Texas Medical Center Mobility Study

DRAFT
BACKGROUND INFORMATION REPORT

Prepared for:

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Partners
Texas Medical Center

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1.0 INTRODUCTION

The Texas Medical Center is the largest medical center in the world with 92,500 employees located close to downtown Houston. The City of Houston and the Texas Medical Center (TMC) are proceeding with the development of an updated Transportation Master Plan for the TMC area. This Mobility Study will identify a comprehensive set of multi-modal transportation improvements seeking to improve accessibility, address traffic congestion, and better serve future development in the TMC area. The study consists of collecting and assessing data from major intersections, parking facilities, transit lines, and current/ proposed developments for the purpose of addressing long-term mobility needs. Funding for the study is furnished from an earmarked Federal Transit Administration (FTA) grant, with TMC and the City of Houston providing the local match. The area in and around TMC includes numerous interests whose involvement in the study process is critical. These interests will be addressed in a series of Steering Committee meetings and Stakeholder meetings, as well as two general public meetings. While overall improvements will be considered for a general area in the vicinity of TMC, the majority of analysis will focus on TMC and its immediate surroundings.

The project's general study area is bound by Alabama Street (north), Scott Street (east), Sam Houston Tollway (south), and Buffalo Speedway (west). Within the general study area is a primary study area, bounded by Hermann Drive/ Sunset Boulevard (north), Almeda Road (east), Holly Hall Street (south), and Greenbriar Drive (west). The TMC study area falls within the Greater Southeast Management District in City of Houston. There are four Super Neighborhoods within the primary study area - Medical Center, Astrodome Area, University Place and Museum Park. Figure 1.1 shows a map of the overall study area.

A Steering Committee was formed to provide direction to the TMC Mobility Study. Members of the Steering Committee include representatives from the following organizations:

- City of Houston
- Harris County
- Houston Galveston Area Council (H-GAC)
- MD Anderson Campus
- METRO
- Rice University
- Texas Children’s Hospital
- Texas Department of Transportation (TxDOT)
- Texas Medical Center Corporation
- The Methodist Hospital System

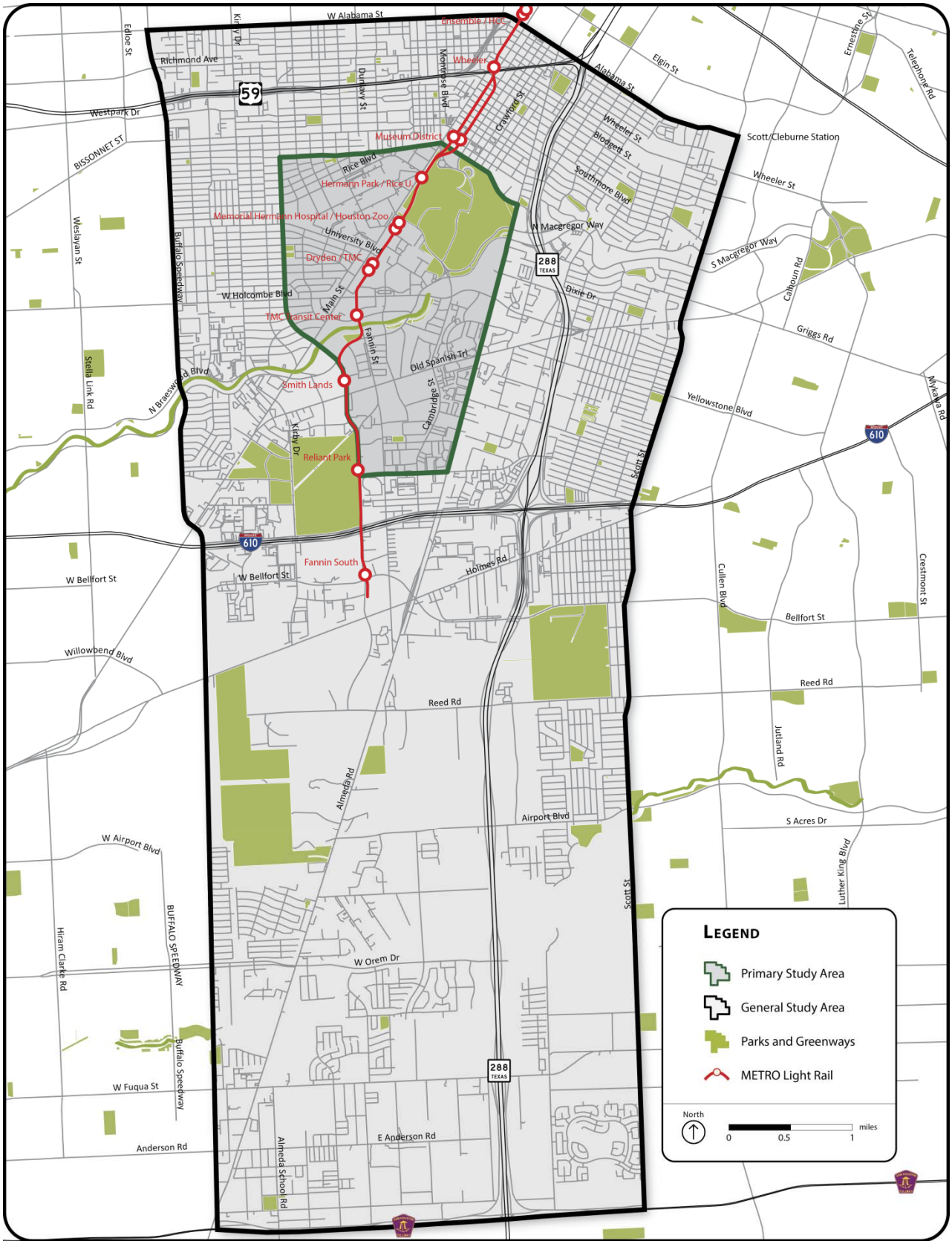

FIGURE 1.1
STUDY AREA

1.1 Purpose of Report

The purpose of this report is to document existing conditions and facilities for vehicular traffic, transit, pedestrians and bicyclists. This report will be used to inform the stakeholders and Steering Committee members about the current operating conditions of all facilities in the TMC study area. As part of the TMC Mobility Study, data for all the study area were obtained from TMC and member institutions, City of Houston, TxDOT, METRO and H-GAC. This document will form the basis for the next step in the project including needs assessment and alternatives evaluation for future conditions.

