FINAL REPORT | DECEMBER 2011

Corridor Access Management Plan

Douglas Pike (Route 7) and George Washington Highway (Route 116)

SUBMITTED TO

TOWN OF SMITHFIELD
64 FARNUM PIKE
SMITHFIELD, RI 02917

SUBMITTED BY

VHB Vanasse Hangen Brustlin, Inc.

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Study Process and Framework

This Chapter presents the study background, study area, study goals/vision, scope, and public participation. Furthermore, a description of access management and the principles used to accomplish safe access are discussed in this chapter.

This Corridor Access Management Plan for the Douglas Pike (Route 7) and George Washington Highway (Route 116) corridors is critically important to the future economic viability and quality of life along the corridor and in the region. This plan reviews existing traffic conditions and land use, and seeks to make improvements that will address future traffic conditions and development opportunities. These improvements are aimed at increasing overall mobility, accessibility and safety for residents, businesses, employees, and visitors while decreasing traffic congestion and its negative impacts on the environment, economy and sustainability.

1.1 Study Background

The Corridor Access Management Plan for the Route 7 and Route 116 corridors began in July 2010. The overarching goal of this effort was to identify access management principles and designs that can and should be implemented to reduce congestion and improve safety along these corridors with the projected increase in traffic. These access management principles will be incorporated into an ordinance that can be adopted by the Town and used along these corridors, as well as in other areas of the Town.

1.1.1 Access Management – An Overview

The goal of access management is to control the location, number, spacing, and design of curb cuts/access points along a major roadway while promoting alternate access to parcels through supporting street systems and interconnecting driveways between parcels. Promoting improved access results in a roadway that operates

more safely and efficiently for all users. Poor access management can result in the following consequences:

- An increase in vehicle crashes;
- Collisions involving pedestrians or bicyclists;
- Reduction in roadway efficiency;
- Unsightly commercial strip development;
- Degradation of roadside landscaping;
- Promotion of cut-through traffic on residential streets;
- An increase in commuting times;
- Costly improvements to correct poor access management; and
- Safe access concerns for businesses.

Therefore, it is important to preserve a public roadway through the management of roadway access. The following section reviews principles to promote access management.

1.1.2 Ten Principles of Access Management

It is important to start an access management study by first defining the principles of access management before developing recommendations. Access management can be accomplished by applying the following principles, which have been developed by the Transportation Research Board (TRB):

1. Provide a Specialized Roadway System: design and manage roadways according to the primary functions they serve

2. Limit Direct Access to Major Roadways: direct property access is more compatible with local and collector roadways

3. Promote Intersection Hierarchy: a functional classification system is important to promote access from one classification of roadway to another

4. Locate Signals to Favor Through Movements: poor signal placement may lead to delays and uniform spacing enhances the ability to coordinate traffic signals and ensure continuous movement of traffic

5. Preserve the Functional Area of Intersections: driveway connections too close to intersections can cause conflicts that impair the function of the intersection

6. Limit the Number of Conflict Points: limiting the number and type of conflicts between vehicles, vehicles and pedestrians, and vehicles and bicyclists will reduce the likelihood that drivers will make mistakes and have collisions

7. Separate Conflict Areas: increasing driveway spacing provides drivers with the ability to address one set of potential conflicts before addressing another. As travel speeds increase along a corridor, so should driveway spacing.

8. Remove Turning Vehicles from Through Traffic Lanes: accommodate left-turns to the extent possible

9. Use Raised Medians to Manage Left-Turn Movements: minimize left turns

10. Provide a Supporting Street and Circulation System: well-planned, interconnected development is desirable; commercial strip development with separate driveways to each use is not desired

Promoting access management techniques can benefit the businesses, motorists, cyclists, pedestrians, transit riders, government agencies and communities.

The following sections review access management in the Town of Smithfield and define the need for access management techniques to be applied to the Study Area corridors.

1.1.3 Access Management in the Town of Smithfield

The Town of Smithfield has been aware that the operation of a transportation corridor has a great impact on the quality of life of its community. The Town has required new businesses and developments in the Town and specifically along the Route 7 and Route 116 corridors to mitigate their impacts on the surrounding roadways and intersections, minimize access/egress points, and provide cross access (or provisions for future cross access) where feasible. Some examples of the Town's commitment to holding new businesses and developments accountable for their impacts on the study area corridors and requiring mitigation are the Fidelity Corporate Campus access roads and intersection improvements and the Hampton Inn access drive which has been designed to provide access locations and cross-connection to future developments.

1.1.4 A Need for Access Management

While traffic volumes in the region have somewhat remained unchanged over the last five years, and in fact may have actually declined over the last two years which may be due to the economy and high gas prices, there is a potential for a significant increase in traffic and the number of driveways along the corridors. The Route 7 and Route 116 corridors are designated as principal arterials that traverse the northeast section in the Town of Smithfield. These corridors provide access to numerous office,

commercial, and industrial properties such as Fidelity Investments, Alexion Manufacturing, Citizens Bank office building and Navigant Credit Union, as well as Bryant University. The proximity to major freeways including Interstate 295 and Route 146 makes properties along these corridors very desirable. That coupled with the large amount of vacant properties and undeveloped land, can result in a large increase in traffic along these corridors. With the potential for future development and traffic growth along the corridors, access conditions are expected to degrade. Therefore, a specific access management plan is needed for these corridors to plan for the future.

Access management and corridor planning is largely a balancing act where safety and congestion issues must be addressed in the context of land use visions, economic development goals, environmental resource preservation, and funding constraints. A collaborative corridor planning process that results in an access management plan and a Town ordinance approved and incorporated in the Town's regulatory documents will result in thriving businesses in which transportation and land use complement and support each other.

How a transportation system can best serve a region with changing demographics and behaviors is an important and difficult question to answer. Access management principles and design, as well as social, land use, environmental and economic evaluations must be considered and presented in an effective and open public outreach process to assure that all impacted parties have been heard.

The Corridor Access Management Plan for the Route 7 and Route 116 corridors builds on previous work to begin developing a more comprehensive answer to the existing and future congestion and safety issues. The objective is to identify access management principles and designs that can be employed along the Route 7 and Route 116 corridors to reduce congestion and to increase safety. Once identified, these management principles and designs will be incorporated into a draft ordinance that can be adopted by the Town and used in this corridor, as well as other areas of Town, when reviewing development proposals.

1.2 Study Area

The following section provides an overview of the Study Area intersections and roadways. Figure 1-1 illustrates the Study Area.

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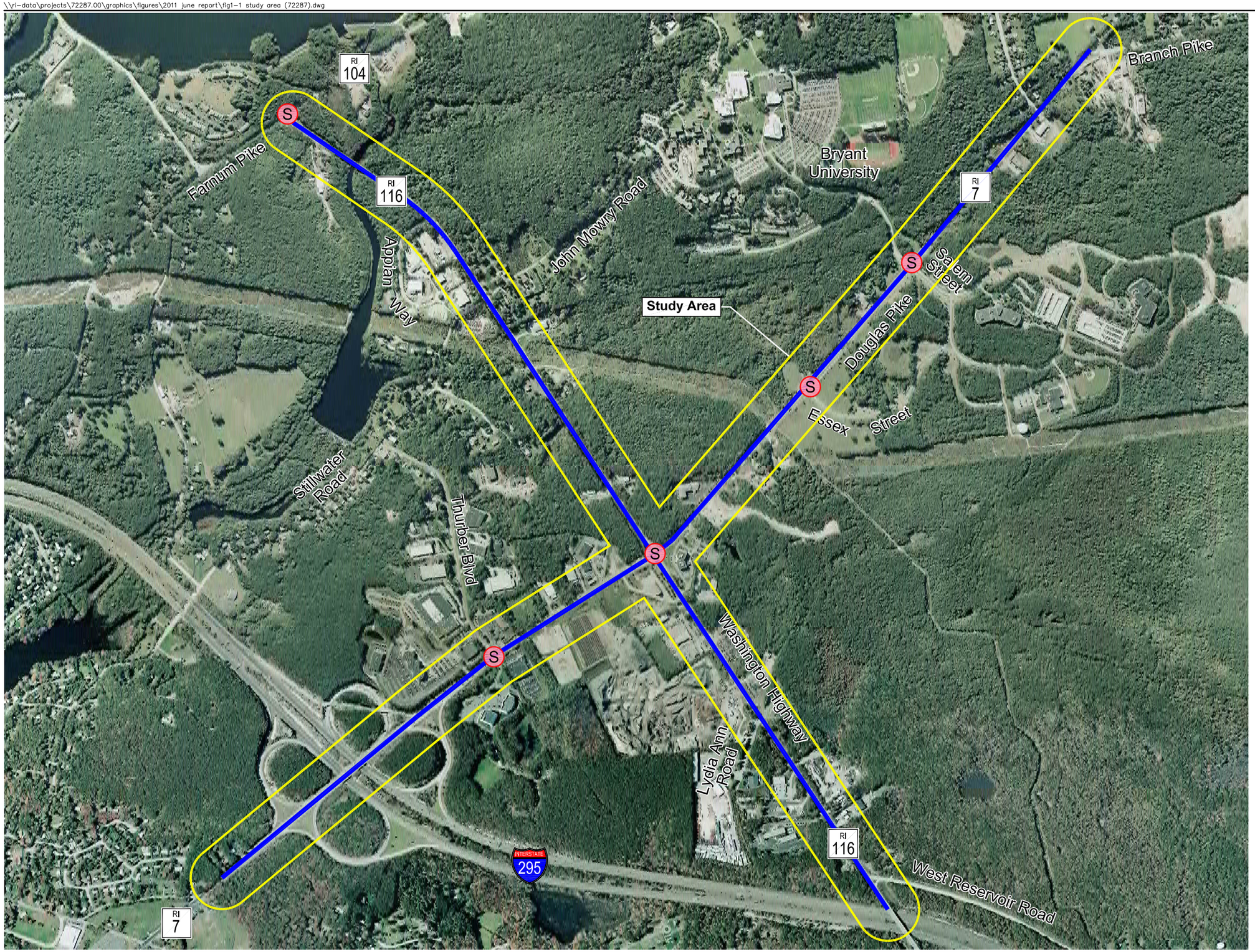

Legend

Study Area Roadway

Existing Traffic Signal

0 1/5 Mile

Source: RIDOT

Vanasse Hangen Brustlin, Inc.

Figure 1-1

Study Area
Route 7/116 Corridor
Access Management Study
Smithfield, Rhode Island

1.2.1 Roadways

The study area includes a segment approximately two miles in length extending along Route 7 from the I-295 interchange to Branch Pike and another two mile segment along Route 116 from Farnum Pike (Route 104) to the I-295 bridge (east of West Reservoir Road). The Route 7 corridor consists of four travel lanes (two travel lanes in each direction) with turning lanes at signalized intersections. The Route 116 corridor consists of two travel lanes (one travel lane in each direction). The study area roadways are principal arterials under the jurisdiction of the RIDOT, serving a number of office, commercial, and industrial developments. There are a number of heavy vehicles utilizing the corridors due to the high commercial/industrial uses including the Nationwide Diesel Technologies heavy vehicles driver training facility located on Route 116.

There are numerous driveway curb cuts, four signalized intersections and five unsignalized intersections that exist along the corridor today. Most of the curb cuts along the corridor serve as a primary or secondary access to office or commercial uses. The Route 7 corridor is congested (as identified by the Congestion Management Task Force) today, and future development and the traffic demands generated will only add to the congestion and needs to be closely reviewed. The State of Rhode Island determines congested facilities through the Congestion Management Process by using the RI Statewide Travel Demand Model or RISM. The corridor has several vacant parcels, and new development could put stress on the corridors that has several access points over its four-mile stretch. Many studies have verified the correlation between crash frequency and the number of driveways and intersections along such congested corridors. Should these sites become occupied in the future, crash frequency may increase. Therefore it is important to establish a plan now that can provide the necessary tools to implement access management techniques for parcels that are to be redeveloped.

1.2.2 Intersections

The corridor includes the following key intersections:

1. Route 7 at Branch Pike (unsignalized intersection);
2. Route 7 at Salem Street/Bryant University Entrance (signalized intersection);
3. Route 7 at Essex Street (signalized intersection);
4. Route 7 at Route 116 (signalized intersection);
5. Route 7 at Thurber Boulevard/Private Driveway (signalized intersection);
6. Route 116 at Farnum Pike (Route 104) (signalized intersection);
7. Route 116 at Appian Way (unsignalized intersection);
8. Route 116 at John Mowry Road/Stillwater Road (unsignalized intersection);

9. Route 116 at Lydia Ann Road (unsignalized intersection); and
10. Route 116 at West Reservoir Road (unsignalized intersection).

In addition to these study area intersections, there are 20± driveways along the Route 7 corridor and 35± driveways along the Route 116 corridor.

1.2.3 Interchanges

Route 7 at Interstate 295

Regional access to/from the study area is provided via I-295 through a full cloverleaf interchange along the Route 7 corridor (south of Route 116). Route 7 is accessed from I-295 by Exit 8A (southbound) and Exit 8B (northbound). There are auxiliary lanes provided along Route 7 at all on/off-ramps. All on ramps to Route 7 operate under yield control and/or provide acceleration lanes.

1.2.4 Land Use

Land use along the Route 7 and Route 116 study area corridors is primarily a mix of office, commercial, retail, and hotel uses, with some residential and industrial uses. The density of development varies along the Route 7 corridor, with greater development to the south and then steadily decreasing as the corridor extends to the north with the exception of the Fidelity and Bryant Campuses which are located to the north. The density of development along the Route 116 corridor also varies, with greater development to the east between Route 7 and West Reservoir Road and then steadily decreasing as the corridor extends to the west. There are large parcels of undeveloped land along both corridors. Within the study area, there is a limited amount of residential uses.

1.3 Study Vision and Goals

The objective of this project is to identify access management principles and designs that can and should be implemented to reduce congestion and increase safety along these corridors with the increase in traffic. These access management principles will be incorporated into an ordinance that can be adopted by the Town and used along these corridors, as well as in other areas of the Town.

This access management plan presents balanced, comprehensive guidelines for the Route 7 and Route 116 corridors. The plan discusses existing and future transportation deficiencies, and incorporates the potential for future development along the corridors. The plan identifies transportation infrastructure needs and improvement opportunities that should be considered for the corridor.

This study is critically important to the future economic viability and sustainability along the corridors and in the region. This plan reviews existing traffic conditions and land uses and seeks to recommend improvements that can address future traffic conditions and development/redevelopment opportunities. These improvements are aimed at increasing overall mobility, accessibility and safety for residents, businesses, employees, and visitors while decreasing traffic congestion and its negative impacts on the environment, economy and quality of life.

To guide the development of this plan, the following objectives were established:

1. Inventory and Data Collection: to collect available roadway, intersection, and land development plans from the Town of Smithfield and RIDOT; develop base mapping; and collect traffic data, speed data, and accident data.
2. Project Future Development: to review the comprehensive plan and zoning subdivision regulations and develop a build-out scenario in order to provide recommendations to accommodate existing and future development without creating unsafe or unduly congested traffic conditions or other adverse community or environmental impacts.
3. Operational Characteristics: to determine existing and future operational characteristics and deficiencies of the transportation system by performing capacity analyses of existing and future build-out conditions.
4. Future Recommendations: to formulate recommendations that are compatible with and help preserve the capacity of future transportation improvements.
5. Access Management Techniques: to establish a framework for implementing access management techniques; develop a draft Access Management Plan and Access Management Ordinance.

6. Public Participation: to develop, through an open, public planning process, recommendations to accommodate travel demands associated with anticipated future development while decreasing traffic congestion and its negative impacts on the environment, economy and quality of life.

1.4 Study Scope

A comprehensive corridor access management plan requires a well-defined structure and process. The Corridor Access Management Plan for the Route 7 and Route 116 corridors is comprised of the following six (6) distinct phases of work and corridor development/planning.

1.4.1 Inventory and Analysis

- **Compilation and Review of Available Data and Plans** - Collect available roadway, intersection, and land development plans from the Town of Smithfield and RIDOT.

- **Preparation of Base Mapping** - Develop a base plan utilizing available plans and mapping showing various features in the study area including the following data obtained in GIS format from the Town and RIGIS:

  - Pertinent land features including topography, ground surface, soils, and utilities.
  - Current/proposed property uses.
  - Environmental constraints.
  - Traffic/roadway issues.
  - Intersection turning movement volumes.
  - Proposed development initiatives.

- **Obtain Existing Traffic Signal Timings** - Obtain existing traffic signal timings in the field because the timings shown on the signal plans often do not reflect actual timings in the field. This information is critical in accurately representing the operation of existing signalized intersections.

- **Traffic Data Collection** - Compile available traffic studies for proposed developments that have been submitted to the Town and other traffic data that is available from the Town and RIDOT. Perform peak hour turning movement counts, including classification of vehicles, pedestrians and cyclists, during the morning (6:00 a.m. to 10:00 a.m.) and afternoon (2:00 p.m. to 6:00 p.m.) peak periods, at the following locations:

- Route 7 at Route 116
- Route 7 at Thurber Boulevard

- **Additional Field Data** - Measure speeds during off-peak hours under ideal weather conditions with a radar gun in each direction using unmarked vehicles (so that motorists do not perceive the recorder's presence as an enforcement activity and adjust their speeds accordingly). This data will be used to investigate sight distance issues along the study roadways. An evaluation of the appropriateness of the posted speed limit as it relates to the existing and proposed adjacent land uses will be completed.

- **Study Area Accident Analysis -** Collect accident data for the most recent available three consecutive years from the Smithfield Police Department and solicit opinions from local police officials concerning roadway safety. This information will be analyzed/summarized to determine if there is a particular pattern of accidents and if there are modifications that could be implemented to improve the operation and/or safety of the intersection(s).

- **Comprehensive Plan and Zoning/Subdivision Regulation Review -** Review land development regulations identified by the Town to determine the potential for development of abutting parcels based on the Future Land Use Plan and development constraints. Project the maximum development potential in the study area that can be created under the Future Land Use Plan. The existing conditions build-out analysis is essential to fully understand the impacts of adopted land use policies. For planning purposes, the results of the existing conditions build-out analysis will most likely represent a worst case scenario and will not be representative of future year conditions. However, the results of the analysis will be a key discussion point for the VHB Team and members of the Town to identify and develop an alternative build-out scenario with access management and smart growth principles implemented. An important goal of both the existing conditions build-out and the alternatives build-out analysis is to portray the results in an effective manner that will facilitate public involvement and support for improving local development regulations and making infrastructure improvements to maintain a high quality of life within the region.

- **Capacity Analysis -** Identify safety and capacity issues based on the findings of the capacity and accident analysis, speed study, and field reconnaissance data. Analyze the roadway and intersection capacities and level of service for the existing and proposed conditions. Also analyze the proposed build-out conditions of the properties in the corridor.

- In addition to determining capacity and level-of service at intersections, the following assessments will be conducted:

  - Driveway access density
  - Intersection sight distance at key intersections where traffic volumes/crashes are high
  - Stopping sight distance along the corridor
  - Analyze future roadway conditions, incorporating mitigation including but not limited to the following:
    - Use of frontage/reverse frontage roads
    - Implementation of shared driveways
    - Circulation improvements internally to existing land use developments
    - Application of corner clearance techniques by moving commercial driveways away from public streets or major intersections
    - Signal timing optimization
    - Installation of turn lanes
    - Consideration of roundabouts
    - Roadway Widening

1.4.2 Coordination with RIDOT, EDC and Proposed Development Projects

- **RIDOT and RIDEC Coordination -** Meet with the Rhode Island Department of Transportation (RIDOT) Road Design and Traffic Sections regarding any constraints or issues with existing conditions and obtain proposed improvements to the corridor that RIDOT may be considering in the future. Coordinate with RIDOT in order to obtain feedback regarding potential design alternatives that may be proposed. Meet with the Rhode Island Department of Economic Development (RIDEC) to get feedback regarding any on-going economic development initiatives in the area.

- **Developer Coordination -** Schedule a series of individual meetings with developers of abutting properties and the Planning Department to learn the expected timelines for their developments and to discuss issues such as site access and the potential for common access with abutting properties.

1.4.3 Draft Access Management Plan & Draft Ordinance

- **Draft Access Management Plan/Design Study Report -** Prepare a complete matrix of potential strategies, and assess them in terms of impacts such as cost, operations, right-of-way, and environmental permitting. A schematic plan shall also be developed that identifies potential constraints, environmental impacts, land use limitations, abutting land uses, utility issues, drainage issues, access

issues, right-of-way issues, and site-specific issues based on the information obtained and summarized sections Tasks 1.4.1 and 1.4.2.

