrastructure directly connected to the new development. Developers commit to an agreement for funding or constructing off-site improvements in exchange for the approvals to proceed with a development project.
- **Bridge Replacement and Rehabilitation Program** provides funds for rehabilitation and replacement of any bridge on a public road. Bridges on the federal aid system or off the federal aid system are eligible for these funds.
- **Chapter 90** provides funding for highway construction, preservation, and improvement projects that create or extend the life of capital facilities. The level of funding is determined by a formula that is based upon public way mileage, population and level of employment in each community. The Chapter 90 Program is a reimbursement program, as the community must initially pay the cost of a particular project.
- **Community Development Block Grant (CDBG) Program** provides for the development or expansion of economic opportunities and the provision of decent housing and public facilities. Eligible use of funds includes community development



(construction or reconstruction of streets, water and sewer facilities, neighborhood centers, recreation facilities, and other public works).

- **Congestion Mitigation and Air Quality Improvement Program (CMAQ)** directs funds toward transportation projects in Clean Air Act non-attainment areas for ozone and carbon monoxide. OCPC is located in the Boston non-attainment area for ozone.
- **National Highway System (NHS)** consists primarily of existing Interstate Highway routes and portions of the Primary System. This program was established to focus federal resources on roads that are the most important to interstate travel, national defense, inter-modal connections, and international commerce.
- **Non-Federal Aid (NFA)** provides state funds for projects that due to federal fiscal constraints would not be able to receive federal funding. Projects under this category are listed for informational purposes only.
- **Public Works Economic Development (PWED)** grants are designed to assist municipalities seeking infrastructure improvements that support economic development goals.
- **Surface Transportation Program (STP)** is a block grant type program that may be used for any roads (including NHS) that are not functionally classified as local or rural minor collectors. These roads are collectively referred to as federal-aid eligible roads.
- **Transportation Bond Bill (TBB)** authorizes and directs the MHD to expend monies for transportation projects such as reconstruction, resurfacing, rehabilitation or improvements of highways, bridges, and parking facilities. From this, the state will issue either general obligation or special obligation bonds.



6.0 Appendices (see enclosed CD)

Appendix A - Route 27 Meeting Minutes

Appendix B - Intersection Crash Rate Equation

Appendix C - Traffic Re-routing Proposal for Stoughton Square

Appendix D - Conceptual Improvement Plans for Route 27 (Reynolds Memorial Highway) & Westgate Mall

Appendix E - Conceptual Improvement Plans for Route 27 (Reynolds Memorial Highway) & Pleasant Street/West Street

Appendix F - MassHighway Project Notification Form

Appendix G - Automatic Traffic Recorder Counts

Appendix H - Intersection Turning Movement Counts

Appendix I – Signal Warrant Analyses