1.2 Content of Report

Roadway conditions, transit routes and schedules, traffic operations, pedestrian and bicycle facilities, parking, socio-economic data and land use and environmental conditions are documented. Data is summarized and presented using tables and figures under each of these sections.

The TMC area comprises of the following five campuses. Parking, land use, pedestrian and bicycle facilities are discussed in this report using these five campuses:

- Main Campus
- Mid Campus
- South Campus
- Leland Anderson Campus
- Rice University Campus

1.3 Primary and General Study Areas

The project study area extends from Alabama Street in the north to the Sam Houston Tollway in the south. This defines the general study area. The primary study area is at the center of the general study area and extends from Sunset Blvd in the north to Holly Hall Street in the south. All multimodal analysis will be conducted for streets, intersections, and buildings included in the primary study area. Land use, traffic growth patterns and connectivity issues will be studied for the streets and intersections in the general study area. Figure 1.1 in the Introduction section of this report shows a map of the primary and general study areas.

The Texas Medical Center area includes 15 renowned hospitals and two specialty institutions, three medical schools, six nursing schools, and schools of dentistry, public health, pharmacy, and virtually all health-related careers. When viewed as a single entity, the TMC institutions are the largest employer in Houston. Some of the facts and figures for TMC are shown in Table 1.1.

TABLE 1.1
TEXAS MEDICAL CENTER FACTS AND FIGURES

Description	Intensity
Number of Institutions	54
Number of Buildings	280
Area	45.5 million square feet; 1300 acres
Annual Patient Visits	7.1 million
Number of Employees	92,500
Number of Volunteers	12,000
Number of Students/Researchers/ Scientists/ Residents and Fellows	45,000
Number of Hospital Beds	6,900

As mentioned earlier, the primary TMC study area comprises of five campuses. This section details the location and buildings of each of these campuses. Figure 1.2 shows a map of the five campuses.

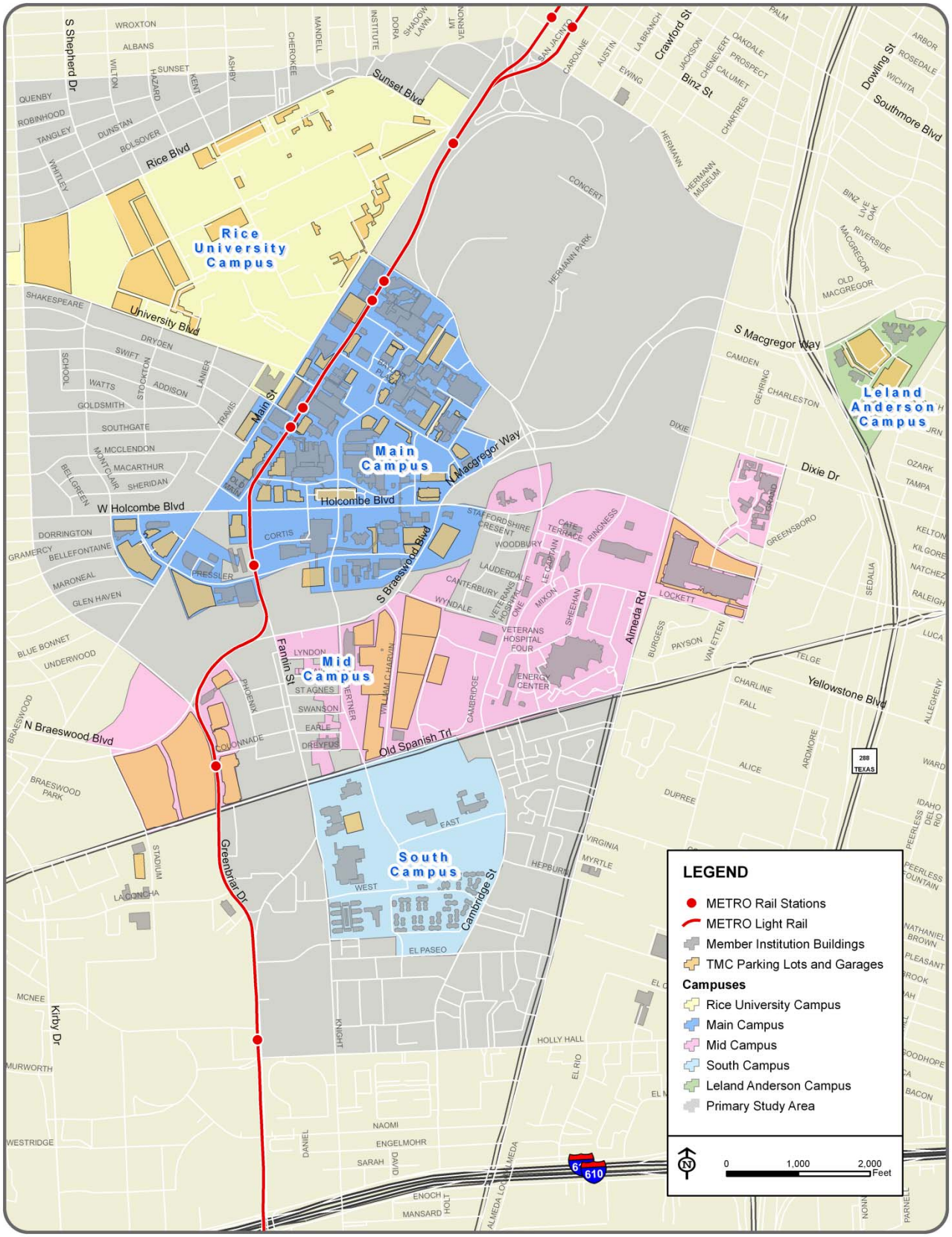

FIGURE 1.2
TMC CAMPUSES

Main Campus

Main Campus is the historic core of the Texas Medical Center. It extends from Main Street to MacGregor Way and Cambridge to Braeswood Boulevard. Main Campus is home to the most number of buildings in the study area focusing on patient care, education, research, parking and administration. Emphasis for this campus is on direct connection to transit, well designed pedestrian environment and superior public spaces. Table 1.2 shows a list of buildings located in the Main Campus. In total, this campus comprises 310 acres, with 72 institutions and buildings.