- **Draft Access Management Ordinance -** Develop a Draft Access Management ordinance for the Town that incorporates the most commonly used access management treatments. The ordinance shall include classification of roadways by function and requirements for sight distance, driveway spacing, maximum driveways per lot, corner access, corner clearance, shared access, turn radius, driveway width, etc. The ordinance will incorporate simple non-site specific graphics illustrating access management practices that can be applied Town-wide, as well as site specific graphics for the corridor. These requirements must meet the minimum standards required by the RIDOT and must be reviewed by the RIDOT to ensure that the proposed ordinance is consistent with department policies.

1.4.4 Review Findings with the Town

- **Meeting With Town -** Prior to development of final recommendations, conduct a briefing meeting with the Town Planner and other Town officials to present the preliminary findings of data collection and evaluations and to discuss planning issues for the potential design alternatives and other access management strategies. Provide a draft of the Access Management Ordinance specific for this corridor but can also be applied on a town-wide basis.

1.4.5 Joint Town Council and Planning Board Meeting

- **Presentation to the Town** - Present the preliminary findings, recommendations and evaluations during the joint meeting and discuss options to be considered for roadway improvements and other access management strategies that might be employed and potential amendments to the Town regulatory documents. Feedback from the public concerning the initial findings will be obtained and documented.

1.4.6 Develop Final Report

- **Final Report -** Revise the report, recommendations, designs, and draft ordinance as necessary based on feedback received at the joint meeting. An interim Final Report shall be reviewed and edited as necessary by the Town prior to printing of the final copies of the Final Report.

2

Existing Conditions

This Chapter provides an assessment of the existing traffic conditions along the Douglas Pike (Route 7) George Washington Highway (Route 116) corridors. Sections included in this Chapter present an evaluation of the transportation infrastructure (including demands, safety, and traffic operations), a review of pertinent land features (topography, ground surface, soils, and utilities), current/proposed property uses, environmental constraints, traffic/roadway issues and proposed development initiatives. This information will set the framework for analyzing future roadway conditions, incorporating recommended improvements and access management techniques to mitigate existing/future issues, and the development of a Corridor Access Management Strategies and Opportunities presented in Chapters 5 and 6.

2.1 Existing Transportation Infrastructure

This section includes an evaluation of the physical conditions of the Study Area Corridor. This information is intended to identify current roadway design issues. Improvements will be considered during the preparation of the action plan in Chapter 6.

Engineering field visits were conducted to document the following:

- Roadway infrastructure and geometric conditions;
- Number access points along the corridor;
- Available right-of-way;
- Maintenance issues;
- Public transportation; and
- Pedestrian and bicycle accommodations.

2.1.1 Study Area Roadways and Intersections

As mentioned in Chapter 1, the defined study area includes a segment approximately two miles in length extending along Route 7 from the I-295 interchange to Branch Pike and another two mile segment Route 116 from Farnum Pike (Route 104) to the I-295 bridge (east of West Reservoir Road). The following key intersections are located along the study area roadways and are described in more depth in this section:

1. Douglas Pike (Route 7) at Branch Pike (unsignalized intersection);
2. Douglas Pike (Route 7) at Salem Street/Bryant University Entrance (signalized intersection);
3. Douglas Pike (Route 7) at Essex Street (signalized intersection);
4. Douglas Pike (Route 7) at George Washington Highway (signalized intersection);
5. Douglas Pike (Route 7) at Thurber Boulevard/Private Driveway (signalized intersection);
6. George Washington Highway at Farnum Pike (Route 104/5) (signalized intersection);
7. George Washington Highway at Appian Way (unsignalized intersection);
8. George Washington Highway at John Mowry Road/Stillwater Road (unsignalized intersection);
9. George Washington Highway at Lydia Ann Road (unsignalized intersection); and
10. George Washington Highway at West Reservoir Road (unsignalized intersection).

The study area roadways and intersections are shown in Figure 2-1.

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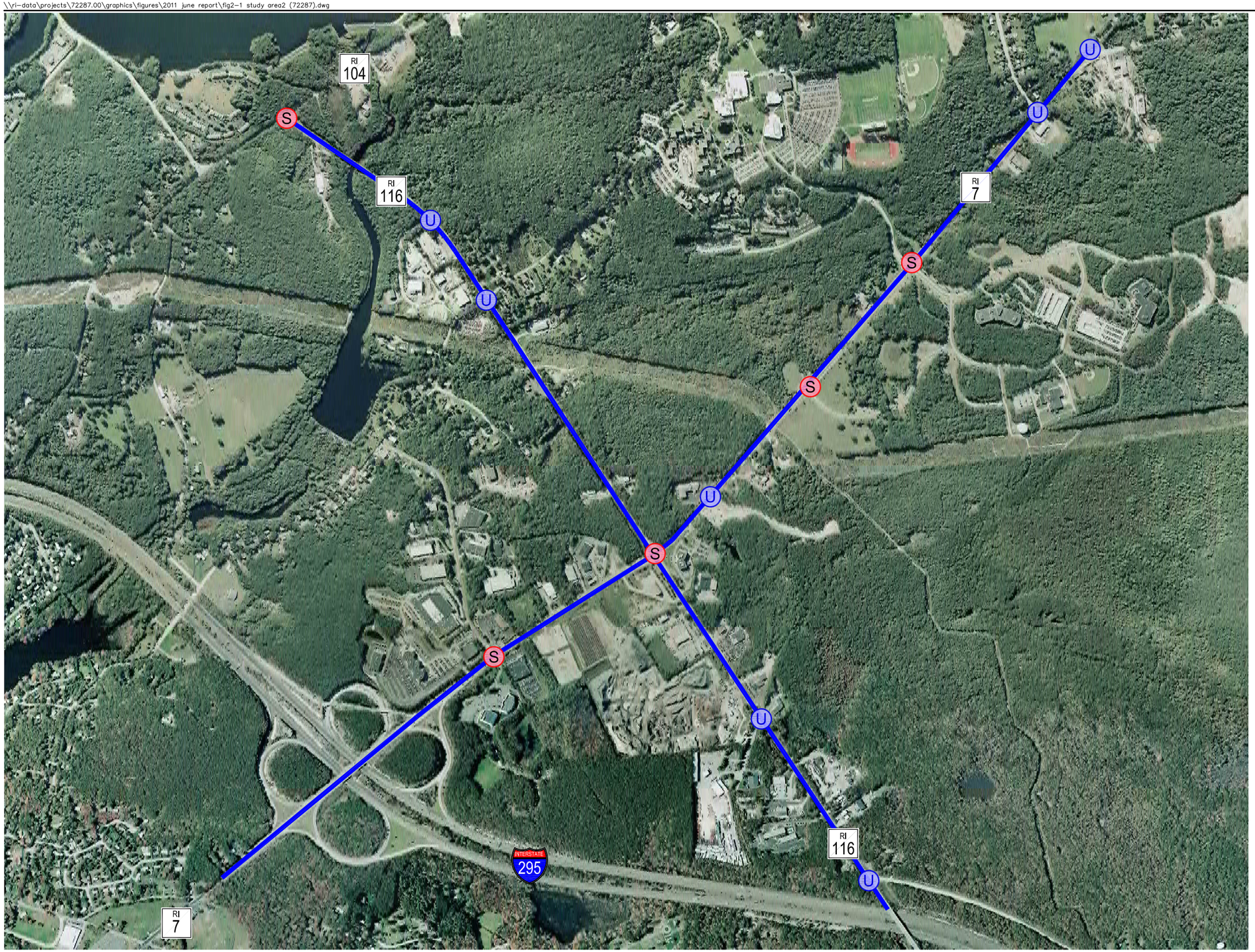

Legend

Study Area Roadway

S Existing Traffic Signal

U Existing Unsignalized

0 1/5 Mile

Source: RIDOT

Vanasse Hangen Brustlin, Inc.

Figure 2-1

Study Area Roadways and Intersections
Route 7/116 Corridor
Access Management Study
Smithfield, Rhode Island

Study Area Roadways

Douglas Pike (Route 7)

Douglas Pike (Route 7) is a north-south principal arterial roadway under the jurisdiction of the Rhode Island Department of Transportation (RIDOT). Route 7 connects to Interstate 295 (I-295) and Providence to the south with Farnum Pike and Uxbridge, Massachusetts to the north. Bryant University is located on the west side of Route 7 to the north of Route 116. Route 7 is classified as a principal arterial. Adjacent to the Fidelity Campus, Route 7 is presently 52 feet wide, consisting of four 11-foot travel lanes with 4-foot shoulders along each side of the roadway. The pavement width increases to accommodate turning lanes at the intersections with Salem Street/Bryant University Driveway, Essex Street, Route 116, and Thurber Boulevard. Land use along Route 7 is comprised of commercial, industrial, and residential uses and has a posted speed limit of 40 miles per hour (mph) within the study area.

The Route 7 corridor is congested today (as identified through the congestion management process by using the RI Statewide Travel demand Model (RISM)), and future development and the traffic demands generated will only add to the congestion and needs to be closely reviewed. The corridor has several vacant parcels, and new development could put stress on the corridors that has several access points over its four-mile stretch.

George Washington Highway (Route 116)

Route 116 is a north-south principal arterial under RIDOT jurisdiction, connecting to Farnum Pike and Putnam Pike (Route 44) in Smithfield to the west with Route 146 and Lincoln to the east. Through the study area, the roadway traverses in an east-west direction. Route 116 is approximately 44 feet wide with one-12 foot travel lane in each direction and 10 foot wide shoulders along each side of the roadway. The pavement width increases at the Route 7 intersection to accommodate turning lanes. Land use along Route 116 is comprised of commercial, industrial, and residential uses, and has a posted speed limit of 30 mph in the immediate vicinity of Route 7 and 50 mph east and west of the Route 7 intersection.

Study Area Intersections

The following is a summary of the ten study area intersections. In addition to the study area intersections, there are approximately 40 driveways along the Route 7 corridor and approximately 35 driveways along the Route 116 corridor.

Douglas Pike (Route 7) at Branch Pike

Branch Pike intersects Route 7 from the north to form a three-way, "Y-type" unsignalized intersection. The Route 7 northbound approach consists of a thru lane and a channelized right turn lane. The Route 7 southbound approach consists of an all-purpose lane. The Branch Pike southbound approach consists of an all-purpose lane and operates under stop control. The RIDOT has performed a warrant analysis at this intersection and it has been determined that installation of a traffic signal or a modern roundabouts at this location is justified. The RIDOT will be proceeding with the design and installation of single lane roundabout at this intersection over the next year.

Douglas Pike (Route 7) at Salem Street/Bryant University Entrance

The Bryant University Driveway and Salem Street intersect Route 7 from the east and west, respectively, to form a four-way fully-actuated signalized intersection. The Route 7 northbound approach consists of an exclusive left-turn lane, two through lanes, and an exclusive right-turn lane. The Route 7 southbound approach consists of an exclusive left-turn lane, a through lane, and a shared through/right-turn lane. The Bryant University Driveway eastbound approach consists of a shared left-turn/through lane and an exclusive channelized right-turn lane. The Salem Street westbound approach consists of an exclusive left-turn lane, a shared left-turn/through lane, and an exclusive right-turn lane.

The traffic signal operates under four phases: phase 1 is for the Route 7 northbound and southbound protected left-turns movements, phase 2 is for Route 7 northbound and southbound through movements, phase 3 is for the Salem Street movements, and phase 4 is for the Bryant University movement. During a field review in October 2010, the controller was programmed to run two coordination timing plans during the morning and afternoon peak periods, while running "free" all other times.

Douglas Pike (Route 7) at Essex Street

Essex Street intersects Route 7 from the east to form a three-way fully-actuated signalized intersection. The Route 7 northbound approach consists of a through lane and a shared through/right-turn lane. The Route 7 southbound approach consists of a shared left-turn/through lane and a through lane. The Essex Street westbound

approach consists of an exclusive left-turn lane and a shared left-turn/right-turn lane.

The traffic signal operates under two phases: phase 1 is for the Route 7 northbound and southbound movements (with permissive left-turn movements) and phase 2 is for Essex Street movements. During a field review in October 2010, the controller was programmed to run two coordination timing plans during the morning and afternoon peak periods, while running "free" all other times.

Douglas Pike (Route 7) at George Washington Highway (Route 116)

Route 116 intersects Route 7 from the east and west to form a four-way fully-actuated signalized intersection. The Route 7 northbound approach consists of an exclusive left-turn lane, two through lanes, and a channelized right-turn lane. The Route 7 southbound approach consists of two exclusive left-turn lanes, two through lanes, and a channelized right-turn lane. The Route 116 eastbound approach consists of an exclusive left-turn lane, a through lane, and a channelized right-turn lane. The Route 116 westbound approach consists of two exclusive left-turn lanes, a through lane, and a channelized right-turn lane. There are crosswalks with pedestrian push-button activated phases on all approaches.

The traffic signal operates under four phases: phase 1 is for the Route 7 northbound and southbound protected left-turns movements, phase 2 is for Route 7 northbound and southbound through movements, phase 3 is for the Route 116 left-turn movements, and phase 4 is for Route 116 through movements. During a field review in October 2010, the controller was not programmed with any coordination or time of day data.

Douglas Pike (Route 7) at Thurber Boulevard/Private Driveway

Thurber Boulevard and a private driveway intersect Route 7 from the west and east respectively to form a four-way fully-actuated signalized intersection. The Route 7 northbound and southbound approaches consist of an exclusive left-turn lane, a through lane, and a shared through/right-turn lane. The Thurber Boulevard eastbound approach consists of an exclusive left-turn lane and a shared through/right-turn lane. The private driveway consists of a wide all-purpose lane

The traffic signal operates under three phases: phase 1 is for the Route 7 northbound and southbound left-turn movements, phase 2 is for Route 7 northbound and southbound through movements (with permissive northbound left-turn movements only), and phase 3 is for Thurber Boulevard and the private driveway movements. During a field review in October 2010, the controller was not programmed with any coordination or time of day data.

George Washington Highway (Route 116) at Farnum Pike (Route 104/5)

Route 116 intersects Farnum Pike from the east to form a three-way fully-actuated signalized intersection. The Farnum Pike northbound approach consists of a through lane and a short channelized right-turn lane. The Farnum Pike southbound approach consists of a shared left-turn/through lane. The Route 116 westbound approach consists of a left-turn lane and a shared right-turn lane.

The traffic signal operates under two phases: phase 1 is for the Farnum Pike northbound and southbound movements (with permissive left-turn movements) and phase 2 is for Route 116 movements. During a field review in October 2010, the controller was not programmed with any coordination or time of day data.

George Washington Highway (Route 116) at Appian Way

Appian Way intersects Route 116 from the south to form a three-way unsignalized intersection. There are no exclusive turn lanes at the intersection, and the Appian Way approach operates under stop control.

George Washington Highway (Route 116) at John Mowry Road/Stillwater Road

John Mowry Road and Stillwater Road intersect Route 116 from the south and north respectively to form a four-way unsignalized intersection. There are no exclusive turn lanes at the intersection and the John Mowry Road and Stillwater Road approaches operate under stop control.

George Washington Highway (Route 116) at Lydia Ann Road

Lydia Ann Road intersects Route 116 from the south to form a three-way unsignalized intersection. There are no exclusive turn lanes at the intersection, and the Lydia Ann Road approach operates under stop control.

George Washington Highway (Route 116) at West Reservoir Road

West Reservoir Road intersects Route 116 from the south to form a three-way "Y-type" unsignalized intersection. The Route 116 eastbound approach consists of an all-purpose lane. The Route 116 westbound approach consists of a through lane and a channelized right-turn lane. The West Reservoir Road approach consists of an all-purpose lane and operates under stop control.

2.1.2 Access Points

As noted in Chapter 1, Route 7 and Route 116 are designated as *Principal Arterials*, which means that they are intended to support regional mobility and that access points should be limited to the least number possible. Since the roadway is under the jurisdiction of RIDOT, a Physical Alteration Permit (PAP) is required for any modification to an existing driveway or addition of a new driveway. The following, taken from the Federal Highway Administration Function Classification Guidelines, identifies characteristics of a Principal Arterial:

- Principal Arterials typically carry between 15,000 vpd and 50,000 vpd;
- Direct access to parcels should be restricted or denied;
- The primary function of a Principal Arterial is to serve through traffic;
- Principal Arterial access is typically at intersections only; and
- Access at other non-intersections (driveways) are typically restricted to right and left-turns in, and right-turns out.

As part of this study, existing driveways (residential, commercial, or retail), and roadway intersections were identified. The following provides an overview of the existing driveway characteristics along the corridor. This information is also summarized in Table 2-1 and Table 2-2 and is illustrated in Figure 2-2.

Douglas Pike (Route 7)

- The overall corridor averages 16 access points per mile (12 access points per mile north of Route 116 and 30 access points per mile between Route 116 and I-295);A total of 29 active access points were identified along the study area corridor (17 access points north of Route 116 and 12 access points between Route 116 and I-295);
- There are 14 inactive access points that would require RIDOT and/or Town approval prior to becoming active. These inactive access points lead to undeveloped properties, unoccupied businesses, National Grid utility right-of-ways, a Fidelity utility building, and the salt barn;
- Approximately 55-percent of these access points are retail, commercial/ business uses, 17-percent are residential uses, and 28-percent are roadway intersections;
- Approximately 65-percent of the access points are on the west side of the roadway;
- The section of the corridor that has the highest density of access points is between Route 116 and I-295 (a total of 12 access points exist in 0.4 miles for a density of approximately 30 access points per mile);
- The section of the corridor with the lowest density is north of Route 116 (a total of 17 access points in 1.4 miles for a driveway density of approximately 12 access points per mile).

Table 2-1 Existing Access Points – Route 7

Driveway Type	Direction/Distance	Branch Pike to Route 116[4] (1.4 miles)	Route 116 to I-295 [5] (0.4 miles)	Total (1.8 miles)
Total Inactive Access Points[1]	Eastside	6	3	9
	Westside	3	2	5
	Total	**9**	**5**	**14**
Non-Residential[2]	Eastside	1	4	5
	Westside	6	5	11
Residential	Eastside	0	0	0
	Westside	5	0	5
Roadway Intersections	Eastside	4	1	5
	Westside	1	2	3
Total Active Access Points	Eastside	5	5	10
	Westside	12	7	19
	Total	**17**	**12**	**29**
Access Density (per mile)[3]	Eastside	3.5	12.5	5.5
	Westside	8.5	17.5	10.5
	Total	**12.0**	**30.0**	**16.0**

Source: Based on field observation data collected by Vanasse Hangen Brustlin in June 2011.
1. Driveways that provide access to unoccupied businesses, utility right-of-ways and undeveloped properties. Also includes blocked driveways and access to the salt barn.
2. Non-residential driveways include commercial, retail and industrial land uses
3. Based on only active driveways
4. Includes Branch Pike but not Route 116
5. Includes Route 116 and Thurber Boulevard

George Washington Highway (Route 116)

- There are 5 inactive access points that would require RIDOT and/or Town approval prior to becoming active. These inactive access points lead to undeveloped properties, unoccupied businesses, National Grid utility right-of-ways, and the salt barn;
- A total of 44 active access points were identified along the study area corridor (18 access points west of Route 7 and 26 access points east of Route 7);
- The overall corridor averages 22 access points per mile (16 access points per mile west of Route 7 and 29 access points per mile east of Route 7);
- Approximately 73-percent of these access points are retail, commercial/ business uses, 7-percent are residential uses, and 20-percent are roadway intersections;
- Approximately 55-percent of the access points are on the south side of the roadway;

- The section of the corridor that has the highest density of access points is east of Route 7 (a total of 26 access points exist in 0.9 miles for a density of approximately 29 access points per mile);
- The section of the corridor with the lowest density is west of Route 7 (a total of 18 access points in 1.1 miles for a driveway density of approximately 16 access points per mile).

Table 2-2 Existing Access Points – Route 116

Driveway Type	Direction/Distance	Route 104 to Route 7 (1.1 miles)	Route 7 to W. Reservoir Rd. 5 (0.9miles)	Total (2.0 miles)
Total Inactive Access Points[1]	Northside	2	1	3
	Southside	1	1	2
	Total	**3**	**2**	**5**
Non-Residential[2]	Northside	3	10	13
	Southside	7	12	19
Residential	Northside	3	0	3
	Southside	0	0	0
Roadway Intersections	Northside	2	2	4
	Southside	3	2	5
Total Active Access Points	Northside	8	12	20
	Southside	10	14	24
	Total	**18**	**26**	**44**
Access Density (per mile)[3]	Northside	7	13.5	10
	Southside	9	15.5	12
	Total	**16**	**29.0**	**22**

Source: Based on field observation data collected by Vanasse Hangen Brustlin in June 2011.
1. Driveways that provide access to unoccupied businesses, utility right-of-ways and undeveloped properties. Also includes blocked driveways and access to the salt barn.
2. Non-residential driveways include commercial, retail and industrial land uses
3. Based on only active driveways
4. Includes Route 104 but not Route 7
5. Includes Route 7 and West Reservoir Road

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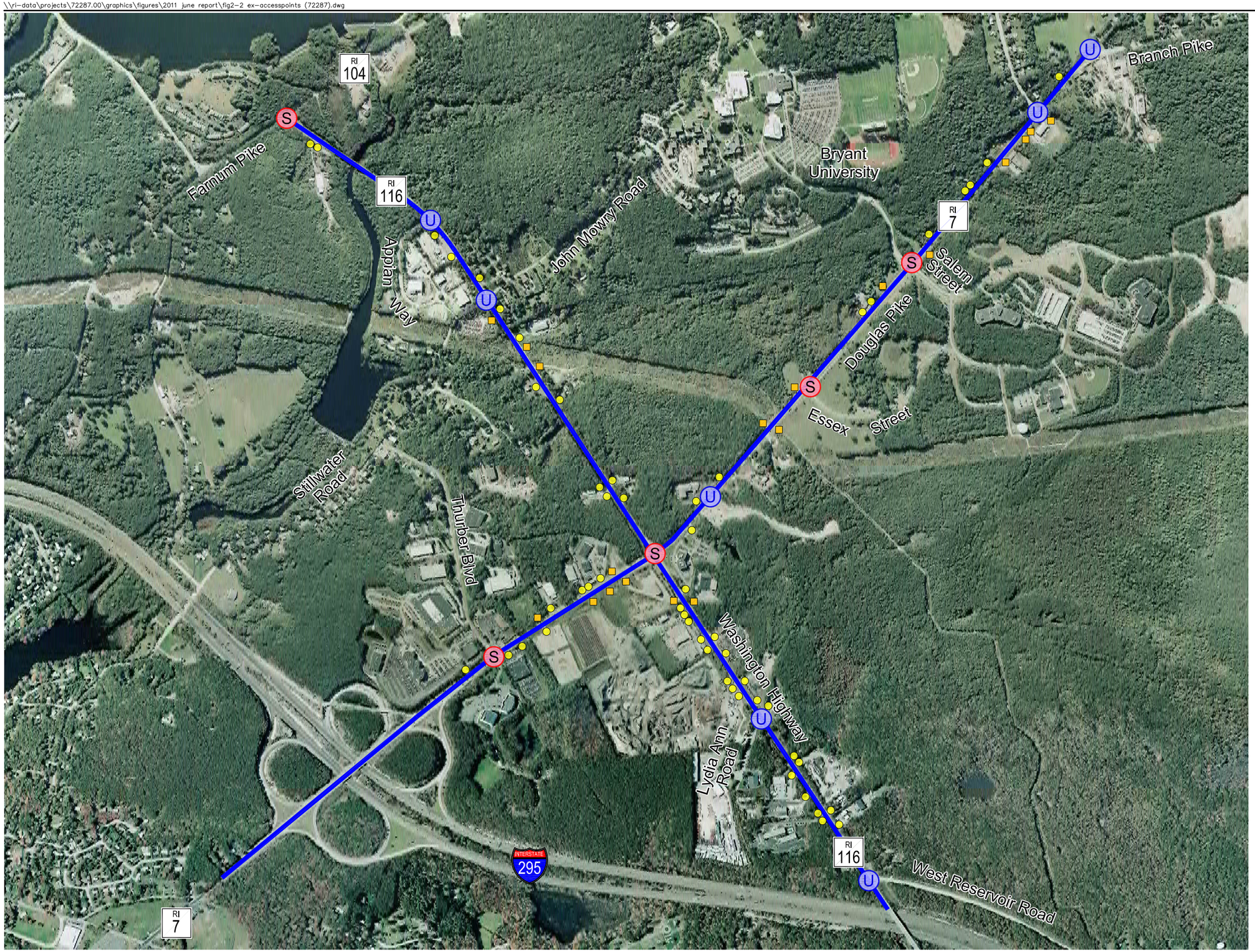

Legend

- Study Area Roadway
- Existing Traffic Signal
- Existing Unsignalized
- Curb Cut
- Curb Cut Not Used Regularly

0 1/5 Mile

Source: RIDOT

Vanasse Hangen Brustlin, Inc.

Figure 2-2

Existing Access Points
Route 7/116 Corridor
Access Management Study
Smithfield, Rhode Island

2.1.3 Planned Roadway Improvements

RIDOT reported no major construction projects planned along these corridors. The RIDOT has performed a warrant analysis at this intersection and it has been determined that installation of a traffic signal or a modern roundabouts at this location is justified. The RIDOT will be proceeding with the design and installation of single lane roundabout at this intersection over the next year.

2.1.4 Right-of-Way (ROW)

Table 2-3 summarizes the approximate ROW for the study area corridors.

Table 2-3 Existing Right-of-Way

Corridor	Roadway Section	Existing Roadway Length	Existing ROW Width (feet)
Route 7	Branch Pike to Route 116	1.40 miles	100'
Route 7	Route 116 to I-295 Interchange	0.40 miles	100'
Route 116	Farnum Pike to Route 7	1.10 miles	150' to 180'
Route 116	Route 7 to I-295	0.90 miles	125' to 150'

Source: Information obtained from RIGIS and construction plans provides by RIDOT.

2.1.5 Public Transportation

Bus service is provided along the corridor by the Rhode Island Public Transit Authority (RIPTA) via Route 52. Scheduled stops along the corridor are currently provided near the Route 7/I-295 interchange, at Bryant University, and at the Fidelity campus. The route operates with 45 to 60 minute headways on weekdays. Service to the Fidelity Campus is provided during the weekday afternoon commuter period only; with morning commuter service upon request.

2.1.6 Pedestrian Accommodations

As previously stated the Route 7 and Route 116 corridors are principal arterials, which means that they are intended to support regional mobility and that access points should be limited to the extent possible; therefore, limited pedestrian accommodations have been installed along the corridors. The corridors do not have sidewalks on either side of the roadways and there are limited opportunities to actually cross the corridor. There are currently pedestrian push buttons at the Route 7 intersections with Essex Street and Route 116. While there may not be a need to install these treatments now, the application of pedestrian crossings may be more relevant in the future.

Opportunities for pedestrian access within the corridor currently exist along the Hanton City Trail. Efforts should be made to maintain and improve linkages between the Hanton City Trail, Stillwater Scenic Trail and conservation areas in the northern part of the corridor.

2.1.7 Bicycle Accommodations

Route 7 and Route 116 are designated as "Suitable Roads" for bicycle travel according to the 2009-2010 "Guide to Cycling in the Ocean State". Route 7 provides 4± foot shoulders north of Thurber Boulevard. South of Thurber Boulevard the shoulder varies from 4± feet near the signalized intersection, then turning into acceleration/deceleration lanes with 2± foot shoulders. There is a 10± foot shoulder between the on and off-ramps. In this section bicyclists are forced to share the roadway with the drivers where a shoulder of 4 feet or greater is not provided.

Route 116 provides 10± foot shoulders; therefore bicyclists can travel in the shoulders.

2.2 Land Features

Zoning districts, environmental resource areas, major utilities, and topography within the study area have been mapped using Rhode Island Geographic Information System (RIGIS) data that was supplemented with GIS layers from the Town of Smithfield. This information will help set the framework for future traffic and land use assessments as part of this study. The mapped environmental resources and land use included:

- Existing Zoning
- Existing Utilities
- Wetlands and stream
- 10′ Contour Topography

2.2.1 Existing Zoning

The latest Zoning Regulations, dated May 1998 (including amendments in May 2009 and October 2010) were reviewed. The current zoning in the study area, as of the date of this report, consist of the following.

- Residential
- Commercial
- Heavy Commercial
- Light Industrial

- Planned Corporate
- Industrial
- Planned Development

The limits of these zoning areas are shown in Figure 2-3.

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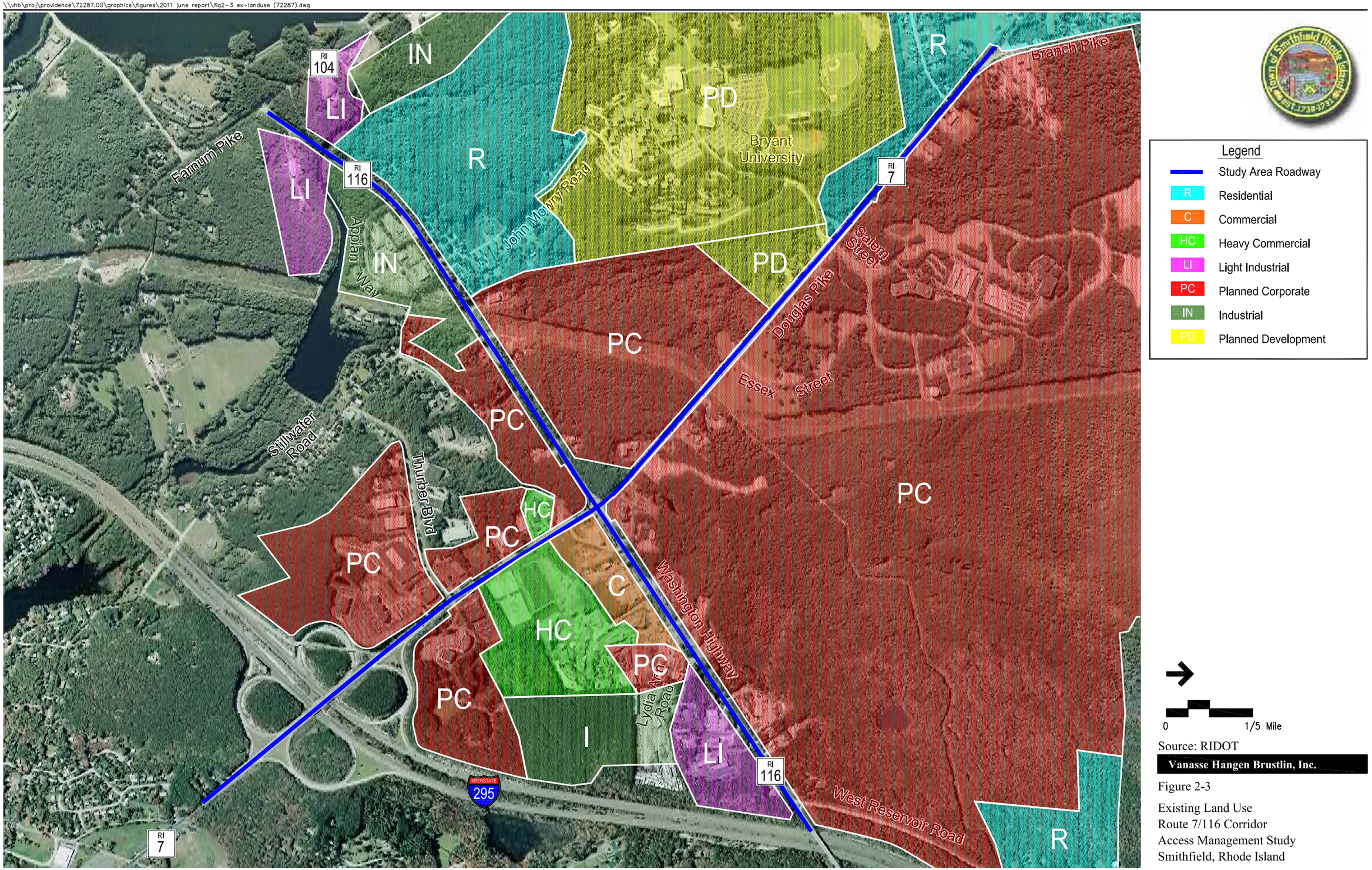

Source: RIDOT

Vanasse Hangen Brustlin, Inc.

Figure 2-3

Existing Land Use
Route 7/116 Corridor
Access Management Study
Smithfield, Rhode Island

2.2.2 Existing Utilities

The current major utilities located within the study area were obtained from the RIGIS data. The following utilities are included:

- Water – Smithfield Water Department
- Electric – National Grid
- Gas – National Grid
- Sewer – Smithfield Sewer Authority

The limits of these major utilities are shown in Figure 2-4. When determining the full build out developable land areas the utility right-of-ways were subtracted from the total area.

It should be noted that the electric, telephone, fiber (Verizon FiOS), and other services along Route 7 and Route 116 are not included in this figure.

2.2.3 Wetlands and Streams

The existing wetlands and streams located within the study area were obtained from the Town's GIS data. The wetlands and streams are shown in Figure 2-5. It should be noted that based on current Town regulations, buildings cannot be located within 100 feet of any wetland or stream. When determining the full build out of developable land areas the wetlands, streams and buffers were subtracted from the total area.

2.2.4 Topography – 10 Foot Contours

The existing 10 foot contours located within the study area were obtained from the RIGIS GIS data. The contours are shown in Figure 2-6.

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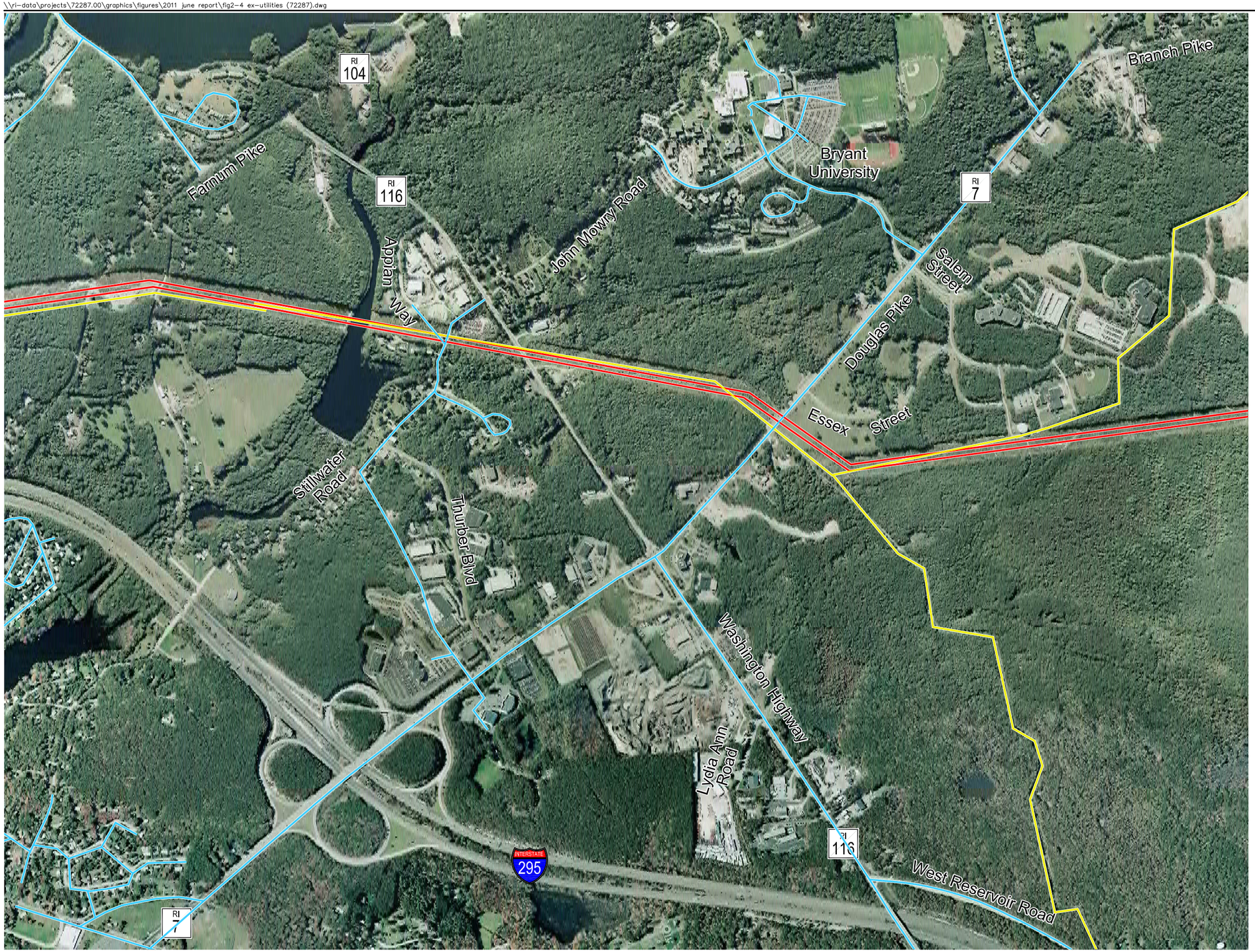

Legend

- Water Line
- Electric
- Gas

0 1/5 Mile

Source: RIGIS

Vanasse Hangen Brustlin, Inc.

Figure 2-4

Existing Utilities
Route 7/116 Corridor
Access Management Study
Smithfield, Rhode Island

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Legend

- Study Area Roadway
- Existing Wetland
- Stream

0 1/5 Mile

Source: RIGIS

Vanasse Hangen Brustlin, Inc.

Figure 2-5

Existing Wetlands and Streams
Route 7/116 Corridor
Access Management Study
Smithfield, Rhode Island

\\ri-data\projects\72287.00\graphics\figures\2011 june report\fig2-6 topography (72287).dwg

Legend

Study Area Roadway

0 1/5 Mile

Source: RIDOT

Vanasse Hangen Brustlin, Inc.

Figure 2-6

Topography
Route 7/116 Corridor
Access Management Study
Smithfield, Rhode Island

2.3 Existing Traffic Volumes

This section includes an evaluation of the existing traffic volumes within the study corridors and provides a general discussion on how traffic volumes along the Route 7 and Route 116 corridors have fluctuated over the past several years. All traffic data that was obtained as part of this access management plan can be found in the Appendix.

2.3.1 Historical Traffic Volumes

In reviewing the previously described transportation studies, VHB developed a summary of the relevant traffic data along the corridor that provides an accurate representation of traffic growth for the corridor. It was determined that the corridors have experience growth in the past 5 years, primarily due to the expansion of the Fidelity Campus along Route 7.

2.3.2 Existing Traffic Volumes

Manual turning movement counts (TMCs) were conducted by Automated Counts & Traffic Surveys, INC. on Tuesday, October 21, 2010 during the morning peak period (6:00 AM to 10:00 AM) and the afternoon peak period (2:00 PM to 6:00 PM) at the Route 7 intersections with Route 116 and Thurber Boulevard. The weekday morning peak hour occurred between 7:30 AM and 8: 30AM and the weekday afternoon peak hour occurred between 4:30 PM and 5:30 PM. In addition to the TMCs, daily traffic volumes along Route 7 and Route 116 were obtained from the RIDOT 2009 Traffic Flow Map. The traffic volumes can be found in Table 2-4.

Table 2-4 Existing Traffic Volumes

		Daily	Weekday Morning Peak Hour			Weekday Afternoon Peak Hour		
Location	Direction	ADT[2]	Volume[3]	"K" Factor[4]	Directional Distribution[5]	Volume[3]	"K" Factor[4]	Directional Distribution[5]
Douglas Pike, [1]	NB	8,100	1,505		63%	1,110		45%
South of George	SB	8,100	895		37%	1,340		55%
Washington Hwy	TOTAL	16,200	2,400	14.8%	100%	2,450	15.1%	100%
George Washington Hwy[1]	NB	6,100	515		54%	345		29%
North of Douglas Pike	SB	6,100	435		46%	835		71%
	TOTAL	12,200	950	7.8%	100%	1,180	9.7%	100%

Source: Compiled by Vanasse Hangen Brustlin, Inc. (VHB).
1 Daily volumes based on RIDOT data. Peak hour data based on TMC's performed by Automated Counts & Traffic Surveys in 10/2010.
2 Expressed in vehicles per day. ADT = Average Daily Traffic. 50% direction distribution assumed for ADTs provides by RIDOT.
3 Expressed in vehicles per hour.
4 "K Factor" = Percent of Daily Traffic which occurs during the peak hour.
5 Peak hour directional traffic flow in percent

In addition, traffic counts from previous studies conducted by VHB were compiled and reviewed. This included turning movement counts collected in 2005 on Route 7 between Branch Pike and Route 116. Turning movement counts (TMCs) can be found in the Appendix.

2.3.3 Seasonal Variation

The traffic data was collected in late September 2010, when the various colleges and universities in the area, including nearby Bryant University, were in session. Experience on other studies in Providence has shown that traffic volumes collected when schools are in session are considered higher than when they are not in session. Also, the RIDOT seasonal adjustments factors indicated that traffic in the month of September is higher than the average month along urban facilities, Therefore, RIDOT seasonal adjustment factors were not applied to the traffic counts collected in September 2010. The traffic volumes can be found in Figure 2-7. The turning movement counts can be found in the appendix.

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Legend

- Study Area Roadway
- S Existing Traffic Signal
- U Existing Unsignalized
- 0000 (0000) AM/PM Peak Hour Traffic Volumes

0 1/5 Mile

Source: RIDOT

Vanasse Hangen Brustlin, Inc.

Figure 2-7

Existing Traffic Volumes
Route 7/116 Corridor
Access Management Study
Smithfield, Rhode Island

2.4 Speed Observations

The posted speed limit along Route 7 is 40 mph. The posted speed limit Route 116 is 50 mph, except on the approaches to Route 7 in which the posted speed limits on reduced to 30 mph.