TABLE 1.2
LIST OF BUILDINGS IN MAIN CAMPUS

Buildings and Facilities in Main Campus		
Memorial Hermann Medical Plaza	The O'Quinn Medical towers	HCHD BEN TAUB General Hospital
U.T.H.S.C. Professional Building	Baylor Clinic	TIRR Memorial Hermann
Pairie View A&M University College of Nursing	Texas Children's Pavilion for Women	BCM Margaret M. Alkek Building
The Methodist Hospital Outpatient Care Center	Texas Woman's University Institute of Health Sciences	Jewish Institute
Smith Tower	M.D.A. Fannin Building	University of Houston College of Pharmacy
Scurlock Tower	TAMU-IBT	Neurosensory Center
Rice BRC Building	P.G Bell Building	Dunn Tower
Baylor Faculty Center	Hornberger Conference Center	Alkek Tower
Shriners Hospital for Children	Memorial Hermann Administration Building	TMHRI
Teco Annex	Memorial Hermann TMC	The Methodist Hospital
HCC Coleman College for Health Sciences	Cyclotron Building	Mary Gibbs Jones Hall
UT Health Sarofim Research Building	UT Health Medical School	Abercrombie Building
UT Health University Center Tower	HAM-TMC JJ Library	St. Luke's Episcopal Hospital
Hearth & Vascular Institute	Alkek Building BCM	Texas Children's Hospital
Cullen Pavilion	Baylor College of Medicine	Texas Heart Institute
Children's Memorial Hermann Hospital	BEN TAUB Neuropsychiatric Center	Clinical Care Center
Feigin Center	Jones Research Building	M.D.A. Jesse H. Jones Rotary House International
Texas Children's NRI	M.D.A. Duncan Building	M.D.A. Radiology Outpatient Center
M.D Anderson Cancer Center	M.D.A. Mays Clinic	Bank of America
Mitchell Building	UT Health School of Nursing	Dental Library
Clinical Research Building	UT Health School of Public Health	University of Texas School of Dentistry
Alkek Building	TECO Central Plant	Baptist Student Union Rice
Clark Clinic	M.D.A. Faculty Center	Houston Health Human Services
Lemaistre Clinic	UT Pickens Tower	UT Mental Sciences Institute

Mid Campus

Mid Campus extends south of Braeswood Boulevard to Old Spanish Trail. In the recent years, development has extended west of Greenbriar Drive and east of Almeda Road. Mid Campus hosts large developments and buildings such as the Michael E.DeBakey Veterans Affairs Medical Center, the H.Markley Crosswell Campus, the John P. McGovern Campus, the South Extension and Smith Lands parking lots. Its focus includes patient care, research, retail, administration, office, housing and parking. Table 1.3 shows a list of buildings located in the Mid Campus. In total, this campus comprises 375 acres, with 24 institutions and buildings.

TABLE 1.3
LIST OF BUILDINGS IN MID CAMPUS

Buildings and Facilities in Mid Campus	
Texas Children's Hospital Meyer Building	Boiler Plant B-105
The Methodist Hospital Annex	Chiller Plant B-104
Mid Campus Building	Engineering Shops B-103
Joseph A. Jachimcyzk of Harris County	B-101
Baylor College of Medicine Hospital & Clinic	Blind & Visual Impaired B-120
BCM Medical Building	Administration Building
Houston Hospice	Fisher House
Ronald McDonald House of Houston	Recreation Gym B-108
Research Building B-109	FEE Basis & Patient Account Services Building B-110
Outpatient Mental Health Services	Michael E. DeBakey Veterans Affairs Medical Center
Houston Veterans Affairs Regional Office	City of Houston Department of Health and Human Services
TMC John P. McGovern Campus	Alameda Dental Group

South Campus

South Campus extends south of Old Spanish Trail to El Paseo Street and between Fannin Street and Cambridge Street. The South Campus hosts premier world-class cancer research and treatment center, a dental school and mental health institute. Established uses include student housing, recreation center, police administration and parking. Table 1.4 shows a list of buildings located in the south campus. In total, this campus comprises 148 acres, with 17 institutions and buildings.

TABLE 1.4
LIST OF BUILDINGS IN SOUTH CAMPUS

Buildings and Facilities in South Campus	
M.D.A. Proton Therapy Center	South Campus Research Building No. 3
Saberioon Building	South Campus Research Building No. 4
South Campus Conference Center	UT Health Behavioral and Biomedical Sciences Building
South Campus Research Building No 1	UT Health Central Plant
University of Texas Police Department	UT Health School of Dentistry
R.E. "Bob" Smith Research Building	Denton A. Cooley, MD and Ralph C. Cooley, DDS University Life Center
UT Health University Housing	US Marine Corps Recruiter
UT Health Recreation Center	Kroger Pharmacy/UT Dentist
UT Health Child Development Center	

Leland Anderson (LA) Campus

The Leland Anderson (LA) Campus has fewer buildings and is east of SH 288 and south of MacGregor Way. This campus is adjacent to a residential neighborhood with a high school for health professions and a child-care center. It has strong links to the open space system along Brays Bayou. Its focus includes mental health; community based health care education, child-care services and parking. Table 1.5 shows a list of buildings located in the LA campus. In total, this campus comprises 39 acres, with 5 institutions and buildings.

TABLE 1.5
LIST OF BUILDINGS IN LELAND ANDERSON CAMPUS

Buildings and Facilities in LA Campus
The Rise School
YMCA Child Care Center
Michael E. DeBakey High School for Health Professions
UT Health Harris County Psychiatric Center
Patient Recreation Building

Rice University Campus

The Rice University Campus extends south of Sunset Boulevard to University Boulevard and from Rice Boulevard to Main Street. Rice University buildings, housing and libraries are at this campus. The proximity to TMC area provides continuing opportunities for collaboration with TMC institutions. The university comprises 318 acres, with over 3,708 undergraduate and 2,374 graduate degree-seeking students and 74 buildings.

2.0 RELATED PLANS AND STUDIES

2.1 1999 TMC 50 Year Master Plan

The 1999 Master Plan provided a vision for TMC to establish a clear framework to guide institutional growth, improve the physical environment, strengthen the community, anticipate technologies and identify future patient care, research and education needs. The Plan established TMC planning within a regional context. A vision and set of goals were developed for streets and access, open spaces, parking initiatives, comprehensive transit and sustainability.