Speed measurements were collected by VHB in October 2010 along Route 7, both north and south of Route 116, and along Route 116, north and south of Route 7. The speed measurements were collected during off-peak periods using a radar gun in an unmarked vehicle. The 95th, 85th and 50th percentile speeds were collected as shown on Figure 2-8 and in Table 2-5.

Table 2-5 Posted and Observed Speeds

			Observed Speeds[2]		
Location	Direction	Posted Speed[2]	95th percentile	85th percentile	50th percentile
Douglas Pike, North of	NB	40	57	56	51
George Washington Hwy	SB	40	56	51	48
Douglas Pike, South of	NB	40	51	50	46
George Washington Hwy	SB	40	50	48	45
George Washington Hwy	NB	50	51	46	43
North of Douglas Pike	SB	50	47	44	42
George Washington Hwy	NB	50	52	51	48
South of Douglas Pike	SB	50	56	52	47

Source: Compiled by Vanasse Hangen Brustlin, Inc. (VHB).
1 Based on speed measurements and field visit in October 2010.
2 Expressed in miles per hour

2.5 Safety Assessment

Crash data from the past three years (2007-2009) was obtained from the Smithfield Police Department for the Route 7 and Route 116 corridors with the study area. This data was reviewed and summarized as shown on Figure 2-9 and in Tables 2-6, 2-7, and 2-8.

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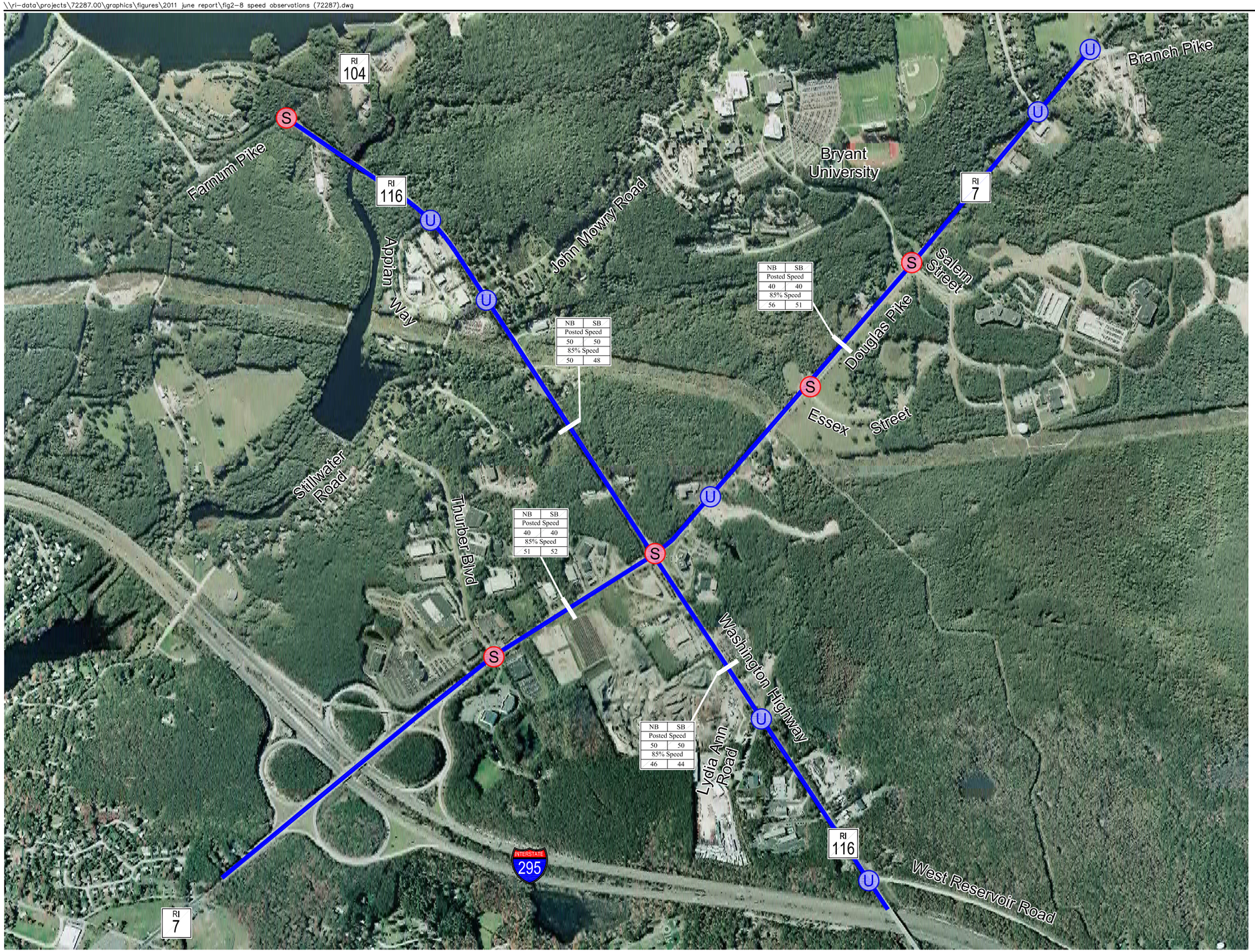

Legend

- Study Area Roadway
- S Existing Traffic Signal
- U Existing Unsignalized

0 1/5 Mile

Source: RIDOT

Vanasse Hangen Brustlin, Inc.

Figure 2-8

Speed Observations
Route 7/116 Corridor
Access Management Study
Smithfield, Rhode Island

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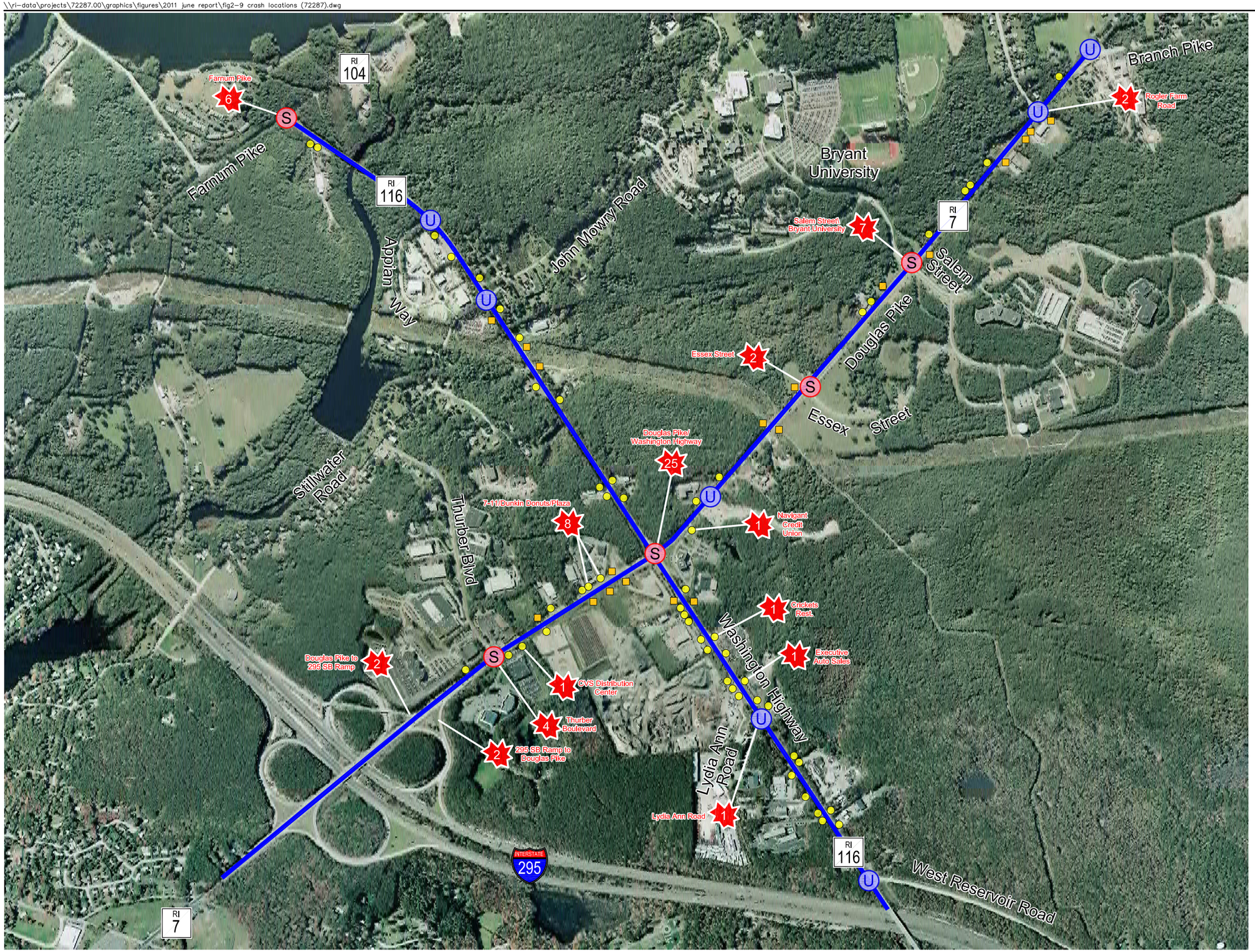


Legend

- Study Area Roadway
- Existing Traffic Signal
- Existing Unsignalized
- Crashes/ Year (2007-2009)
- Curb Cut
- Curb Cut Not Used Regularly

0 1/5 Mile

Source: RIDOT

Vanasse Hangen Brustlin, Inc.

Figure 2-9

Crash Locations
Route 7/116 Corridor
Access Management Study
Smithfield, Rhode Island

Table 2-6 Route 7 Intersections - Vehicular Crash Summary: 2007 to 2009

	Route 7 at Route 116	Route 7 at Thurber Blvd.	Route 7 at Salem Dr/ Bryant U.	Route 7 at Essex St.	Route 7 at Rogler Farm Rd	Route 7 at Branch Pike
Signalized?	Yes	Yes	Yes	Yes	No	Yes
Year						
2007	25	4	7	1	2	1
2008	23	4	5	5	2	0
2009	28	3	8	1	1	0
Total	76	11	20	7	5	1
Collision Type						
Angle	6	2	6	0	1	0
Head-on	1	1	1	0	0	0
Rear-end	60	7	9	4	2	1
Sideswipe	4	0	1	1	0	0
Broadside	2	0	0	0	0	0
Single-vehicle crash	2	0	3	2	2	0
Unknown	1	1	0	0	0	0
Total	76	11	20	7	5	1
Severity						
Fatality	0	0	0	0	0	0
Injury	18	2	7	3	2	0
Property-related	58	9	13	4	3	1
Unknown	0	0	0	0	0	0
Total	76	11	20	7	5	1
Time of day						
Weekday, 7:00 AM - 9:00 AM	14	5	5	1	1	0
Weekday, 9:00 AM - 4:00 PM	23	1	8	3	1	0
Weekday, 4:00 PM – 6:00 PM	13	2	3	2	1	0
Weekday, 6:00 PM – 7:00 AM	15	3	1	1	0	1
Weekend	11	0	3	0	2	0
Total	76	11	20	7	5	1
Pavement Conditions						
Dry	64	9	14	6	4	0
Wet	10	1	1	0	0	1
Snow	2	1	1	1	0	0
Ice/Slush	0	0	3	0	1	0
Other	0	0	1	0	0	0
Unknown	0	0	0	0	0	0
Total	76	11	20	7	5	1

Source: Town of Smithfield Police Department crash data.

Table 2-7 Route 116 Intersections - Vehicular Crash Summary: 2007 to 2009

	Route 116 at Farnum Pike	Route 116 at Stillwater Rd./ J. Mowry Rd.	Route 116 at Lydia Ann Rd.	Route 116 at W. Reservoir Rd.	Route 116 at Appian Way
Signalized?	Yes	No	No	No	No
Year					
2007	8	0	1	1	0
2008	3	4	1	0	1
2009	8	1	1	0	0
Total	19	5	11	7	1
Collision Type					
Angle	3	0	2	0	0
Head-on	0	0	0	0	0
Rear-end	9	2	1	1	0
Sideswipe	2	0	0	0	0
Broadside	0	0	0	0	0
Single-vehicle crash	5	3	0	0	1
Unknown	0	0	0	0	0
Total	19	5	3	1	1
Severity					
Fatality	0	0	0	0	0
Injury	6	1	0	0	1
Property-related	13	4	3	1	0
Unknown	0	0	0	0	0
Total	19	5	3	1	1
Time of day					
Weekday, 7:00 AM - 9:00 AM	0	0	1	0	0
Weekday, 9:00 AM - 4:00 PM	5	1	1	0	0
Weekday, 4:00 PM – 6:00 PM	3	0	1	1	0
Weekday, 6:00 PM – 7:00 AM	5	1	0	0	0
Weekend	6	3	0	0	1
Total	19	5	3	1	1
Pavement Conditions					
Dry	16	3	3	0	1
Wet	2	0	0	0	0
Snow	0	2	0	0	0
Ice/Slush	1	0	0	1	0
Other	0	0	0	0	0
Unknown	0	0	0	0	0
Total	19	5	3	1	1

Source: Town of Smithfield Police Department crash data.

Table 2-8 Corridor Crash Data – February 2007 to February 2009

Roadway/Segment	Total Crashes
Route 7	
North of Route 116	12
Between Route 116 and Thurber Blvd	9
South of Thurber Blvd.	0
Total – Route 7 Corridor	**21**
Route 116	
West of Route 7	0
East of Route 7	3
Total – Route 116 Corridor	**3**

Source: Town of Smithfield Police Department.

As shown in the above tables the intersection that had the highest number of crashes was Route 7 at Route 116. There were 60 rear-end crashes out of the total 76 crashes at this intersection over the three year period (2007 – 2009). Rear-end crashes are often the most common type of crashes at signalized intersections. Several of the rear-end crashes at this intersection may be attributed to the right turn yield conditions on all approaches where drivers may be looking to their left for a gap in the traffic and the vehicle in front of them stops. Other rear-end crashes may be the result of vehicles expecting the vehicle in front of them to proceed through during the yellow clearance but instead the vehicle stops.

The second highest number of crashes occurred at the intersection of Route 7 at Salem Drive/Bryant University. There were 9 rear-end crashes out of the total 20 crashes at this intersection over the three year period. As stated previously, rear-end crashes are the most common type of crashes at signalized intersections. Several of the rear-end crashes at this intersection may be attributed to the right turn stop conditions on the Bryant University eastbound approach because many drivers use this as a yield condition rather than the signed Stop condition. Drivers that are assuming that the car in front of them is going to yield at this location may be looking to their left for a gap in the traffic and the vehicle in front of them stops. Other rear-end crashes may be the result of vehicles expecting the vehicle in front of them to proceed through during the yellow clearance but instead the vehicle stops.

The Route 116/Farnum Pike intersection has the third highest crashes reported in the study area. There were 9 rear-end crashes out of the total 19 crashes at this intersection over the three year period. As stated previously it is not uncommon that rear-end crashes are the most prevalent type of accident at a signalized intersection. Several of the rear-end crashes at this intersection may be attributed to the northbound right turn yield conditions where drivers may think that the driver in front of them is going to yield but instead the vehicle in front of them stops. Other

rear-end crashes may be the result of vehicles expecting the vehicle in front of them to proceed through during the yellow clearance but instead the vehicle stops.

All other intersections had 11 crashes or less over the three year period (2007 -2009).

2.6 Existing Intersection Operations

Measuring existing traffic volumes quantifies traffic flow within the study area. To assess quality of flow, intersection capacity analyses were conducted with respect to existing traffic volumes, intersection geometry, and traffic control. Capacity analyses provide an indication of how well the roadway facilities serve the traffic demands placed upon them. Roadway operating conditions are classified by calculated levels of service as described below.

Using existing traffic volumes, and the latest, operating signal timings, VHB conducted existing conditions signalized intersection capacity analyses using SYNCHRO software for the intersection of Route 7 with Route 116 and Thurber Boulevard.

2.6.1 Level-Of-Service Criteria

Level-of-service (LOS) is the term used to denote the different operating conditions which occur on a given roadway segment under various traffic volume loads. It is a qualitative measure of a number of factors including roadway geometrics, speed, travel delay, freedom to maneuver, and safety. Level-of-service provides an index to the operational qualities of a roadway segment or an intersection. Level-of-service designations range from A to F, with LOS A representing the best operating conditions and LOS F representing the worst operating conditions.

The LOS designation is reported differently for signalized and unsignalized intersections. For signalized intersections, the analysis considers the operation of each lane or lane group entering the intersection and the LOS designation is for overall conditions at the intersection. For unsignalized intersections, the analysis assumes that traffic on the mainline is not affected by traffic on side streets. The LOS is only determined for left-turns from the main street and all movements from the minor street. The evaluation criteria used to analyze intersections is based on the *Highway Capacity Manual* (HCM)[1]. Table 2-9 provides a summary of the delay criteria versus LOS.

▼

[1] Highway Capacity Manual; Transportation Research Board; Washington D.C.; 2000.

Turn Lanes and Coordinated Traffic Signals – There are existing turn lanes at all of the existing Route 7 traffic signals within the study area. All future intersections along the corridors need to be evaluated to determine if turn lane(s) are required. All existing and proposed traffic signals should also be evaluated to determine the appropriate method of coordination that should be implemented.

Route 7 southbound at Essex Drive

High Speeds and Turning Movements at Route 7/Branch Pike - High speeds along the northern section of Route 7 and turning movements from Branch Pike are issues that need to be considered and addressed in this section of the study area. Access to and from proposed developments using Branch Pike should be considered.

High Speeds and Turning Movements at Route 7/Branch Pike

Route 116/Farnum Pike - The signalized intersection and Stillwater Viaduct Bridge are located at the west end of the project limits. The river creates a natural barrier that requires developments in the southwest corner of the study area to obtain access from Farnum Pike or Route 116.

Route 116 westbound approaching the Stillwater Viaduct and the Farnum Pike Intersection

Route 116/John Mowry Road/ Stillwater Road - John Mowry Road and Stillwater Road primarily service residential uses. New roadways parallel to John Mowry Road located to the east and west could provide access to additional development.

Route 116 eastbound approaching John Mowry Road/ Stillwater Road

Poorly Defined Curb-Cuts along Route 116, West of Route 7 - The Blackie's Tavern restaurant is an example of a poorly defined/delineated curb-cut that currently exists along the western section of Route 116. Access to existing and future developments should be limited to a defined width (24′ to 30′) and better delineated.

Route 116 eastbound at Blackie's Tavern

Numerous Curb-Cuts and Poorly Defined Curb-Cuts along Route 116 East of Route 7 - Existing businesses have multiple curb-cuts that should be limited to a maximum of one access drive per development or a combined access with the adjacent property. The use of frontage or reverse frontage roads should be considered. Other businesses have wide open curb-cuts that should be reduced to a defined width (24′ to 30′) and better defined/delineated.

Route 116 westbound at Crickets Restaurant/Shell Station

Access to Undeveloped Land in Northeast Quadrant of Study Area - Access to undeveloped land in the northeast quadrant of the study area should be considered from Rocky Hill Road and West Reservoir Road, as well as Route 116.

Route 116 eastbound at West Reservoir Road

Alternative Access to/from I-295 - Alternative access to and from I-295 should be considered from Route 116. Providing this new connection would free up capacity at the Route 7/Route 116 intersection, accommodating new traffic generated by additional developments in the area.

Looking east across West Reservoir Road with I-295 in the background

3

Land Use and Projected Development

This Chapter presents the findings of a review of existing Town of Smithfield zoning and the potential for future development of the parcels abutting the study area corridors. The intent of this analysis is to identify the maximum development potential in the study area that can be created under the current regulations given the physical, zoning, and environmental constraints. Projecting the full build-out traffic volumes is essential to fully understand the impacts of land uses on the study area roadways/intersections and access to future developments. For planning purposes, the results of the full build-out analysis will represent a worst case scenario and will not be representative of future year conditions; therefore, a percentage of the full build-out development will be analyzed. The results of the analysis will be a key discussion point to identify and develop an alternative build-out scenario with access management and mitigation to accommodate the projected traffic. An important goal of both conditions (build-out and the alternative build-out) is to portray the results in an effective manner that will facilitate public involvement and support for improving local development regulations and making infrastructure improvements to maintain a high quality of life within the region.

A transportation system exists in part to serve and provide access to adjacent land uses, which in turn generate traffic demands which dictate the design and layout of a transportation system. This interconnectivity between transportation and land use has long been documented as a fundamental relationship that must be considered for a comprehensive transportation and land use planning effort. It was noted in previous chapters that the Douglas Pike (Route 7) and George Washington Highway (Route 116) study area corridors are principal arterials, which based on this classification alone, is a roadway that should primarily provide regional mobility. Lack of coordination between vehicular access and land use has often led to safety issues (crashes), congestion, and air pollution.

Existing and potential land uses are critically important factors to consider during the investigation of corridor access enhancements. The types of uses, their peak use

times, and whether they are daily, weekly, weekends or seasonal, all impact traffic flow and access along the corridor. Therefore, it is important to understand existing and anticipated future land use patterns to understand existing traffic patterns and how they may change over time.

3.1 Existing Land Use

An initial review of existing land uses was summarized based on field reviews and discussions with the town. Based on this review the following existing uses were noted:

- Institutional (Bryant University)
- Corporate Campus (Fidelity Investment, Inc.)
- Hotel
- Restaurant
- Office
- Retail
- Commercial/Business
- Residential

There are a few parcels that were developed but were unoccupied at the time the field edits were performed. During the review of existing conditions the undeveloped/unoccupied parcels were identified so that future build-out could be developed as discussed in the following sections.

3.2 Existing Regulations

The Route 7 and Route 116 corridor study area includes the Town of Smithfield's Planned Corporate, Commercial, Highway Commercial, Industrial, Light Industrial, Planned Districts, and Residential zoning districts, as shown in Figure 2-3. In addition, both the Route 7 and Route 116 corridor is under the jurisdiction of the RIDOT, and as such State Regulations are applicable to the corridor. The following is a zoning summary for the major zones along the corridors.

3.2.1 Town of Smithfield Zoning

Most of the vacant land is located in the Planned Corporate (PC) district. The following is a discussion of the Smithfield Zoning Ordinance regulations for the properties zoned Planned Corporate.

3.2.2 PC – Planned Corporate

- Uses allowed by right or special permit include:
  - **Agriculture Uses** – Non-commercial raising of crops & trees; Conservation.
  - **Office Uses** – Construction Trailer on Construction Site; Government, Business, or Professional Office; Office Park; Real Estate Office (Temporary); Medical/Dental Office; HMO.
  - **Public & Semi**-Public Uses – College; Cultural Activities, Libraries, Museums, Galleries; Day Care Center; Municipal Building (except penal facility); Municipal Fire, Police, or Rescue Station; School (Public or Private); Trade School (not utilizing vehicles repair); Utilities (Public or Private).
  - **Outdoor Recreation** – Golf Course or Country Club; Public Park (Playground).
  - **Restaurant & Entertainment** – Restaurant (with entertainment and alcohol) as accessory use.
  - **Retail Business & Service** – Bank (with or without drive-thru); Catering Establishments; Dry Cleaning Establishments; Health & Fitness Center; Hotel & Conference Center; Full/Self Service Laundry as accessory use; Radio, Televisions, and Communications Studio/ or Tower; Indoor Recreation; Retail Sales under 5,000 square feet; Communications Antenna.
  - **Wholesale Business & Storage** – Including Storage of Flammable Materials.
  - **Service Industries** – Automotive Body Shop; Trade Establishments; Machine Shop (metal works).
  - **Industrial Uses** – Research & Development; Industrial Park; Light Industrial; General Industrial.
  - **Transportation Uses** – Airport; Heliport; Helipad; Off-Street Commercial Parking, Parking Storage.
  - **Accessory Uses**

- Primary Dimensional Regulations (based on a single site):
  - minimum lot size 3 acres
  - minimum frontage and lot width is 200′
  - height is limited to 48′
  - maximum lot coverage is 35% (structure only)
  - setbacks - 150′ front; 50′ to lot line (side)

3.2.3 State Review Procedures

As stated previously, Route 7 and Route 116 are under the jurisdiction of the Rhode Island Department of Transportation (RIDOT). Any modifications proposed along the study area corridors within the state right-of-way will require RIDOT approval through the Physical Alteration Permit (PAP) process. The permit guidelines and requirements are described in the Rules and Regulations Concerning Permission for Use of State Highway Rights-of-Way. The purpose of these rules and regulations is to prescribe conditions pursuant to Rhode Island General Laws, Chapter 24-8, under which the RIDOT will allow alterations, through the PAP process, including but not limited to modifications/installation of curbs, sidewalks, highway access, stormwater disposal, construction within the State Highway Right-of-Way, and signage.

It should be noted that although the corridors are under the jurisdiction of the RIDOT, which means that any access must meet state requirements and be approved through the PAP process, additional restrictions/requirements can be mandated by the Town in order to insure that the design standards and planning goals of the Town are met. The Town's standards and goals include increasing overall mobility, accessibility and safety for residents, businesses, employees, and visitors while decreasing traffic congestion and its negative impacts on the environment, economy and quality of life.

3.3 Future Land Use

One component of forecasting future traffic volumes within the study area is to identify the development potential of the parcels along the corridor. In the case of this study, the primary focus is the development of the large area of undeveloped parcels along the study area corridors and less on the redevelopment of existing parcels. For this study the redevelopment of existing parcels to determine the amount of additional development that could occur was not performed because this incremental increase was considered to be insignificant compared with the impacts of developing the vacant/undeveloped parcels. The study did; however, include proposed developments in the study area that were discussed with property owners. The following is a summary of the undeveloped parcels, current zoning, lot sizes, buildable area, and maximum allowable building size.

Table 3-1 Undeveloped/Underdeveloped Parcels along Route 7 & Route 116 Corridors

Plat/Lot	Address	Owner	Lot Size (ksf)	Buildable* Lot Size (ksf)	Max New Structure Size (ksf)
45/18	955 Douglas	Jake Development Co.	1,401.0	1,023.5	459
46/173	950 Douglas	Smithfield Realty	155.1	135.5	47
46/179	944 Douglas	Cedar Swamp Realty	127.5	87.5	31
46/260	176 Washington	Jackvony	167.5	44.5	16
46/277	0 Washington	Bryant	172.4	49.0	17
46/290	999 Douglas	Town of Smithfield	158.8	136.5	48
46/375	14 Summer	Belair Realty	242.0	191.5	67
46/379	0 Washington	Crossroads Enterprise	198.4	198.5	69
46/64	0 Washington	Bryant	177.2	71.0	25
46/66	0 Douglas	Route 7 Realty	187.0	78.0	27
46/66A	220 Washington	Baffoni	74.8	70.1	25
46/71	0 Washington	Rollingwood Acres	208.6	169.0	59
46/72	105 Lydia Ann	Jake Development Co.	117.5	27.3	10
46/73	311 Washington	Jake Development Co.	75.6	15.3	5
46/74	95 Washington	Rollingwood Acres	203.6	62.6	22
46/75B	975 Douglas	Conti	248.6	246.0	86
46/76	961 Douglas	Rollingwood Acres	1,474.6	1,131.1	396
46/77	961 Douglas	New Life Worship Cen.	1,690.0	1,307.6	100
46/85	900 Douglas	Smithfield Office Cen.	1,601.5	1,193.8	132
46/87D	0 Hanton City	GDC Realty	78.0	78.0	27
46/89	235 Washington	Windham	104.3	104.5	45
46/89A	0 Hanton City	Windham	127.3	127.5	45
48/10	84 Hanton City	Haley Trust	851.7	728.0	255
48/2	364 Washington	Dover Two LLC	2,850.8	2,163	757
48/3A	21 W Reservoir	Weinberg	104.6	77.5	27
48/4	376 Washington	Weinberg	362.8	297.0	104
48/4B	99 Hanton City	Weinberg	69.1	45.0	16
48/9	73 Hanton City	Daniel	2,145.2	1,658.5	580
49/64	55 Branch	Gallo	1,078.4	760.5	266
49/65	35 Branch	Ramos	977.9	279.5	98
49/78	30 Hanton City	Alexion Manufacturing	954.0	567.9	199
49/92	50 Hanton City	Bissonnette	477.1	83.0	29
49/93	56 Hanton City	Bissonnette	40.2	40.0	14
49/95	60 Hanton City	Daniel	751.9	703.0	246
49/96	61 Hanton City	Dover Two LLC	1,328.3	1,030.0	360
49/100	0 Washington	Alice C. Sleboda	642.3	296.1	104
49/101	0 Washington	Harris Revocable Trust	1,007.3	177.6	62

Plat/Lot	Address	Owner	Lot Size (ksf)	Buildable* Lot Size (ksf)	Max New Structure Size (ksf)
49/102B	280 Washington	Butera	111.5	87.5	31
49/109	1070 Douglas	Bryant	4,599.0	1,440.7	504
49/#	Varies	FMR Rhode Island	2,347.8	1,279.9	448
49/##	Varies	RI Econ. Development	1,637.6	519.0	182

Source: Compiled by Vanasse Hangen Brustlin, Inc. (VHB).
1 Additional structures that are proposed on underdeveloped parcels.
Includes Lots 98, 98A, and 99
Includes Lots 74A, 75, 76, 77, 102, 102A, 106, 106A, 107, 107A, 107B, 108

4

Future Traffic Conditions

This Chapter provides an assessment of the future traffic conditions at the two key study area intersections identified in previous chapters of this study. Sections of this chapter present discussions on future traffic growth, which includes potential developments and future traffic operations.

4.1 Traffic Forecasts

Traffic volumes in the study area are projected to increase in the future primarily due to the construction of buildings on undeveloped parcels in the study area. Trip generation projections based on full build-out and partial build-out of the undeveloped parcels are detailed in this chapter.

Traffic growth in the study area will also increase to a lesser extent from traffic traveling through the study area that is not included in the full build-out trip generation of unoccupied parcels. This increase in traffic is considered as background growth. Several methods can be used to estimate this growth. A procedure frequently employed is to estimate an annual percentage increase based on historic data and apply that increase to existing study area traffic volumes. Based on a review of historic data, traffic volumes have remained relatively flat or have experienced a reduction over the past few years. For the purpose of this study, and to provide a planning level assessment of the study area, only the traffic growth based on various build-out scenarios of undeveloped properties will be utilized. The two levels of build-out consist of full build-out and partial build-out. Full build-out consists of full development of all unoccupied parcels while partial build-out consists of developing only the amount of development that can be supported with only minor infrastructure improvements. More details on the methodology used for each is described below.

4.1.1 Future Build-Out of Undeveloped Parcels

This section discusses the procedures used to project the volume of traffic expected to be generated by the full build-out and partial build-out of the undeveloped parcels

in the study area. This effort consisted of identifying the location, owner(s), and size of undeveloped parcels in the study area. The next step was to identify site constraints including wetlands/streams (including required buffers), utility easements, and various regulations including, but not limited to, setback requirements and maximum structure size. Based on the maximum allowable structure size and the type of use(s) allowed (based on the Town Zoning Regulations), the full build-out daily and peak hour traffic volumes were calculated using trip generation rates based on the Institute of Transportation Engineers (ITE) Trip Generation 8th Edition database. After developing full build-out traffic projections, a partial build-out scenario was developed that could be reasonably supported based on limited improvements to study area roadways and intersections to mitigate the projected increase it traffic. The following is a summary of the development of projected traffic volumes for the full build-out and partial build-out of currently undeveloped parcels.

Table 4-1 Projected Full Build-Out Traffic Generation

Plat/Lot	Address	Owner	Lot Size (sf)	Buildable* Lot Size (ksf)	Max Structure Size (ksf)	Daily Trips	AM Peak Trips	PM Peak Trips
45/18	955 Douglas	Jake Development Co.	1,401.0	1,023.5	459	4,315	635	595
46/173	950 Douglas	Smithfield Realty	155.1	135.5	47	750	105	130
46/179	944 Douglas	Cedar Swamp Realty	127.6	87.5	31	535	75	115
46/260	176 Washington	Jackvony	167.5	44.5	16	320	40	95
46/277	0 Washington	Bryant	172.4	49.0	17	345	45	100
46/290	999 Douglas	Town of Smithfield	158.7	136.5	48	755	105	130
46/375	14 Summer	Belair Realty	242.0	191.5	67	980	135	155
46/379	0 Washington	Crossroads Enterprise	198.4	198.5	69	1,005	140	155
46/64	0 Washington	Bryant	177.2	71.0	25	455	60	105
46/66	0 Douglas	Route 7 Realty	187.0	78.0	27	490	65	110
46/66A	220 Washington	Baffoni	74.8	70.1	25	450	60	105
46/71	0 Washington	Rollingwood Acres	208.6	169.0	59	890	125	145
46/72	105 Lydia Ann	Jake Development Co.	117.5	27.3	10	105	15	15
46/73	311 Washington	Jake Development co.	75.6	15.3	5	60	10	10
46/74	95 Washington	Rollingwood Acres	203.6	62.6	22	415	55	105
46/75B	975 Douglas	Conti	248.6	246.0	86	1,190	165	175
46/76	961 Douglas	Rollingwood Acres	1,474.6	1,131.1	396	4,360	615	590
46/77	961 Douglas	New Life Worship Cen.	1,690.0	1,307.6	100	1,100	155	150
46/85	900 Douglas	Smithfield Office Cen.	1,601.5	1,193.8	132	1,455	205	195
46/87D	0 Hanton City	GDC Realty	78.0	78.0	27	490	65	110
46/89	235 Washington	Windham	104.3	104.5	36	720	100	130
46/89A	0 Hanton City	Windham	127.3	127.5	45	715	100	130

Plat/Lot	Address	Owner	Lot Size (sf)	Buildable* Lot Size (ksf)	Max Structure Size (ksf)	Daily Trips	AM Peak Trips	PM Peak Trips
48/10	84 Hanton City	Haley Trust	851.7	728.0	255	2,740	395	365
48/2	364 Washington	Dover Two LLC	2,850.8	2,163	757	6,340	945	925
48/3A	21 W Reservoir	Weinberg	104.6	77.5	27	490	65	110
48/4	376 Washington	Weinberg	362.8	297.0	104	1,375	195	195
48/4B	99 Hanton City	Weinberg	69.1	45.0	16	320	45	95
48/9	73 Hanton City	Daniel	2,145.2	1,658.5	580	5,170	765	730
49/64	55 Branch	Gallo	1,078.5	760.5	266	2,835	410	375
49/65	35 Branch	Ramos	977.9	279.5	98	1,310	185	190
49/78	30 Hanton City	Alexion Manufacturing	954.0	567.9	199	2,265	325	300
49/92	50 Hanton City	Bissonnette	477.1	83.0	29	515	70	110
49/93	56 Hanton City	Bissonnette	40.2	40.0	14	295	40	95
49/95	60 Hanton City	Daniel	751.9	703.0	246	2,670	385	355
49/96	61 Hanton City	Dover Two LLC	1,328.3	1,030.0	360	3,580	525	485
49/100	0 Washington	Alice C. Sleboda	642.3	296.1	104	1,370	195	195
49/101	0 Washington	Harris Revocable Trust	1,007.3	177.6	62	685	95	95
49/102B	280 Washington	Butera	111.5	87.5	31	535	75	115
49/109	1070 Douglas	Bryant	4,599.0	1,440.7	504	5,550	780	750
49/#	Varies	FMR Rhode Island	2,347.8	1,279.9	448	4,955	715	665
49/##	Varies	RI Econ. Development	1,637.6	519.0	182	2,000	280	270
			Total Projected Trips			**66,900**	**9,565**	**9,970**
			5% Build-Out Scenario Projected Trips			**3,345**	**478**	**498**
			15% Build-Out Scenario Projected Trips			**10,035**	**1,435**	**1,495**

Source: Compiled by Vanasse Hangen Brustlin, Inc. (VHB).
* Excludes Non-Buildable Areas with 50' Wetland Buffer, 50' Lake Buffer, 100' Stream Buffer, 100 Year Flood Plane Zone, and Lot Boundary Offset Requirements.
\# Includes Lots 98, 98A, and 99
\## Includes Lots 74A, 75, 76, 77, 102, 102A, 106, 106A, 107, 107A, 107B, 108

As shown in Table 4-1, the total traffic volumes projected for the full build-out of all undeveloped parcels are substantial (approximately 66,900 trips per day, 9,565 trips during the morning peak hour, and 9,970 trips during the evening peak hour). The existing study area roadways and intersections cannot accommodate the total full build-out traffic volumes. In order to assess the traffic impacts of a more modest development program, 5 to 15 percent of the full build-out of the undeveloped parcels was considered. This more modest development program would result in a projected traffic increase of approximately 3,350 – 10,050 trips per day, 475 – 1,450 trips during the morning peak hour, and 500 – 1,500 trips during the evening peak hour

4.2 Future Traffic Operations Analysis

Measuring existing traffic volumes and projecting future traffic volumes quantifies traffic flow within the study area. To assess quality of flow, roadway capacity analyses were conducted with respect to Existing and projected Future traffic volume conditions. Capacity analyses provide an indication of how well the roadway facilities serve the traffic demands placed upon them. Roadway operating conditions are classified by calculated levels of service. Using the same criteria defined in Chapter 2, which is again summarized in Table 4-2 below, the level-of-service analysis for the future conditions was determined.

Table 4-2 Level of Service Criteria

Level of Service	Signalized Intersection (delay)	Unsignalized Intersection (delay)
A	0 to 10 seconds	0 to 10 seconds
B	10 to 20 seconds	10 to 15 seconds
C	20 to 35 seconds	15 to 25 seconds
D	35 to 55 seconds	25 to 35 seconds
E	55 to 80 seconds	35 to 50 seconds
F	Greater than 80 seconds	Greater than 50 seconds

Source: 2000 Highway Capacity Manual Exhibits 16-2 and 17-2

It is recommended that a larger study be undertaken and the study area be expanded in order to further assess the impacts of the full build-out of undeveloped parcels including land that is located along Route 116 east of I-295 and impacts to the existing I-295/ Route 7 interchange and proposed new I-295/Route 116 interchange. An Environmental Impact Statement (EIS) would be required for this project.

4.2.1 Signalized Intersections Capacity Analysis

A capacity analysis was conducted for two of the signalized intersections within the study area (Route 7 at Route 116 and Thurber Boulevard) based on traffic generated by 5 to 15 percent of the full build-out of the undeveloped parcels. Based on an equal distribution of development and projected traffic along the Route 7 and Route 116 study area corridors the existing roadways and intersections can accommodate the projected traffic generated by 5 to 15 percent of the total build-out of the undeveloped parcels with the following mitigation:

Route 7/Route 116 Intersection

- Restripe the northbound approach to add a second left-turn lane (no widening required) in order to reallocate time (increase time allocated to the southbound through movement)
- Restripe the eastbound approach to add a second left-turn lane (no widening is required) in order to reallocate time (increase time allocated to the westbound through movement)

Route 7/Thurber Boulevard Intersection

- Widen Route 7 to provide a third lane on the southbound approach
- Change the northbound protected/permissive left-turn to protected only

This preliminary assessment is based on the assumption that the partial build-out and projected traffic is equally distributed over the entire study area. Depending on the actual location where developments may occur, the level of development may vary dramatically.

In order to accommodate traffic generated by the additional development beyond the 5 to 15 percent of the full build-out, new access/egress to and from I-295 from Route 116 will need to be constructed. This new interchange is required to avoid sending more traffic through the congested Route 7/Route 116 signalized intersection. The Route 7/Route 116 signalized intersection already has dual left-turns on the Route 116 westbound and Route 7 southbound approaches. As stated previously dual left-turn lanes can be added to the northbound and eastbound approaches by restriping; however it is impractical to widen this intersection to accommodate over 25% of the full build-out of the undeveloped parcels in the study area.

In addition to constructing a new I-295/Route 116 interchange, additional roadways providing access to proposed developments and providing a bypass of the Route 7/Route/116 signalized intersection may be required. These roadways will not only allow traffic generated by proposed developments to bypass the congested Route 7/Route 116 signalized intersection, but with proper design can also provide better access management along the Route 7 and Route 116 corridors.

4.2.2 Unsignalized Intersection Capacity Analysis

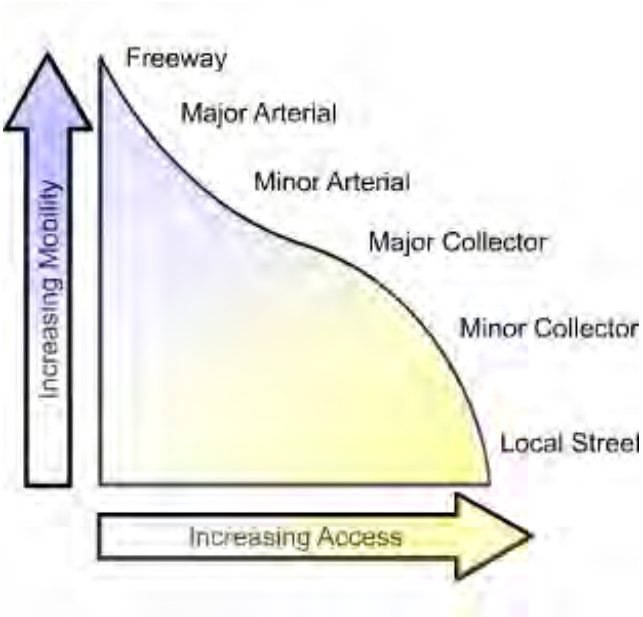
None of the unsignalized intersections were analyzed as part of this study; however based on the relatively high mainline traffic volumes, the unsignalized driveways along the Route 7 and Route 116 corridors experience long delays during the peak periods. As traffic volumes increase the delays will continue to increase under the build-out scenario.