Notable goals for TMC Campus include:

- Establish a framework to guide future growth of the TMC and unify the campus lands
- Strengthen the identification, use and value of each district within the TMC Campus
- Ensure future street access to all districts; Extend Bertner Ave south and connect Cambridge Street to N. MacGregor Drive across the Brays Bayou with new bridges; Extend Hermann Pressler Street to Galen Drive creating an important east-west link.
- Strengthen the campus setting using open spaces
- Establish a comprehensive parking strategy for year 2000 based on projected institutional growth; Construct a new garage south of Holcombe Boulevard, expand an existing garage and construct new surface lots at Smith Land site. Parking strategies for other years include building below-grade parking, acquiring land for peripheral surface parking and strategizing transit ridership development.
- Establish a comprehensive approach to public transit for the convenience of patients, visitors, employees and students; Investigate both a Main Street/Fannin Street corridor and Braeswood Boulevard transit route option; Develop METRO bus transit center; expand shuttle bus system

The goals for Main Campus include projected expansion within the Main campus for every five years; require new buildings to respect street network; Separate service and emergency access; locate parking facilities adjacent to major roads; Create a continuous network of air bridges and skywalks for pedestrians; Integrate public transit and campus bus stops with vertical linkages to the skywalk network

2.2 2002 TMC Transportation Master Plan

The goal of this study was to assess and develop strategies to meet the mobility needs for year 2002 and projected levels of development within the TMC study area. The study effort analyzed traffic and development for the target year 2025 and determined that the additional demand for travel cannot be accommodated by the current or expanded roadway system. The study identified that projected traffic beyond the 2025 target year would result in an even greater imbalance between travel demand and available capacity. Consequently, to achieve the mobility needs of the study area, implementation of a combination of strategies was proposed. The proposed improvements include multi-modal supply side improvements; travel demand actions to reduce and manage vehicle trips and land use development policies that reduce trip demand by balancing the mix of uses or reducing the level of development density.

TABLE 2.1
CANDIDATE SHORT AND LONG RANGE PROJECTS AND STRATEGIES PROPOSED BY MASTER PLAN

Project	Range
1. POLICY CHANGES Policy changes encompass actions that would enable the transportation system to achieve the greatest level of performance through enhanced planning, operations and management. Policy changes could be adopted and implemented by both public and private sector stakeholders depending upon the particular policy.	
1.1 Land Use Policies	
1.1.1 Encourage mixed use complementary developments	Short, long
1.1.2 Transit oriented development	Short, long
1.1.3 Increase development compactness and densities	Short, long
1.1.4 Promote compatible residential development	Short, long
1.1.5 Balance transportation infrastructure requirements with plans for additional or new land use	Short, long
1.1.6 Develop access management policy for the study area	Short, long
1.2 Parking Policies	
1.2.1 Develop Shared Parking Policy	Short, long
1.2.2 Encourage peripheral & Remote Parking	Short, long
1.3 Area Transportation Management	
1.3.1 Establish an Area Transportation Management District (TMD)	Short
2. TRAVEL DEMAND REDUCTION Travel demand reduction strategies are primarily targeted at reducing the percentage of driving trips especially during peak periods.	
2.1 Management Of Travel Demand During Peaks.	
2.1.1 Employee work schedules	Short
2.1.2 Scheduling of special events	Short, long
2.1.3 Promote non-driving modes	Short, long
2.2 Transit Incentives	
2.2.1 Provide direct financial incentives to encourage transit use	Short
2.3 Ride Share Programs	Short
2.4 Parking Management Policies	Short
3. **TRANSPORTATION OPERATIONS** Transportation Operations strategies are intended to increase the efficiency of the existing system through better management and minor improvements. Improvements would be applied to both the street and transit systems	
3.1 Traffic Signal Operations	
3.1.1 Traffic signal timing coordination	Short
3.1.2 Manage operating speeds – Shepherd/ Greenbriar	Short
3.1.3 Review traffic signal operations	Shore
3.2 Traveler Information	
3.2.1 Wayfinding sign improvements	Short
3.2.2 Pre-advance trip information system	Short
3.3 Ramp Metering Operations	
3.3.1 Implement ramp metering and update timing at existing locations	Short
3.4 Reversible Lanes	
3.4.1 Use reversible lanes to increase roadway capacity for unbalanced flow	Short
3.5 Traffic Management Plans	

Table 2-1 Contd.

Project	Range
3.5.1 Develop traffic management plan	Short
3.5.2 Hermann Park traffic operations plan	
3.5.3 Binz corridor analysis	Short
3.6 Intelligent Transportation Systems (ITS)	
3.6.1 Deploy intelligent transportation system	Short, long
4. INFRASTRUCTURE IMPROVEMENTS Infrastructure improvement strategies are directed at providing additional roadway, transit, parking, and pedestrian and bicycle mobility by expanding or improving facilities.	
4.1 Transit Improvements	
4.1.1 LRT shuttle service	Short
4.1.2 Bus stop attractiveness	Short
4.1.3 Local transit service	Short, long
4.1.4 Secondary park & ride service	Short
4.1.5 Area shuttle service	Short
4.1.6 High capacity transit corridors	Short, long
4.1.7 Priority transitway along Holcombe corridor	Short
4.1.8 TMC intercampus people mover	Short, long
4.2 Pedestrian Improvements	
4.2.1 TMC skyway pedestrian system	Short, long
4.2.2 Pedestrian bridges Reliant Park	Short
4.2.3 High frequency pedestrian accident locations	Short, long
4.2.4 Brays Bayou pedestrian corridor	Short, long
4.3 Bicycle Improvements	
4.3.1 Extend and connect existing bikeway network.	Short, long
4.3.2 Brays Bayou bicycle corridor	Short, long
4.4 Roadway and Transit Infrastructure Improvements	
4.4.1 Intersection improvements	Short, long
4.4.2 Right-of-way preservation	Short
4.4.2.1 Bertner – Old Spanish Trail (OST) to IH-610	Short
4.4.2.2 Additional Brays Bayou crossing	Short
4.4.2.3 Realignment of N. MacGregor Way	Short
4.4.2.4 Holcombe Boulevard corridor – Greenbriar to SH-288	Short
4.4.2.5 TMC intercampus people mover	Short