As stated above, it is recommended that additional roadways be constructed in conjunction with future developments providing access to proposed developments and providing a bypass of the Route 7/Route 116 signalized intersection. These roadways will not only allow traffic generated by proposed developments to bypass the congested Route 7/Route 116 signalized intersection, but with proper design can also provide better access management along the Route 7 and Route 116 corridors.

5

Corridor Access Management

Access management is a useful strategy to preserve the character of a roadway and to ensure safe and efficient traffic operations through the management of points of access to adjacent land uses. Land use and transportation planning must be coordinated to ensure that a roadway is accessible, safe, and can provide adequate traffic operations now and in the future. Applying proper access management techniques provides a balance amongst the movement of traffic, access to local land uses, and maintaining the character of the community and the corridor. Poor access management can cause deterioration in traffic operations and safety. In addition, poor planning of land development increases conflicts between adjacent land uses and regional corridor operations.



This study adresses the challenges of integrating transportation, land use, and context sensitive design. Reaffirming land use tools are key to providing a successful plan along a corridor that has the Town of Smithfield and the Rhode Island Department of Transportation as distinct stakeholders. The plan developed will need to balance the needs of regional mobility while paying particular attention to the local needs. The collaboration of town officials and planners, and the consultant selected, will need diverse options to develop the "best" possible solution for the corridor.

There are numerous driveway curb cuts, five signalized intersections and approximately 60 unsignalized driveways/intersections that exist along the corridors today. Most of the curb cuts along the corridor serve as primary or secondary access to office or commercial uses.

Developed areas of the Douglas Pike (Route 7) and George Washington Highway (Route 116) corridors are congested today, and future development and the traffic demands generated will only add to the congestion and needs to be closely monitored/reviewed. The corridors have several large vacant parcels that have the

potential to generate a significant amount of traffic and new access points over study area roadways. Many studies have verified the correlation between crash frequency and the number of driveways and intersections along such congested corridors. Should these large sites become occupied in the future, crash frequency may increase. Therefore it is important to establish a plan now that can provide the necessary tools to implement access management techniques for parcels that are to be developed/redeveloped.

The implementation of access management techniques along the Route 7 and Route 116 corridors will be easier to accomplish due to the fact that there are large areas of undeveloped land along these corridors and the fact that the town is actively in the process of developing guidelines and ordinances that require implementation of access management techniques. There are some areas along the corridors where implementation of access management techniques will be more challenging in that private infrastructure (driveways, parking, signage, utilities, etc.) have already been constructed immediately adjacent to the roadway's right-of-way. In these areas efforts should be made to eliminate, consolidate, or restrict access for some of the properties and provide internal circulation between parcels and limit truck delivery access.

Since there are some existing operating deficiencies along developed sections of the corridors (i.e. congestion, crash frequency and a high number of access points), access management needs to be retrofitted to the corridors and a plan needs to be established for future redevelopment. This Chapter provides an overview of transportation strategies, land use strategies, and provides a brief summary of techniques used by other agencies. The following is discussed in greater detail:

- A review of the Ten Principles of Access Management and how they compare to the Route 7 and Route 116 corridors.
- A summary of access management techniques and the access issues they would address.
- A review of land use regulations.
- A summary of access management practices.

5.1 Transportation Strategies

Typically corridors that have been extensively developed may never meet access management standards or requirements. This is why it is so important that the Town is taking the initiative to implement an ordinance and policies to address issues before the corridors experience major development. In areas where there has already been development, policies need to be adopted to avoid further degradation of the corridor. The town must develop and adopt procedures/ordinances that require

future developments or modifications to existing developments to implement improvements that address traffic and access issues. In this section, the ten principles of access management will be reviewed and evaluated in relation to the Route 7 and Route 116 corridors. Following this evaluation, a set of strategies have been identified that may be applicable to study area corridors.

5.1.1 Ten Principles of Access Management

In Chapter 1 an overview of the Ten Principles of Access Management were reviewed. These principles have also been defined and summarized in this section; however, each principle has been compared to the existing characteristics of the corridor. The goal of this effort is to provide the reader with an overview of the issues and challenges with the application of access management techniques to the Route 7 and Route 116 corridors.

1. Provide a Specialized Roadway System: Design and manage roadways according to the primary functions they serve.

   Corridor Comparison: The Route 7 and Route 116 corridors are classified as Principal Arterial Roadways, meaning through traffic mobility is considered a priority. For the most part the study area corridors are currently operating in this manner; however, there are some locations along the corridor where there are many access points, emphasizing access and not mobility.

2. Limit Direct Access to Major Roadways: Direct property access is more compatible with local and collector roadways.

   Corridor Comparison: As mentioned in bullet 1 above, the Route 7 and Route 116 corridors are both Principal Arterial Roadways promoting regional mobility. The Route 7 corridor currently has approximately 25 access points (driveways or intersections) over the two-mile length. The Route 116 corridor currently has approximately 45 access points (driveways or intersections) over the two-mile length. All access points along both corridors provide full turning access for vehicles, which creates numerous vehicle conflicts and negatively impacts mobility. Providing direct property access to the corridor encourages the corridor to operate more as a local or collector roadway.

3. Promote Intersection Hierarchy: A functional classification system is important to promote access from one classification of roadway to another.

   Corridor Comparison: Under this principle the following roadway hierarchy would be most desired. Note that definitions have been provided below for each roadway classification. These definitions were obtained from the Access Management Manual prepared by the Transportation Board (TRB) in 2003.

A. *Arterial Roadways: A major roadway intended primarily to serve through traffic, and where access is carefully controlled. This roadway is intended to serve moderate to high volumes of traffic.*
B. *Collector Roadways: Road intended to move traffic from local roads to secondary arterials.*
C. *Local Roadway: A roadway with the primary function of providing access to adjacent properties and to roadways of a higher functional classification.*

As indicated above, access is most desired from either a collector or local roadway. The lack of these two roadways along the study area corridors limits the ability to reduce vehicle conflict by promoting parcel connections with adjacent streets. As a result, the Route 7 and Route 116 corridors have been developed over the years to promote direct access from parcels to an arterial roadway; this does not promote intersection hierarchy.

4. Locate Signals to Favor Through Movements: Poor signal placement may lead to delays and uniform spacing enhances the ability to coordinate traffic signals and ensure continuous movement of traffic.

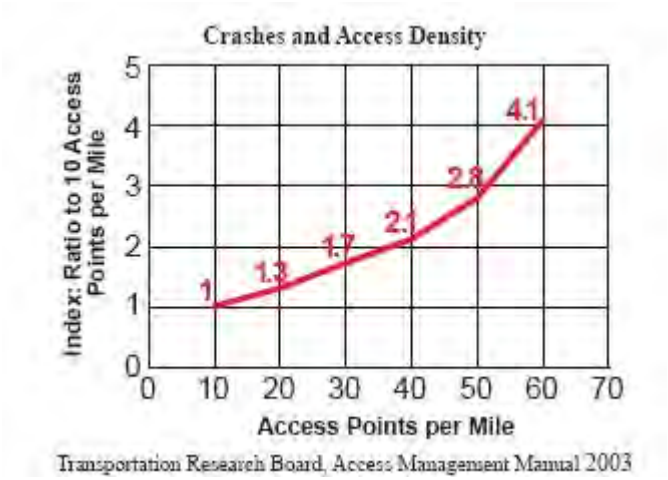
   Corridor Comparison: The Route 7 corridor currently has four traffic signals that are adequately spaced. There are only two traffic signals on Route 116 (one being the intersection with Route 7) that are located at the beginning and middle of the study area corridor which are adequately spaced. The long distance between traffic signals and relatively straight alignments of both corridors may also be the reason for the vehicle speeds along these corridors being above the posted speed limit.

5. Preserve the Functional Area of Intersections: Driveway connections too close to intersections can cause conflicts that impair the function of the intersection.

   Corridor Comparison: The only intersection that currently has driveways in close proximity is the Route 7/Thurber Boulevard intersection with driveways located on the eastbound approach and on the northbound departure.

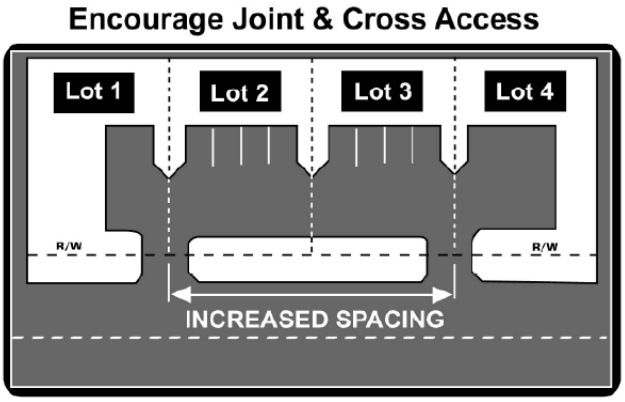
6. Limit the Number of Conflict Points: Limiting the number and type of conflicts between vehicles, vehicles and pedestrians, and vehicles and bicyclists will reduce the likelihood that drivers will make mistakes and have collisions.

   Corridor Comparison: There are approximately 90 access points (driveways or intersections) over the four-mile study area corridors, with all of these driveways providing full access for vehicles. The number of access points increases the likelihood of collisions, as more driveways introduce more conflict points.

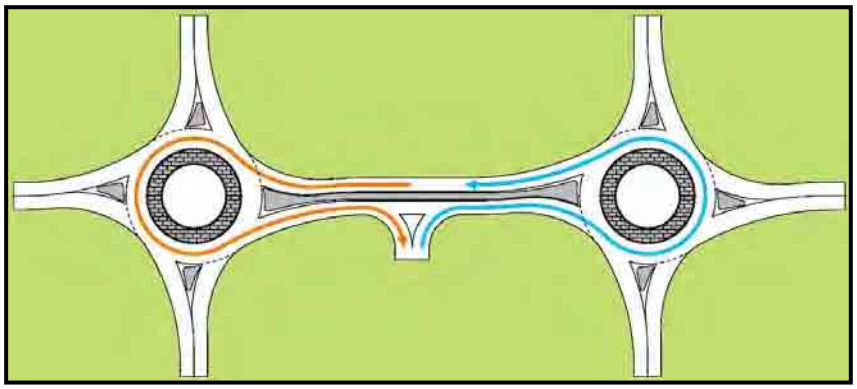


7. Separate Conflict Areas: Increasing driveway spacing provides drivers with the ability to address one set of potential conflicts before addressing another. As travel speeds increases along a corridor so should the driveway spacing.

   Corridor Comparison: As a Principal Arterial, the Route 7 corridor should have driveways spaced every 530 feet (see the Access Management Techniques section). The Route 116 corridor, which is also a Principal Arterial, should have driveway spacing every 780 feet. Both corridors have sections where the driveway spacing is less than 200 feet. Therefore, both corridors currently have areas that do not meet the requirements of its functional classification.



8. Remove Turning Vehicles from Through Traffic Lanes: Accommodate left-turns to the extent possible.



Corridor Comparison: All key intersections along the Route 7 and Route 116 corridors provide designated left-turn lanes with the exception of the Route 7/Essex Street intersection. A southbound left turn lane at the Route 7/Essex Street intersection was not provided because almost all southbound left-turns into the Fidelity campus are made at the Route 7/Salem Street intersection. There are currently no accommodations for left-turn movements at any of the unsignalized intersections/driveways with the exception of the Route 116 eastbound left-turn into the Navigant Credit Union driveway. Provisions for left turn storage will improve the operation and safety of a corridor and should be considered. If feasible, roundabouts along the corridors can remove stopped turning vehicles from the through lanes and the occurrence of unexpected stopped vehicles within the roadway is greatly reduced. This creates a "Dog-Bone" configuration, in which all left-turning movements can be removed between adjacent roundabouts.

9. Use Raised Medians to Manage Left-Turn Movements: Minimize left turns.

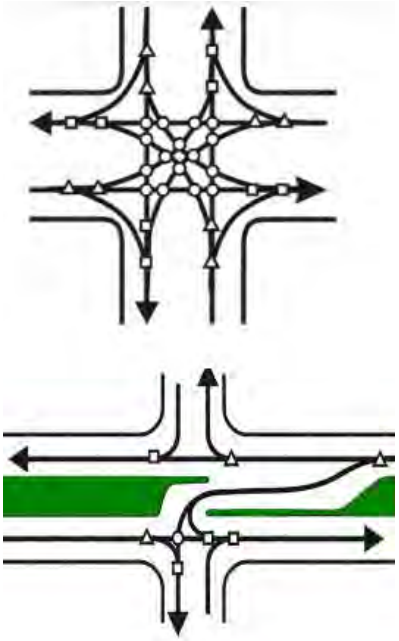
   Corridor Comparison: A median is currently not present along either corridor. In order to accommodate a raised median, and maintain access to existing businesses, widening and relocation of utilities and signs could be required at some locations. In addition, u-turns would need to be provided at critical intersections and accommodations for large trucks would need to be provided.

10. Provide a Supporting Street and Circulation System: Well-planned, interconnected, commercial strip development with separate driveways is not desired.

    Corridor Comparison: The Route 7 and Route 116 corridors are currently operating with parcels that access the roadway with individual access driveways, and in some cases parcels have multiple access points. This principle supports the construction of collector roadways and local streets so that parcels can access the arterials in a fashion so that shared access driveways and interconnecting driveways can be provided.

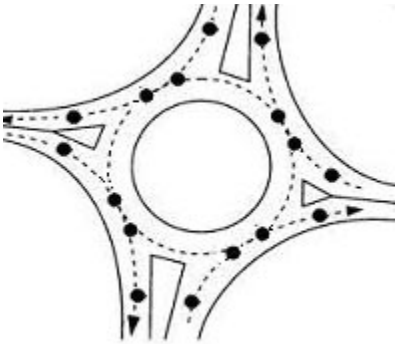
Since the corridor doesn't meet most of these principles, and in some instances parcels are developed up to the roadway with little to no buffer, introducing implementation of an access management plan and ordinance is recommended. The following section reviews some of the more common retrofit strategies.

5.1.2 Retrofitting a Corridor



Most retrofit actions limit the number of conflict points, separate conflict areas, and remove turning lanes from the through lanes. As illustrated to the left, the installation of center medians with left-turn lanes and roundabouts reduce the number of conflict points compared to a typical four-way intersection. The following provides a summary of various retrofit techniques:

- Provide right-turn lanes;
- Provide left-turn lanes;
- Provide two way left turn lane (TWLTL);
- Install a median;
- Close median openings;
- Install a frontage road;
- Install or modify traffic signals;
- Widen driveways and improve storage area;
- Consolidate driveways;
- Relocate or reorient access;
- Close driveways;
- Redesign internal road and parking system; and
- Remove signals and install roundabouts.



The characteristics of the Route 7 and Route 116 corridors are such that implementation of many of these techniques can be accomplished in conjunction with further development along the corridors. The following section presents both access management techniques that could be implemented to the corridor under current conditions, and if and when parcels are developed/redeveloped.

5.1.3 Access Management Techniques

There are several access management techniques that can be used to organize or minimize traffic movements (or conflicts). This section reviews techniques that could be applied to the corridors so that the capacity of the study area along Route 7 and Route 116 can be preserved and/or enhanced. Some of these techniques can also be applied to manage entering and exiting traffic from land uses more efficiently; however, these techniques cannot be forced upon the owner of the adjacent parcel.

An access management matrix has been prepared that correlates access concerns to access management techniques. This matrix is summarized below and illustrated in Table 5-1.

Table 5-1 Access Management Matrix

	Access Issues									
Access Techniques	Limit Turning Movement Conflicts	Separate Turning Movement Conflicts	Auxiliary (Turn) Lanes	Left Turns Exiting a Site	Left Turns Entering a Site	Pedestrian Access/Safety	Bicycle Access/Safety	Roadway Operations	Excessive Driveways	Driveway Operations
Roadway Treatments										
Continuous Two-Way Left-Turn Lane (TWLTL)			X		X			X		
Center Raised Median	X			X	X	X		X	X	X
Shoulder Lane Treatments		X					X	X		
Secondary Roadways										
Frontage/Service Roads	X	X						X	X	
Reverse Frontage Roads	X	X				X		X	X	
Controlled Access										
Traffic Signal Spacing		X		X	X	X	X	X		X
Driveway Design Standards										
Closure								X	X	X
Spacing, corner clearances	X	X		X	X	X	X	X	X	X
Joint and Cross Access	X	X		X	X	X	X	X	X	X
Sight Distances		X		X				X		X
Throat Length		X		X	X			X		X
Pedestrian Facilities										
Crosswalk Treatments		X				X	X	X		
New Pedestrian Crossings						X	X	X		
Public Transit										
Bus Stop Location		X				X		X		
Vehicle Guidance										
Restrict Turn Movements	X			X	X	X	X	X		X

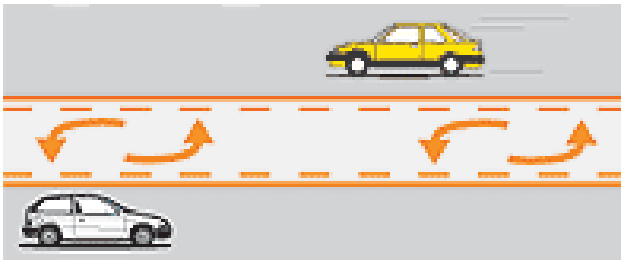
In many cases the access management techniques discussed above are unlikely to be applied to the corridor as stand-alone alternatives, and they also may need to be considered as part of land use regulations (ordinance or new zoning). These land use regulations are discussed in the next section.

Roadway Treatments

Roadway treatments can be used to improve safety, access and capacity along a particular segment of roadway or along a corridor as a whole. The following provides a short summary and breakdown of advantages and disadvantages for each treatment.

Continuous Two-Way Left-Turn Lane (TWLTL)

This treatment can improve capacity and traffic flow along a corridor by removing left-turn traffic from the mainline. Implementation of this alternative is not as desirable as other treatments; however, there may be intermediate term applications along the Route 116 corridor where this may be considered. Application of a TWLTL is commonly used in developed areas with a high frequency of low volume driveways such as strip commercial developments. This often results in motorists exiting driveways and using the TWLTL as a refuge or acceleration lane. This treatment typically loses its efficiency when roadway daily traffic volumes are over 24,000 vehicles per day.[2]



Aside from separating the mainline left turning traffic from the through movements, the safety and efficiency of this treatment is contingent primarily on driveway location, spacing and volume. Driveways on opposite sides of a roadway where this treatment is applied should be located such that opposing left-turn movements on the mainline can be completed by a vehicle without having to occupy the same portion of the TWLTL. Furthermore, driveways should be spaced adequately such that vehicles making left-turns from a property do not conflict with vehicles at adjacent driveways.

Advantages

- Removes left-turn movements from main travel lane which could result in an increase in vehicle safety when compared to a roadway with no TWLTL
- Increases capacity compared with an undivided roadway
- Reduces delay compared with undivided roadways

Disadvantages

- Efficiency of TWLTL is compromised when traffic volumes reach 24,000 vehicle per day
- Lane can be used as an acceleration or deceleration lane
- Doesn't restrict turn movements, and full access is permitted from driveways

[2] Access Management Manual, Transportation Research Board of the National Academies, 2003

- Accommodates strip development along major roadways with frequent access points, which can lead to safety issues if driveway spacing is inadequate
- Longer pedestrian crossings with no refuge area
- Overlapping left-turn movements

Roundabouts

A roundabout is a type of circular intersection with yield control of entering traffic, islands on the approaches, and appropriate roadway curvature to reduce vehicle speeds. Roundabout can provide a level of flexibility for driveways and other access points at and near intersections and along corridors.

The following are some reasons to consider roundabouts along the Route 7 and Route 116 corridors:

Advantages

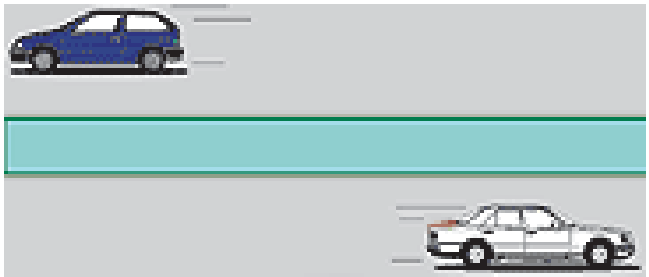
- Roundabouts shown to improve safety, with a reduction in 35% in all crashes, with 76% reduction in injury crashes.
- Reduce congestion, pollution and fuel use by offering fewer stops and hard acceleration and less time idling.
- Eliminated left-turning movements at intersections.
- Driveways on opposite sides of the roadway can be located closer together;
- Reduces length of pedestrian crossings and establishes a pedestrian refuge area;

Disadvantages

- Requires higher costs and ROW compared to a traditional intersection.

Center Raised Median

Non-traversable raised medians can provide improved access control, capacity and safety along a corridor. Implementation of a raised median limits the majority of private driveways to right-in/right-out operation thus reducing the number of vehicle conflict points and the amount of information that motorists have to process before and during a movement. However, turn-around locations (or u-turns) also need to be constructed at critical intersections to allow vehicles access to properties on both sides of the roadway. If feasible, roundabouts along the corridors can remove stopped turning vehicles from the through lanes and the occurrence of unexpected stopped vehicles within the roadway is greatly reduced. This creates a "Dog-Bone" configuration, in which all left-turning movements can be removed between adjacent roundabouts. The following are some reasons to consider a raised median along the Route 7 and Route 116 corridors:



- Research has concluded that raised medians reduce crash rates by approximately 30-percent over a roadway that has a TWLTL.[3]
- Research has found that raised medians are increasingly safer than roadways with a TWLTL when volumes exceed 24,000 to 28,000 vehicles per day.

Advantages

- Improves safety through reduced vehicle conflicts by separating opposing movements;
- Driveways on opposite sides of the roadway can be located closer together;
- Reduces length of pedestrian crossings and establishes a pedestrian refuge area;
- Improves traffic mobility by removing delay caused by left-turning vehicles (left-turns came be made at roundabouts); and
- Has the potential to reduce the number of crashes than if no median is present.

Disadvantages

- Restricts driveway movements to a right-turn in and out only;
- Requires u-turns to be accommodated at intersections (if roundabouts are not implemented), which could require additional right-of-way to accommodate movements; and
- Could require roadway widening and impacts to adjacent businesses.

Shoulder Treatments

Shoulder widths can have a significant impact on mobility and vehicle safety. As currently configured, the Route 7 corridor has 2 to 6 foot shoulders and the Route 116 corridor has 10 to 14 foot shoulders. As a result, there are various locations that do not meet current design standards. It is important to note that design standards have changed since the existing Route 7 and Route 116 roadway cross sections were constructed. Also, wider shoulders become more critical when coupled with a raised median; therefore, if medians are installed the space for evasive maneuvers would be limited and the shoulders should be widened.

The RIDOT Highway Design Manual provides a summary of shoulder widths that are recommended to accommodate various functions. It is required that the latest RIDOT standards be followed and RIDOT will make the final determination in regard to the required shoulder width ; however, it is recommended that the minimum offset to a curbed median be two feet and the minimum paved shoulder be four feet.

▼

[3] Gluck, J., H.S. Levinson, and V. Stover, *NCHRP Report 420: Impacts of Access Management Techniques.* TRB, National Research Council, Washington, D.C.; 1999.

Secondary Roadways

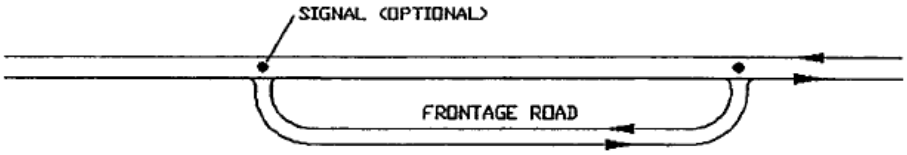
The following section reviews secondary roadway treatments that should be considered along the corridor. A secondary roadway typically parallels an arterial roadway and is used to limit direct access to the arterial by adjacent parcels. The goal of these treatments would be to reduce the number of access points directly to the study area corridor through the creation of other roadways. The following treatments were considered:

- Frontage/Service Roads
- Reverse Frontage Roads

Frontage Roads

Frontage roads are constructed to run parallel to the corridor along the frontage of several adjacent parcels and between the roadway right-of-way and the front building setback. These roadways provide interconnectivity between the parcels and shared access/egress points. Construction of a frontage road would usually occur prior to or as parcels are developed, and the actual roadway may be located on private property.

Although this treatment is feasible along the majority of the study area corridor, it may be more desirable to implement a reverse frontage road since parcels are generally large and frontage is available.
It is desirable that the Town maintain jurisdiction over the frontage roads that provide access to multiple property owners.



TWO-WAY BETWEEN INTERSECTIONS

The following lists some advantages and disadvantages for frontage roads.

Advantages

- Improves safety through reduced traffic conflicts on major arterial
- Improves mobility by consolidating arterial access points
- Businesses are still visible from the major roadway
- Provides interconnectivity between land uses

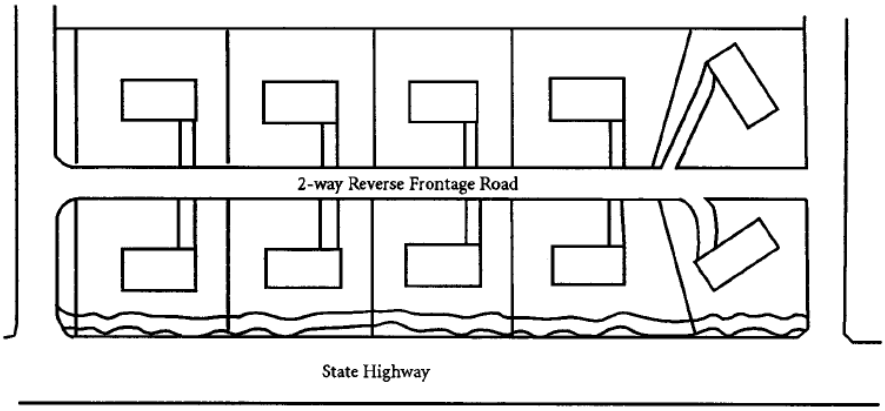
Disadvantages

- Operational and safety problems can occur if the distance between the frontage road and crossroad is inadequate (this is why the implementation of reverse frontage roads is recommended)
- Frontage road serves properties on one side only
- Can be costly if property acquisition is needed to implement
- Can require easements between property owners
- Restricts driveway movements to a specific location

Reverse Frontage Roads

Reverse frontage roads, or sometimes called service roads, are somewhat similar to a frontage road. However, the primary difference is they typically run along the rear of adjacent parcels. This allows for access on both sides of the reverse frontage roadway and can provide opportunities for parcels to be subdivided or provide access for land-locked parcels, thus providing additional development opportunities.

It is preferred to implement reverse frontage roads instead of frontage roads where feasible because a greater distance between the main road and the reverse frontage road can be provided. This increased distance provides longer stacking for vehicles and reduces the possibility of operational issues that could impact mainline traffic.



The following lists some advantages and disadvantages for reverse frontage roads.

Advantages

- Improves safety through reduced traffic conflicts on major arterial
- Improves mobility by consolidating arterial access points
- Businesses are still visible from the major roadway (businesses can be located closer to the street and more visible than implementation of a frontage road)
- Provides interconnectivity between land uses
- Provides opportunities for additional development on both sides of the roadway

Disadvantages

- Operational and safety problems can occur if the distance between the reverse frontage road and crossroad is inadequate (most of the lots along the corridors are deep enough so that this should not be an issue);
- Can be costly if property acquisition is needed to implement;
- Can require easements between property owners;
- Restricts driveway movements to a specific location; and
- Could require additional signage or way-finding signs to guide patrons to businesses.

Controlled Access

Traffic signals can be used to provide protection for specific movements at key locations and to properties that generate a significant amount of traffic. Currently there are four traffic signals located along the Route 7 corridor, and two traffic signals located along Route 116. The two northern signalized intersections along Route 7 provide access to the Bryant University and Fidelity campuses. There are currently two traffic signals located along Route 116 (one of which is the intersection with Route 7). Traffic signals can create gaps in through traffic both up- and down-stream from the signal location resulting in improved capacity for other unsignalized driveways. The following provides an overview of the existing traffic signals along the corridor and traffic signal spacing. It should be noted that the feasibility of implementing roundabouts should be analyzed and studied before installation of a new traffic signal is considered.

Signal Spacing

While a signalized intersection or driveway provides the best and safest alternative for a controlled access to a driveway or intersection, traffic signals should not be installed unless specific thresholds are met. Typically the advantages need to outweigh the disadvantages, so to provide some consistency on their installation, a series of warrants must be reviewed to define minimum conditions under which a traffic signal may be appropriate. These warrants include the review of traffic volumes, pedestrian volumes, progression movements, and crash experience. These warrants are currently defined in the national publication of the Manual on Uniform Traffic Control Devices (MUTCD).

However, even if warrant thresholds were met, they cannot be installed without RIDOT approval. In order to preserve the mobility of the Route 7 and Route 116 corridors, if traffic signals are installed they need to be spaced so that a vehicle can travel at a reasonable speed. The optimal spacing for traffic signals typically depends on the cycle length and the posted speed limit. Shorter cycle lengths and

lower speeds enable closer spaced traffic signals, and having uniform spacing is essential. Table 5-2 illustrates traffic signal spacing standards that should be considered along the Route 7 and Route 116 corridors. However, further engineering assessment should be used rather than just the information in the table below.

Table 5-2 Signalized Intersection Spacing

Cycle Length (Seconds)	Operating Speed (mph)				
	30	35	40	45	50
60	1,320	1,540	1,760	1,980	2,200
70	1,540	1,800	2,050	2,310	2,560
80	1,760	2,050	2,350	2,640	2,930
90	1,980	2,310	2,640	2,970	3,300
100	2,200	2,570	2,930	3,300	3,670

Source: NCHRP Report 348, Access Management Guidelines for Activity Centers, Table 7-2, page 59.

Driveway Design Standards

While driveways should be designed (width, radii, etc.) to accommodate the most appropriate design vehicle, the following section reviews critical driveway design standards that could improve access and circulation along Route 7 and Route 116. It should be noted that the existing characteristics of the developed sections of the corridors (driveway spacing, parcel size, etc.) may result in many of these standards not being met, but these standards should be considered if and when a parcel is developed and/or redeveloped.

The following treatments are discussed in this section: Driveway spacing; Corner Clearances; Joint and Cross Access; Sight Distance; and Throat Length.

Driveway Spacing

When driveways (or intersections) are located and spaced properly, vehicle safety and mobility for the corridor can be enhanced. Providing adequate spacing between driveways allows for safer turning movements in and out of driveways. Longer distances between driveways also provide safer travel for bicycles and pedestrians by providing fewer conflicts. Eliminating or reducing driveway offsets (driveways located on opposite sides of the roadway) should be considered if the corridor is undivided.

As the roadway functional classification increases, spacing standards become more stringent and driveways are spaced further apart. This is typically a result of vehicle speeds being higher on arterials than local roadways, and driveway spacing is typically based on vehicle stopping sight distance (SSD). Stopping sight distance is

the distance it takes for a vehicle to stop before hitting an obstruction in the roadway while traveling at a certain speed.

Driveways spaced too close to each other can result in an increase in vehicle conflicts, and can create safety issues. Therefore, driveway spacing standards should be considered. Typically two different standards are created, including: (i.) standards for an undivided roadway, such as the Route 7 and Route 116 corridors, and (ii.) standards for a divided roadway, or a roadway with a median. Tables 5-3 and 5-4 provide recommended spacing for each scenario.

Minimum Spacing Between Opposite Side Driveways: It is desired to have driveways aligned with driveways directly on the opposite side of the roadway. If this is not possible, it is then desired to have driveways offset by an appropriate distance, as summarized in Table 5-4. These distances are measured from centerline of the proposed driveway to the centerline of the driveway on the opposite side of the roadway. However, these spacing standards may not be possible along some developed sections of the Route 7 and Route 116 corridors.

Table 5-3 Driveway Spacing – Opposite Side of Roadway (Undivided)

Posted Speed	Required Minimum Driveway Spacing
30 mph	370 feet
35 mph	460 feet
40 mph	530 feet*
45 mph	670 feet
50 mph	780 feet

Source: NCHRP Report 348, Access Management Guidelines for Activity Centers, Table 7-8 page 63.
Note: The posted speed limit on the Route 7 corridor is 40 mph and the 85th percentile speed ranges from 51 mph to 56 mph. The posted speed limit on the Route 116 is 50 mph and the 85th percentile speed ranges from 44 mph to 50 mph.

Minimum Spacing between Adjacent Driveways: For driveways on the same side of the street, the required minimum driveway spacing summarized in Table 5-4 should be measured from the centerline of the proposed driveway to the centerline of the adjacent driveway. This spacing is more applicable for a corridor that is divided and movements consist primarily of a right-turns in and/or out only. The measurements in Table 5-4 are based on the acceleration rate of a vehicle exiting a driveway, and the deceleration rate of a vehicle approaching the driveway that the vehicle just exited. However, these spacing standards may not be possible along some sections of the Route 7 and Route 116 corridors.

Table 5-4 Driveway Spacing – Same Side of Roadway (Median)

Posted Speed	Minimum Driveway Spacing
30 mph	185 feet
35 mph	245 feet
40 mph	300 feet
45 mph	350 feet
50+ mph	450 feet

Source: TRB, Access Management Manual, Table 9-7, page 152.
Note: The posted speed limit on the Route 7 corridor is 40 mph and the 85th percentile speed ranges from 51 mph to 56 mph. The posted speed limit on the Route 116 is 50 mph and the 85th percentile speed ranges from 44 mph to 50 mph.

Corner Clearances

Corner clearances are the distances between an intersection and the nearest driveway. Typically corner clearances would meet or exceed the driveway spacing requirements. However, driveways should typically not be located within the functional area of the intersection, and if a driveway is located within the functional area, it should be restricted to a right-turn in/out, right-turn in, or right-turn out only.

Joint and Cross Access

Some developed sections of the Route 7 and Route 116 corridors have a high density of access points. Consolidating access points through joint and cross access provisions provides a unified property access and circulation system between two parcels. Implementing either joint or cross access can provide many advantages to the corridor. The following provides some key advantages and disadvantages.

Advantages

- Reduces the number of individual access points;
- Increases access spacing;
- Provides customer convenience for circulation between properties,
- Landscaping increases along the properties frontage; and
- May improve circulation and parking layout.

Disadvantages

- Properties cannot be forced to implement this technique, and must redevelop for this technique to apply;
- Closure or sharing of driveways can be contentious and involve legal agreements for liability; and
- Local and State officials must be on same page for effective implementation.

Sight Distance

Sight distance is always the most important consideration in the placement of driveways, as it provides the maximum safety for the general public and provides access for the property owner. Both vertical and horizontal alignment can limit sight distance. The following provides a summary of stopping sight distance and intersection stop distance.

- *Stopping sight distance:* is the length of roadway ahead visible to a driver and ensures that drivers have sufficient visibility to anticipate and avoid collisions before reaching a stationary object in the roadway.
- *Intersection sight distance:* is the view a driver has from the side street (the Site driveway, for example) of approaching traffic. The desirable values for intersection sight distance are such that the major-street traffic would not have to substantially reduce its speed when the driver exits the side street and into the main flow of traffic.

Sight distance measurements can sometimes be used for the location of driveways. A review of stopping sight distance versus intersection sight distance indicates that using intersection sight distance will result in longer driveway spacing. Required sight distances are typically determined using the 85th percentile speed of a roadway. Sight distance requirements based on speed are summarized below in Table 5-5. For driveway design, AASHTO[4] recommends that (at a minimum) the provision of stopping sight distance (at an intersection) is fundamental to intersection operation.

Table 5-5 Sight Distance Analysis Summary

Design speed (mph)	Stopping Sight Distance (feet)	Intersection Sight Distance (feet)
25	155	280
30	200	335
35	250	390
40	305	445
45	360	500
50	425	555
55	495	610

Source: based on guidelines established in A Policy on the Geometric Design of Highways and Streets, American Association of State Highway and Transportation Officials [AASHTO], 2004.

It should be noted that there are vertical curves along Route 116 located between Route 7 and West Reservoir Road that limit sight distance. Any proposed new

[4] A Policy on the Geometric Design of Highways and Streets, American Association of State Highway and Transportation Officials [AASHTO], 2004

driveways or roadway modifications must take into consideration these vertical curves

Throat Length

Throat length is the distance parallel to the centerline of the driveway from the first on-site location where a driver can make a right turn or a left turn onto the "on-site circulation roadway" to the edge of roadway at the major corridor; which is typically the curb or roadway gutter line. Creating a driveway throat length is important for safe and efficient access to and from the corridor. A sufficient throat length enables drivers to clear the intersection at the corridor before encountering on-site circulation. When vehicle conflict occurs on-site, it can result in poor traffic operation on the corridor and in the vicinity of the intersection.

The following should be considered for driveways where parcels generate less than 50 peak hour vehicles in both the entering and exiting directions. For driveways that generate more traffic, this information should be assessed in greater detail through the preparation of a traffic study and site plan for a particular parcel. In these cases the calculated 95th percentile queue should be considered.

- A driveway throat length should be able to accommodate at least two passenger cars, or a minimum of 60 feet depending on the types of vehicles entering and exiting;
- Entering and exiting traffic should be separated with a solid yellow line; and
- Left and right turn lanes can be considered for driveway that are expected to generate significantly more traffic.

Pedestrian Connections

While the Route 7 and Route 116 corridors are principal arterials, special consideration could be given to improve pedestrian connectivity across the corridor at signalized intersections and between parcels. The corridors do not have sidewalks on either side of the roadways and there are limited opportunities to cross the corridor. While there may not be a need to install these treatments now, the application of pedestrian crossings may be more relevant in the future, and therefore should be considered if there is any future roadway or intersection improvement projects or when parcels are developed/redeveloped. There are currently pedestrian push buttons at the Route 7 intersections with Essex Street and Route 116.

The following reviews various pedestrian crosswalk treatments that could be considered along the corridor at existing or future locations.

Intersection Crossings

Consideration should be given to providing new pedestrian crossings of Route 7 and Route 116 at existing signalized intersections and future traffic signals. However, since there is currently limited pedestrian activity along the corridor, this treatment could be considered in the future if warranted or if improvements are made to the signalized intersections.

Public Transit

Bus service is provided along the corridor by the Rhode Island Public Transit Authority (RIPTA). Scheduled stops off the corridor are currently provided at Bryant University and at the Fidelity campus. It is not recommended that bus stops be provided on the Route 7 or Route 116 corridors. It would be better if any future stops were to be located off of the corridors in existing or future developments. If stops are located along the Route 7 and/or the Route 116 corridors it would be desirable to provide bus stop turnouts and it is typically desired to have bus stops located on the far side of a signalized intersection. This reduces the delay at the intersection, and promotes pedestrian crossings at a signalized intersection.

Turning Restrictions

Turning restrictions restrict specific turn movements at unsignalized access points or driveways. By restricting movements, vehicle conflicts along a corridor can be significantly reduced. The left-turn movement to and from an access point is typically the most critical movement and has the most conflict on a corridor. The following types of driveways with restricted movements could be considered:

- Prohibit all left-turn movements at a driveway;
- Restrict turning movements from TWLTL during peak hours;
- Channelized right-turns in and out, right-turn in, right turn out, driveways; and
- Provide entrance or exit only driveways.

The restriction of turning movements at driveways can improve safety conditions and corridor operations; however, these restrictions can be difficult to enforce unless physical barriers like a raised median or raised channel are incorporated into the corridor or driveway.

5.2 Land Use Regulation Strategies

Because there is a large amount of undeveloped land within the study area, additional land use regulation strategies should be considered along the Route 7 and Route 116 corridors. These regulations would include applying access management techniques specific to the corridor that should be considered when a parcel is developed. This section will review the following:

- Site Plan Review;
- Traffic Impact and Access Studies (TIAS);
- Zoning Regulations; and
- Funding Mechanisms.

5.2.1 Site Plan Review

The intent of the site plan review is to set a series of standards that developments need to comply with. When reviewing a site plan, the local permitting agency should assure that all structures and uses are developed in a manner which considers community needs, including protection of abutting properties and visual amenities, convenience and safety of vehicular and pedestrian movement within the site and in relation to adjacent corridor, adequacy of methods of disposal for wastes and surface water drainage and protection of environmental features on the site and in adjacent area.

The following provides a list of some of the more critical items that should be considered on a site plan to help assess corridor access issues:

- Proposed and existing access points within five hundred (500) feet on either side of the corridor, and along both sides of any adjoining streets, shall be shown and dimensioned on the site plan.
- Distances to existing adjacent access points, traffic signals and intersections.
- Number of turning lanes to be provided on the proposed driveway.
- Striping and signing plans.
- Parking and internal circulation plans.
- Plan showing all existing property lot lines, easements, rights-of-way, lot size in acres or square feet, abutting land uses and location and use of structures within three hundred (300) feet of the site.
- The proposed clear vision, or sight triangles, of all curb cuts leading to the public way should be illustrated.

The local permitting agency can approve a site plan subject to conditions, modifications and restrictions as deemed necessary, and to ensure the improvement

of a road or utilities to accommodate increased demand likely generated by the proposal.