Project	Range
4.4.3 **Roadway Improvements** Numerous roadway improvements were identified as being beneficial to area mobility, ranging from smaller site-specific projects, construction of remaining arterial segments, to new freeway ramps and major improvements to the freeway system abutting the study area	
4.4.3.1 Main Street/eastbound US-59 exit ramp	Short
4.4.3.2 MacGregor Way at SH-288	Short, long
4.4.3.3 Freeway accessibility IH-610 – SH 288	Short, long
4.4.3.4 Additional Brays Bayou crossing	Short, long
4.4.3.5 Holcombe – Greenbriar to SH-288	Long
4.4.3.6 N. MacGregor Way – Almeda to S. Braeswood	Long
4.4.3.7 Bellfort extension – Stella Link to Buffalo Speedway	Short
4.4.3.8 Reliant Park – IH-610 on-ramp	Long
4.4.3.9 Travis Street – Holcombe to University	Short or long
4.4.4 Parking	
4.4.4.1 Peripheral and remote parking	Short, long
4.4.4.2 Parking garage design review	Short, long
4.4.4.3 Valet parking review	Short
4.4.5 Planning Studies Several planning studies are recommended in addition to the previous recommended corridor analysis projects.	
4.4.5.1 Southgate Area	Short
4.4.5.2 Major Investment Study (MIS) – SH-288	Short
4.4.5.3 Major Investment Study IH-610	Short, long
4.4.6 Flood Control & Drainage Improvements In separate work efforts, several major projects are underway to improve storm water runoff in the study area. Coordination with transportation projects must be maintained relative to specific design elements and project phasing. All transportation projects must be designed to include drainage improvements that reduce street flooding.	
4.4.6.1 Brays Bayou bridge	Short, long
4.4.6.2 Emergency vehicle access	Short, long

2.3 2002 TMC Pedestrian Circulation Master Plan

The 1999 Master Plan established some principles for the skywalk system – continuous network, integrated public transit and campus bus stops with vertical linkages to the skywalk network. The 2002 Pedestrian Circulation Master Plan promoted public uses at the skywalk level and developed security guidelines.

The intent of the Pedestrian Circulation Master Plan was to examine the use of above-grade pedestrian circulation systems, including skywalks, to complement at-grade pedestrian walkways, TMC shuttle services, public transportation, and parking facilities. The existing conditions, current and projected needs of individual member institutions were taken into consideration to ensure a plan which guided

development and accommodated future growth. For streets and sidewalks within the TMC area, issues were identified, goals were developed and design guidelines were established.

Potential location for transit plazas were identified as Memorial Hermann/ Houston Zoo Light-Rail Station Plaza and Dryden/TMC Light-Rail Station Plaza. The Plan recommended a minimum of 12 feet and a maximum of 25 feet skywalk dimensions to be adopted by TMC. On TMC lands, the setback on the streets for sidewalks was recommended to be greater than 25 feet. One of the system design strategies include developing a consistent way finding system for pedestrians.

2.4 2006 TMC 50-Year Master Plan Update

The 1999 TMC 50 Year Master Plan established a framework to guide institutional growth and improve the physical environment of the TMC. The 2006 Master Plan Update presented a road map for the next five years. It updated and advanced the central themes of the 1999 Master Plan, documented recent changes at TMC, and identified priority initiatives for the next five years.

- Reviewed regional initiatives in which TMC should continue to take an active role. These include enhancing regional access and understanding TMC's role in regional growth patterns.
- Identified nine specific initiatives that will strengthen TMC as a whole. These nine initiatives are coordinate growth, improve streets and access, enhance open space, implement stormwater management, expand utility service, link transit service and parking, strengthen main street, promote sustainability and develop mixed-use centers around transit
- Identified specific initiatives each campus should undertake to strengthen their respective identities and environments. Special emphasis was placed on strengthening Main Street as a mixed use corridor, creating a framework plan for developing the Mid Campus and a conceptual plan for the Leland Anderson Campus.

2.5 City of Houston's General Plan

Houston's General Plan is a compilation of plans, regulations, strategies, projections and resources that provide the direction and guidance for Houston's growth and development. The goal of the General Plan is to provide decision makers with the most up-to-date, useful information and tools to manage City's growth. The General Plan provides a way to view and conduct planning efforts in a more cohesive, integrated manner. The General Plan Committee has prioritized mobility and drainage issues in the city. The current TMC Mobility Study is one of the mobility studies that were initiated by the City for several subareas. The City's Urban Corridor Planning initiative regulates development and designs its streets and other infrastructure in order to create a high quality urban environment in areas along METRO's light rail corridors: Main Street, Uptown, East End, North, Southeast and University. Table 2.2 shows the list of projects included in the CIP plan with construction end dates in the future.

TABLE 2.2.
PROJECTS LISTED IN CITY OF HOUSTON CAPITAL IMPROVEMENTS PLAN

CIP_NO	PRO_DESCRIPTION	CONST_START	CONST_END
N-000400-0001	COLQUITT: MONTROSE TO SPUR 527 / NSR 467	1/13/2014	12/22/2014
N-000400-0001	MAIN: MONTROSE TO SPUR 527 / NSR 467	1/13/2014	12/22/2014
N-000400-0001	SUL ROSS: MONTROSE TO BRANDT / NSR 467	1/13/2014	12/22/2014
N-000400-0001	ROSELAND: ALABAMA TO RICHMOND / NSR 467	1/13/2014	12/22/2014
N-000400-0001	BRANDT: SUL ROSS TO ALABAMA / NSR 467	1/13/2014	12/22/2014
N-000400-0001	GREELEY: ALABAMA TO RICHMOND / NSR 467	1/13/2014	12/22/2014
N-000400-0001	BRANARD: MONTROSE TO SPUR 527 / NSR 467	1/13/2014	12/22/2014
N-000400-0001	JACK: ALABAMA TO RICHMOND / NSR 467	1/13/2014	12/22/2014
N-000400-0001	AUSTIN: CLEBURNE TO TRUXILLO / NSR 467	1/13/2014	12/22/2014
N-000400-0001	BUTE: ALABAMA TO MAIN / NSR 467	1/13/2014	12/22/2014
N-000400-0001	STANFORD: ALABAMA TO RICHMOND / NSR 467	1/13/2014	12/22/2014
N-000650-0040	DOWLING @ BLODGETT: Traffic Signal Management	10/26/2009	3/20/2014
N-000400-0001	GARROTT: ALABAMA TO SPUR 527 / NSR 467	1/13/2014	12/22/2014
N-000000-0000	WROXTON: SHEPHERD to WILTON / TBD	7/1/2019	6/30/2020
N-000000-0000	MARONEAL: MORNINGSIDE TO GREENBRIAR	7/1/2019	6/30/2020
N-000000-0000	NORTH BLVD: WOODHEAD TO MANDELL	7/1/2019	6/30/2020
N-000000-0000	UNDERWOOD: KELVING TO MORNINGSIDE / TBD	7/1/2019	6/30/2020
N-000000-0000	BLUE BONNET: KELVING to GREENBRIAR	7/1/2019	6/30/2020
N-000000-0000	KELVING: UNDERWOOD to BLUE BONNET	7/1/2019	6/30/2020
N-000806-0002	ALMEDA BRIDGE: Replacement over Brays Bayou and MACGREGOR BRIDGE: Extension over Brays Bayou	3/6/2015	12/10/2016
N-000000-0000	MILFORD: HAZARD TO WOODHEAD	7/1/2019	6/30/2020
N-000650-0040	DOWLING @ ALABAMA: Traffic Signal Management	10/26/2009	3/20/2014
N-000650-0040	DOWLING @ SOUTHMORE: Traffic Signal Management	10/26/2009	3/20/2014
N-000650-0040	DOWLING @ WHEELER: Traffic Signal Management	10/26/2009	3/20/2014
N-000383-0001	STANTON: BUFFALO SPEEDWAY TO GREENBUSH / NSR451	7/30/2012	7/17/2013
N-000383-0001	CONWAY: BUFFALO SPEEDWAY TO GREENBUSH / NSR451	7/30/2012	7/17/2013
N-000383-0001	CASTLEWOOD: S BRAESWOOD TO GREENBUSH / NSR451	7/30/2012	7/17/2013
N-000650-0040	DOWLING @ CLEBURNE: Traffic Signal Management	10/26/2009	3/20/2014
N-000650-0060	MACGREGOR @ SCOTT : Traffic Signal Construction 2012 Group B	7/23/2012	2/26/2014
N-000000-0000	BELLEFONTAINE: KIRBY to GREENBRIAR	7/1/2019	6/30/2020
N-000000-0000	MANDELL: BISSONNET TO SUNSET	7/1/2019	6/30/2020
N-000824-0001	BLODGETT: ALMEDA TO SAUER / Third Ward to Main Street Connectivity Project	9/17/2012	6/22/2013
N-000806-0001	ALMEDA: OLD SPANISH TO MACGREGOR	8/17/2014	12/28/2019
N-000383-0001	TILDEN: S BRAESWOOD TO WINSLOW / NSR451	7/30/2012	7/17/2013
N-000383-0001	WINSLOW: BUFFALO SPEEDWAY TO GREENBUSH / NSR451	7/30/2012	7/17/2013
N-000383-0001	PRESCOTT: BUFFALO SPEEDWAY TO GREENBRUSH / NSR451	7/30/2012	7/17/2013
N-000383-0001	FAIRHOPE: SOUTH BRAESWOOD TO GREENBUSH / NSR451	7/30/2012	7/17/2013
N-000594-0003	KIRBY: HOLMES TO AIRPORT	10/5/2014	7/6/2016
N-000650-0061	HOLCOMBE @ VA CAMPUS: CITYWIDE TRAFFIC SIGNAL: REBUILD PACKAGE #2	4/23/2012	7/5/2014
N-000401-0001	PORTSMOUTH: HAZARD TO WOODHEAD / NSR 468	7/1/2014	6/30/2015
N-000000-0000	MORNINGSIDE: S. MAIN TO UNDERWOOD	7/1/2019	6/30/2020
N-000000-0000	MARONEAL: MORNINGSIDE TO KIRBY	7/1/2019	6/30/2020
N-000000-0000	SOUTH: WOODHEAD TO MANDELL / TBD	7/1/2019	6/30/2020
N-000000-0000	BOWLING GREEN: DIXIE to MACGREGOR	7/1/2019	6/30/2020
N-000000-0000	GRAMERCY: KIRBY to MORNINGSIDE	7/1/2019	6/30/2020
N-000000-0000	SOUTHGATE: GREENBRIAR to TRAVIS / TBD	7/1/2019	6/30/2020
N-000000-0000	GLEN HAVEN: KIRBY to KELVING	7/1/2019	6/30/2020

2.6 H-GAC Regional Transportation Plan 2040

The 2040 Regional Transportation Plan (RTP) is a blueprint for the Houston region's transportation system through 2040. It identifies the goals, strategies and priorities for meeting the region's transportation needs. Since 1962, federal law requires that urban areas with populations exceeding 50,000 people to develop and regularly update their RTP, meet air quality budget targets and demonstrate that transportation spending does not exceed anticipated revenues.

In 2012, the federal surface transportation funding legislation, *Moving Ahead for Progress in the 21st Century Act* (MAP-21), was enacted. It requires that RTPs adopt performance measures and standards for the transportation system. Consequently, the 2040 RTP, in addition to being based on new demographic forecast data and anticipated land use changes, contains goals that have been reworded and reformulated in anticipation of performance measures and standards. Although there is no national consensus on performance measures yet, some regions have begun using them to track the progress of their RTP. The Houston region is currently studying which performance measures to use. Several highway, street, transit and pedestrian/bicyclist projects of importance to TMC area will be included in the 2040 RTP.

2.7 METRO Bike and Ride Access and Implementation Plan

The METRO Bike and Ride Access and Implementation Plan will enhance METRO's ability to provide first class transit service by linking the region's expanding bicycle networks to transit infrastructure, while building upon its foundation as a trusted community partner to implement a prioritized set of projects that will provide attractive, safe, healthy, low-cost transportation choices for all users. The METRO Bike and Ride Access and Implementation Plan will define a prioritized set of high-quality links between the bicycle and transit networks in the METRO service area, including TMC, to maximize the ability to make bicycle-transit linked trips for all users.