5.2.2 Traffic Impact and Access Studies (TIAS)

The preparation of a traffic study is a critical element of traffic and site engineering and can provide an assessment of site access and off-site intersection and roadway impacts associated with a particular development or redevelopment. As a result, a traffic impact and access study (TIAS) customarily provides important information regarding present and future impacts of a development or redevelopment on the operation of the surrounding infrastructure and the associated mitigation for such impacts. Establishing a standardization process for the Route 7 and Route 116 corridors would be an important process to ensure safe access and maintain mobility along the corridor.

As stated previously, Route 7 and Route 116 roadways are under jurisdiction of the Rhode Island Department of Transportation (RIDOT); therefore, any modifications proposed within the right-of-way or any adjacent developments require the submission of a Physical Alteration Permit (PAP). The RIDOT may require the submission of a traffic impact and access study (TIAS) as part of the PAP process. Although the RIDOT has ultimate jurisdiction over roadway improvements and access driveways along the Route 7 and Route 116 corridors, the Town can impose additional requirements and guidelines concerning the contents of the TIAS submitted as part of the local approval process. The following provides guidelines to assist municipalities in determining how detailed a TIAS may need to be for a particular development or redevelopment. By developing some general guidelines municipalities are able to standardize and improve their decision making process.

1. Initial meeting or discussion with municipality and RIDOT to determine the size and scope of the TIAS

2. Analysis of Roadway Issues
   - Evaluate existing study area characteristics
   - Proposed driveway sight distance evaluation
   - Evaluation of nearby driveway locations
   - Evaluation of existing traffic conditions in study area
   - Identify other future roadway improvements
   - Crash experience at the study area intersections
   - Identify background traffic growth
   - Future conditions analysis at nearby intersections
   - Mitigation identification and evaluation

3. Site Issues

- Traffic generation
- Traffic distribution
- Evaluation of proposed access points
- Evaluation of site circulation
- Evaluation of cross connection to adjacent developed/undeveloped parcels
- Development of a conceptual plan to modify proposed full access driveways to right-in/right-out and providing future full access through cross connections and a consolidated signalized access on an adjacent property or shared access drive
- Evaluation of future modifications of the proposed driveway(s) to right-in/right out when future developments, cross connections, and a consolidated signalized access is provided on an adjacent property or shared access drive

4. Other Analysis
   - Vehicle gap analysis at the proposed driveway and delay study at comparable driveway along the corridor for unsignalized intersections or driveways
   - Transportation Demand Management (TDM) measures

Identifying the study area is one of the most critical items that needs to be determined as part of the TIAS development process. Adjacent street traffic and peak hour trip generation are commonly called out as critical characteristics when determining the study area. These two characteristics should be considered in the decision making process. For the Route 7/116corridor, the increments of site generated traffic that is typically experience for adjacent uses is illustrated in Table 5-6 below.

Table 5-6 Trip Generation Thresholds

	PEAK HOUR TRAFFIC (VPH)			
	T < 50 vph	51 < T < 100	101 < T < 150	T > 151
Proposed development access point analysis (proposed driveways only, and their impact on the adjacent roadway)	X	X	X	X
Adjacent roadway control point analysis (one or two intersections on each side of the proposed driveways)		X	X	X
Study area key locations analysis (any number of intersections that are determined will be affected by the development)			?	X

Key: X = required
? = may be appropriate on a case-by-case basis

This trip generation information of a particular development should be shared with the local municipality or planning prior to determining the level of study required.

It is important to note that traffic professionals will always have to use professional engineering judgment when deciding how to conduct a TIAS for a particular development. However, the above table could be very useful in providing guidelines to non-technical decision makers. For larger projects it may be necessary for the Town to hire a Traffic Engineer to perform a peer review of the traffic study which could be paid for by the developer.

5.2.3 Zoning Regulations

The techniques discussed in this report should be incorporated into an access management ordinance. VHB has prepared a draft access management ordinance for the Town's consideration, which includes relevant techniques specific to the Route 7 and Route 116 corridors. Once the ordinance is accepted and implemented by the Town, developers will be required to incorporate access management technique into their design.

5.2.4 Financing Mechanisms

Funding opportunities vary depending on federal programs, state programs, and the private sector, which all are influenced by the economy. Moreover, project priorities and schedules vary with administration changes, federal guidance, and political influence. For example, many of the current funding for projects from the economic stimulus program, or 2009 American Recovery and Reinvestment Act (ARRA), were not in existence until the recent economic downturn.

Some of the recommended infrastructure improvements included in the access management techniques hinge on Transportation Improvement Program (TIP) programming and funding, which also means that consensus is needed at the municipal and community level that the recommendation is worthy of TIP programming. As the owner of the Route 7 and Route 116 corridors, RIDOT plays a major role in the advancement of these recommendations. RIDOT cannot implement any major infrastructure improvements unless they are approved through the TIP. As an initial step, the Town would need to take the lead on getting these recommendations included in the TIP.

Public-private partnerships (P3s) should be considered for the delivery and financing of some of the recommendations of this study including many of the transit recommendations. P3s may enable earlier delivery through the leveraging revenue and financing sources. There are many different types of P3 structures that could be considered. For example, a P3 option to be considered is referred to as value capture. Under value capture P3 options, the private sector may participate in the delivery of transportation projects by contributing resources (money or land) in exchange for

enhanced development opportunities/increased private land values resulting from the projects.

Another method of funding transportation infrastructure improvements is through Tax Incremental Financing (TIF). The Rhode Island "Tax Incremental Financing Act" provides "additional and alternative means to cities and towns to fund and/or finance municipal and/or finance municipal and other public facilities…"

5.3 Site Plan Prototypes

This section reviews three example site plans that reflect lot sizes and physical constraints of developable, or re-developable, parcels within the Route 7/116 corridor. The intent is to illustrate example site plans that integrate access management techniques that were discussed in this Chapter. Coordinating with the Study Management Committee, the following three prototype site plans were been prepared. These plans are illustrated in Figure 5-1.

- Small-to-mid size parcel, for a stand-alone commercial establishment.
- Mid-size parcel or an aggregate of parcels, for a commercial or retail multi-tenant site.
- Large size parcel or an aggregate of parcels, for a large scale planned development or planned corporate development with outparcels.

Since adjacent parcels along the Route 7/116 corridor are mostly made up of smaller parcels with some medium and large parcels throughout, the three prototypes were created so that they could be interconnected to illustrate the true benefit that access management may have. The parcels have been arranged in Figure 5-1 to illustrate this.

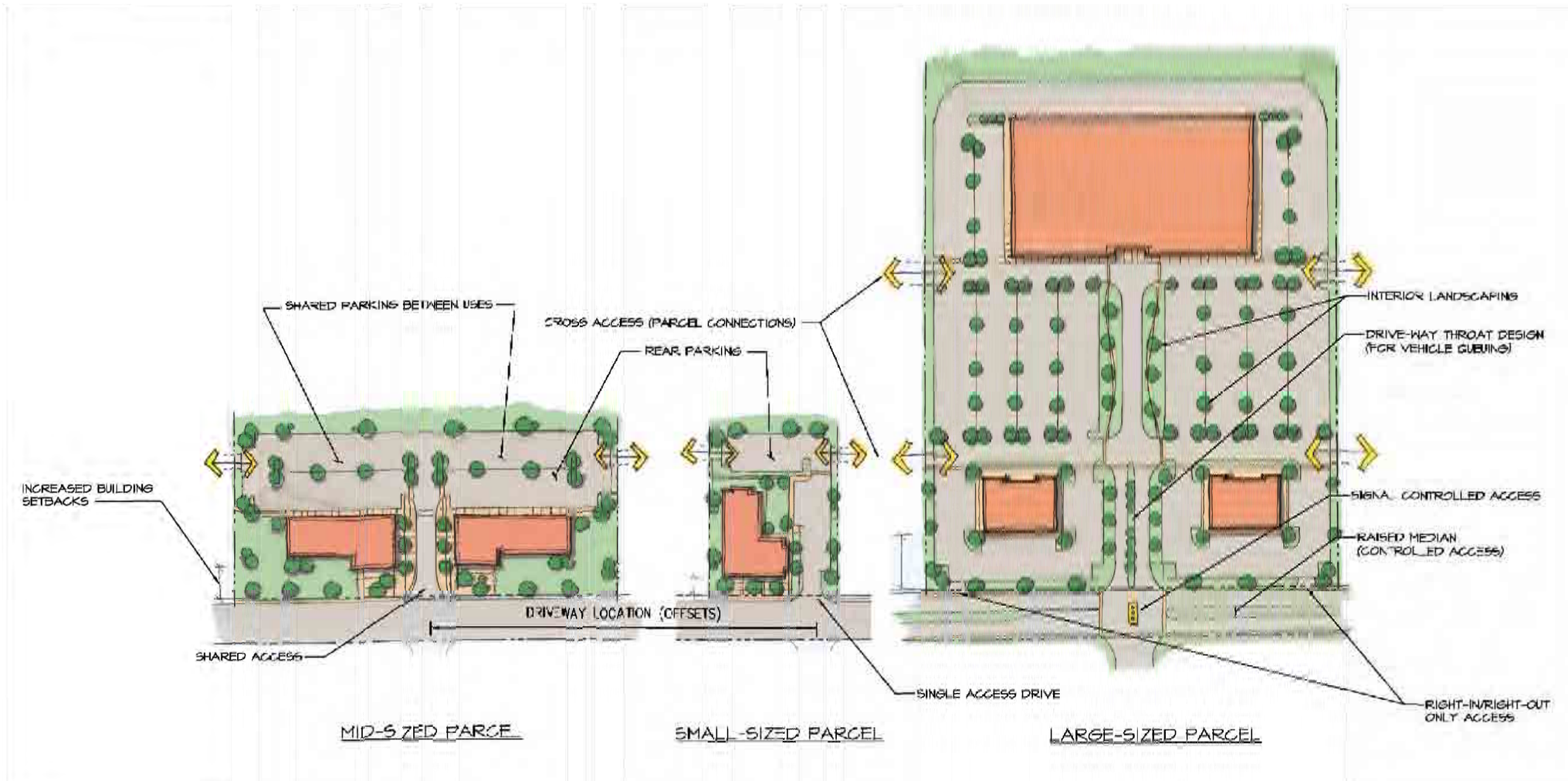


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Figure 5-1

Site Development Prototypes
Route 7/116 Corridor
Access Management Study
Smithfield, Rhode Island

6

Corridor Improvement Opportunities

This chapter provides an overview of the roadway and access improvements that were considered for the Route 7 and Route 116 corridors. The recommendations described in this chapter build upon information from previous chapters including existing corridor safety and driveway access issues, existing and future intersection operations, land development and redevelopment opportunities, and the application of transportation access management strategies.

The following sections present a general overview of each opportunity and how it may benefit or impact the corridor. The following opportunities are recommended for further study as parcels along the corridors are developed.

- *Left-Turn Modifications/Restrictions:* reviews turn restrictions through the implementation of a two-way-left-turn-lane (TWLTL) and/or a raised center median in combination with roundabouts and/or other u-turn treatment to facilitate left-turning vehicles;

- *Driveway Consolidation:* reviews locations where access could be managed better;

- *Frontage Roadways:* reviews the application of either frontage or reverse frontage roads to the corridor for improved corridor access;

- *Signalized Intersection Timing and Phasing Adjustments:* review opportunities for enhancing signal operations through timing and phasing adjustments;

- *Additional Capacity to the Corridors and at Signalized Intersections:* review locations for increasing capacity through restriping and/or roadway widening; and

- *Additional Access to Limited Access Facilities*: review potential locations were additional access to Interstate 295 can be provides to help alleviate traffic congestion along the corridors.

6.1 Improvements Opportunities

This section presents the range of candidate improvement opportunities considered for the Route 7 and Route 116 corridors. Included is an overview of the benefits and potential impacts associated with each treatment, along with an evaluation and recommendation. Figure 6-1 illustrates the range of improvement opportunities discussed in this section.

6.1.1 Left-Turn Restrictions

Left-turn restrictions could eliminate either left-turn movements from Route 7 and Route 116 into abutting properties, or left-turn movements from abutting properties onto Route 7 and Route 116. By restricting this movement, vehicle conflicts along a corridor would be significantly reduced. As discussed throughout this study, when there are more conflicts along a corridor, there is a greater chance for crashes as drivers have to process more information and make quicker decisions. The following highlights specific alternatives that could be applied to the study area corridor.

Restricting left-turn movements from an unsignalized driveway would eliminate a significant amount of vehicle conflicts along the corridor. Given the number of driveways located in close proximity to each other, the driver not only needs to assess through traffic, they also need to assess left-turn movements from other adjacent driveways and from driveways on the opposite side of the roadway.

Non-traversable raised medians can provide improved access control, capacity and safety along a corridor. Implementation of a raised median limits the majority of access points along the corridor and driveways to right-turn in and out operation. This restriction reduces the number of vehicle conflicts along the corridor by eliminating information or decisions that drivers have to process. In a raised median, vehicles would need to reverse direction (or u-turn) if access to all properties along the corridor were provided. These u-turn areas would need to be constructed at key intersections or possibly roundabouts to allow vehicles (including automobiles and trucks) to have the ability to access properties on both sides of the roadway. Figure 6-1 identifies segments of Route 7 and Route 116 where raised medians should be considered.

6.1.2 Driveway Consolidation/Frontage Roads

At a minimum, properties that have two full access curb cuts on the corridor should be reviewed in greater detail to see if the curb cuts can be consolidated into one, or consolidated with an abutting property, or reconfigured to accommodate one entrance and one exit driveway, or if one of the driveways could be eliminated.

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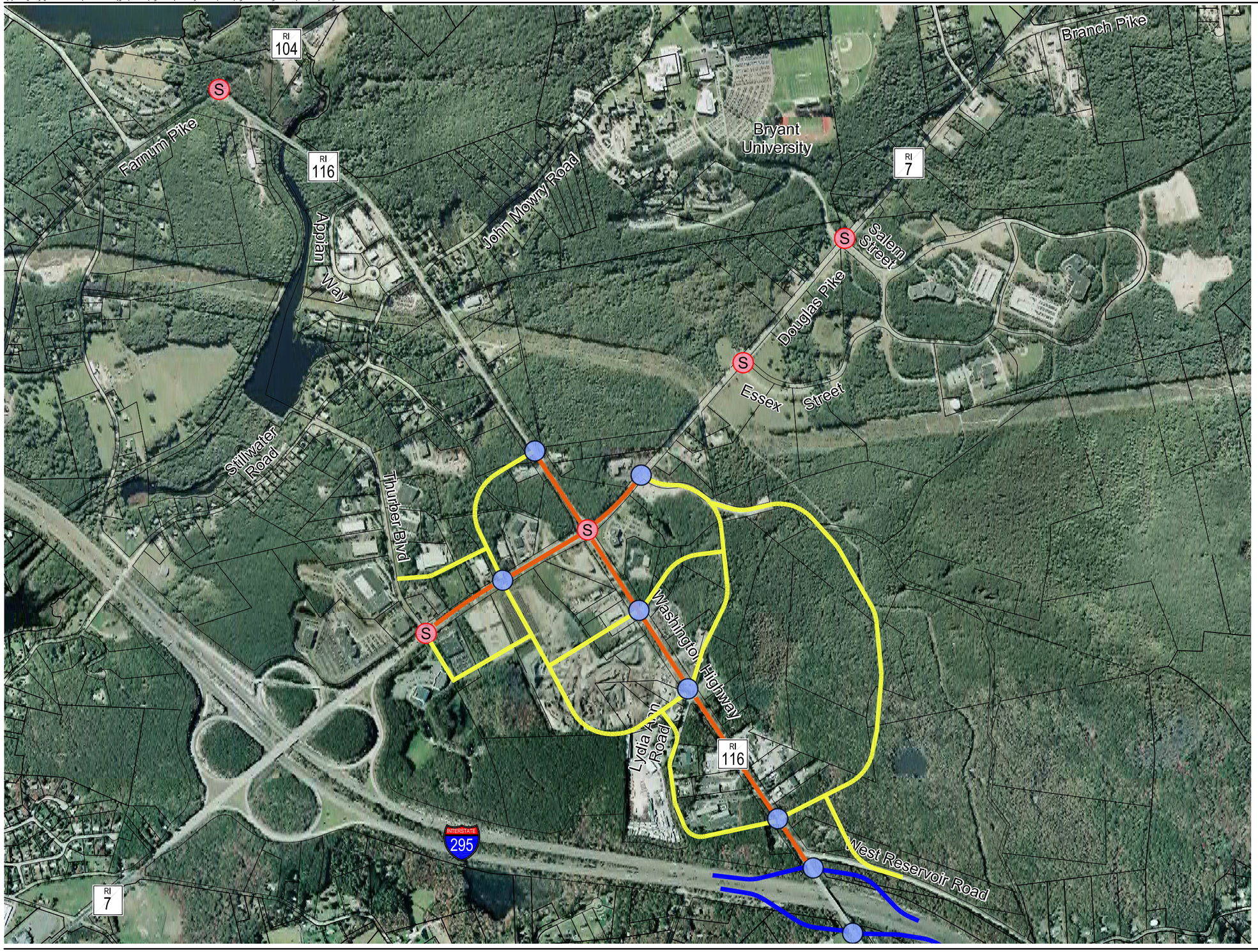

Legend

- Potential Frontage Road
- Potential Access to Interstate
- Potential Restricted Access
- Existing Traffic Signal
- Proposed Full Access Point

0 1/5 Mile

Source: RIDOT

Vanasse Hangen Brustlin, Inc.

Figure 6-1

Proposed Access Management
Route 7/116 Corridor
Access Management Study
Smithfield, Rhode Island

In addition, opportunities for connecting parcels through driveways between properties, or interconnecting driveways, should be explored. Improving access by limiting curb cuts would improve safety along the corridor. However, driveway modifications would likely be voluntary by the property owner unless a property was under the local or state permitting review process.

In addition, legal cross access agreements may need to be in place between two property owners to facilitate these improvements. These cross-access roads can be extended across several parcels resulting in the creation of a secondary roadway system.

Secondary roadways typically parallel an arterial roadway and are used to limit direct access to the arterial by allowing direct access from parcel to parcel. The goal of these treatments would be to reduce the number of access points directly to the study area corridor through the creation of other roadways. Two types of secondary roadways were discussed in the previous chapter, frontage roads and reverse frontage roads.

These frontage/reverse frontage roads can then connect to ring roads providing signalized full access to and from Route 7 and Route 116. Figure 6-1 shows locations where these ring roads and signalized intersections should be considered. The new signalized intersections can also be designed to accommodate U-turns allowing vehicles to switch directions to access limited (right-in/right-out) access points along the corridor if a median is installed.

The ring roads will also provide a bypass of the Route 7/Route 116 signalized intersection. These roadways will not only allow traffic generated by proposed developments to bypass the congested Route 7/Route 116 signalized intersection but with proper design can also provide better access management along the Route 7 and Route 116 corridors.

6.1.3 Signalized Intersection Timing and Phasing Adjustments

The existing and future traffic signals along the Route 7 and Route 116 corridors should be optimized and coordinated as future developments are approved and constructed. The approval process for new developments should require modification of existing timings and phasing at existing traffic signals as well as installing new traffic signals and interconnection if required by the RIDOT. New developments that require new signals or optimization of existing signal timings should be required to perform peak hour traffic counts and capacity analyses after the development is constructed and occupied to determine the actual traffic volumes and signal timings that provide the optimal progression along the Route 7 and Route

116 corridors. The developer shall be responsible for working with RIDOT to modifying the traffic signal timings in the field.

6.1.4 Additional Capacity to the Corridors and at Signalized Intersections

A capacity analysis was conducted for two of the signalized intersections within the study area (Route 7 at Route 116 and Thurber Boulevard) based on traffic generated by partial build-out of the undeveloped parcels. Based on an equal distribution of development and projected traffic along the Route 7 and Route 116 study area corridors the existing roadways and intersections can accommodate the projected traffic generated by 5 to 15 percent of the total build-out of the undeveloped parcels with the following mitigation:

Route 7/Route 116 Intersection

- Restripe the northbound approach to add a second left-turn lane (no widening required) in order to reallocate time (increase time allocated to the southbound through movement)
- Restripe the eastbound approach to add a second left-turn lane (no widening is required) in order to reallocate time (increase time allocated to the westbound through movement)

Route 7/Thurber Boulevard Intersection

- Widen Route 7 to provide a third lane on the southbound approach
- Change the northbound protected/permissive left-turn to protected only

6.1.5 Additional Access to Limited Access Facilities

In order to accommodate traffic generated by the additional development beyond the 5 to 15 percent of the full build-out, new access/egress to and from I-295 from Route 116. This new interchange is required to avoid sending more traffic through the congested Route 7/Route 116 signalized intersection. The Route 7/Route 116 signalized intersection already has dual left-turns on the Route 116 westbound and Route 7 southbound approaches. As stated previously dual left-turn lanes can be added to the northbound and eastbound approaches by restriping; however it is impractical to widen this intersection to accommodate over 25% of the full build-out of the undeveloped parcels in the study area.

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