3.0 ROADWAYS

3.1 Regional Access

The buildings in the TMC area are destinations for employees, visitors, students and patients from all over the greater Houston region. A zipcode study conducted triennially by TMC suggests that employees travel to work from Harris, Fort Bend and Brazoria counties. Regional access to the TMC area is provided by two highways – IH 610 and SH 288. IH 610 runs east-west, south of the primary study area and has interchanges at Main Street, Fannin Street, Kirby Drive and Almeda Avenue. SH 288 is a north-south highway in the area and serves traffic to and from Brazoria and Fort Bend counties. Interchanges along SH 288 are located at Holly Hall Street, Old Spanish Trail, Holcombe Street, MacGregor Way and US 59. US 59 Highway provides access from southwest area of the region.

Destinations in the general study area are also served by US 59 in the north and Sam Houston Tollway in the south.

3.2 Functional Classification

Each roadway in the urban region is classified into four categories depending on the mobility, access and use provided by the roadway. Annually, the City of Houston produces the Major Thoroughfare and Freeway Plan (MTFP). In compiling the MTFP, the City listens to developers and neighborhoods about such issues as congestion, mobility and future development plans. In that plan, the city identifies sections of roadways (either thoroughfares or major collectors) that are in need of expansion, either by lengthening or widening. The plan serves as notice to the public for developing land adjacent to the identified roads.

The Street Hierarchy System is used to classify streets, which is based on the following categories:

- Length of road
- Existing and projected traffic volume
- Character of adjacent properties
- Possibility of expansion, including manmade and natural barriers
- Need to preserve thoroughfare corridors
- Classifications and descriptions

Figure 3.1 shows a map of the MTFP within the primary study area. The descriptions of the categories included in the MTFP are:

- **Principal Thoroughfare:** More than 5 miles long; connects freeways and other principal thoroughfares; more than 30,000 vehicles a day, usually spaced one-half to one mile apart.
- **Major Thoroughfares:** More than 3 miles long; connects freeways and principal thoroughfares; more than 20,000 vehicles per day; usually spaced one-half to one mile apart.
- **Major Collector:** One to two miles long; connects thoroughfares and locals streets; more than 5,000 vehicles per day; less than one mile spacing.
- **Local Street:** Less than one mile long; carries little traffic; provides access to homes and local businesses; accommodates on-street parking and pedestrians.

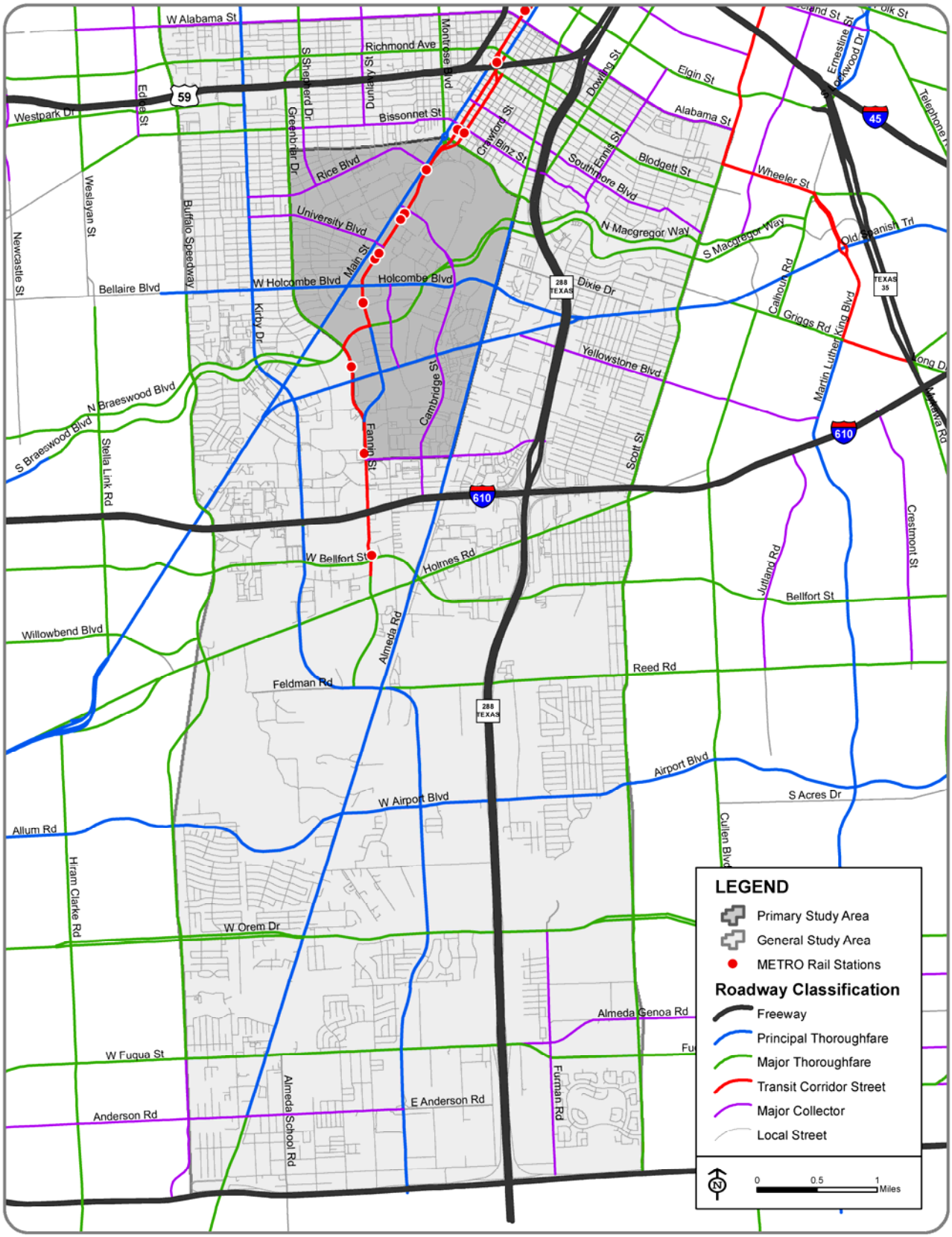

FIGURE3.1
EXISTING ROADWAY FUNCTIONAL CLASSIFICATION

3.3 Street Configurations

The study area roadways serve various functions within the overall study area network. The roadways serving the study area are described below:

Main Street is a north-south principal thoroughfare that runs along the western edge of the TMC. Main Street begins south of IH 610 South Loop, continues through Downtown Houston and crosses North Loop West. South of Kirby Drive, Old Spanish Trail branches off of Main Street. It has four lanes in each direction south of Old Spanish Trail and three lanes in each direction north of Old Spanish Trail. The posted speed limit on Main Street is 35 mph.

Fannin Street is a north-south major thoroughfare and a transit corridor that runs along the western edge of the TMC. Fannin Street begins south of IH 610 South Loop West and continues north through Downtown Houston and eventually merges with San Jacinto Street. South of Old Spanish Trail, Greenbriar Drive branches off of Fannin Street. In the study area, it has two lanes in each direction. The posted speed limit on Fannin Street is 35-40 mph.

Holcombe Boulevard is an east-west major thoroughfare that bisects the TMC. It runs from just east of SH 288 where it connects to Old Spanish Trail west through the TMC to Edloe Street where it becomes Bellaire Boulevard. In the study area, Holcombe Boulevard is three lanes in each direction with left turn lanes at the intersections and a landscaped median. The posted speed limit on Holcombe Boulevard in the study area is 30 mph.

Almeda Road is a north-south principal thoroughfare in the study area that runs along the east side of the TMC. It has two to three lanes in each direction throughout the study area. Almeda Road has a posted speed limit of 40 mph.

Braeswood Boulevard/MacGregor Way is a north-south major thoroughfare that runs from Calhoun Road to the east all the way to Bissonnet Street in the west. North of Holcombe Boulevard, it is known as MacGregor Way, and south of Holcombe Boulevard, it is known as Braeswood Boulevard. In the study area, Braeswood Boulevard has three lanes in each direction separated by a median. Left turn bays are provided at major signalized intersections. The posted speed limit on Braeswood Boulevard/MacGregor Way in the study area is 30 mph.

Cambridge Street is a north-south major collector that bisects the TMC. Cambridge Street has two lanes in each direction. It begins at IH 610 South Loop West, continues through the Medical Center and terminates at Main Street. Cambridge Street has a posted speed limit of 30 mph.

Moursund Street is an east-west local street that connects Bertner Avenue and Braeswood Boulevard. This street has two lanes in each direction divided by a landscaped median. The posted speed limit on Moursund Avenue is 20 mph.

Bertner Avenue is a north-south local street that connects W Road to the south and E. Cullen Street to the north in the TMC. It has two lanes in each direction with a landscaped median in the study area. The posted speed limit on Bertner Avenue is 20 mph.

Lamar Fleming Street is a north-south local street that connects Cambridge Street and Braeswood Boulevard in the TMC. It has one lane in each direction. The posted speed limit on Lamar Fleming Street is 20 mph.

M.D. Anderson Boulevard is a north-south local street that serves the TMC and connects Moursund and Holcombe Boulevard. This roadway is two lanes in each direction with landscaped medians at the intersections. The posted speed limit on M.D. Anderson Boulevard is 20 mph.

Bates Street is an east-west local street that connects Fannin Street and M.D. Anderson Boulevard in the TMC. This roadway has two lanes in each direction between Fannin Street and Bertner Avenue and one lane in each direction from Bertner Street to M.D. Anderson Boulevard. The posted speed limit on Bates Street is 20 mph.

3.3.1 Number of Lanes

Figure 3.1 shows the roadways in the primary study area classified by number of lanes. Table 3.1 identifies the classification of important streets in the area, number of through lanes and right-of-way width as documented in the City of Houston's Street Hierarchy System.

TABLE 3.1
ROADWAY CLASSIFICATION AND NUMBER OF LANES

Street Name	Limits	Roadway Classification	No. of Lanes	Right-of-way Width
Main Street	Sunset to University	Principal Thoroughfare	6	110
Main Street	University to Braeswood	Principal Thoroughfare	6	120
Main Street	Braeswood to OST	Principal Thoroughfare	8	120
Main Street	OST to Buffalo Speedway	Principal Thoroughfare	8	150
Fannin Street	Outer Belt to Holcombe	Principal Thoroughfare	6	100
Fannin Street	Holcombe to Braeswood	Principal Thoroughfare	6	115
Fannin Street	Braeswood to OST	Principal Thoroughfare	6	100
Fannin Street	OST to Greenbriar	Principal Thoroughfare	6	110
Cambridge Street	Main to MacGregor Way	Major Collector	4	
Cambridge Street	MacGregor Way to OST	Major Collector	4	
Cambridge Street	OST to Holly Hall	Major Collector	4	120
Cambridge Street	Holly Hall to Naomi	Major Collector	4	100
Almeda Road	Binz to MacGregor	Major Thoroughfare	4	80
Almeda Road	MacGregor to OST	Principal Thoroughfare	6	150
Almeda Road	OST to South Loop	Principal Thoroughfare	6	160
Braeswood Boulevard	north of Holcombe	Major Thoroughfare	4	80
Braeswood Boulevard	Holcombe to Fannin	Major Thoroughfare	6	100
Braeswood Boulevard	Fannin to N. Stadium	Major Thoroughfare	6	110
Braeswood Boulevard	N. Stadium to Main	Major Thoroughfare	3	60
Braeswood Boulevard	Main to Kirby	Major Thoroughfare	4	70
Braeswood Boulevard	Kirby to Buffalo Speedway	Major Thoroughfare	4	80
Holcombe Boulevard	OST to Braeswood	Principal Thoroughfare	6	80
Holcombe Boulevard	Braeswood to Main	Principal Thoroughfare	6	110
Holcombe Boulevard	Main to Greenbriar	Principal Thoroughfare	6	115
Holcombe Boulevard	Greenbriar to Kirby	Principal Thoroughfare	6	110
Holcombe Boulevard	Kirby to Buffalo Speedway	Principal Thoroughfare	6	120
Old Spanish Trail	Main to Fannin	Principal Thoroughfare	8	100
Old Spanish Trail	Fannin to Scott	Principal Thoroughfare	6	100
MacGregor Way	Holcombe to Almeda	Major Thoroughfare	5	280
MacGregor Way	Almeda to Ardmore	Major Thoroughfare	3	60
Bertner Avenue	Holcombe to OST	Major Collector	4	80

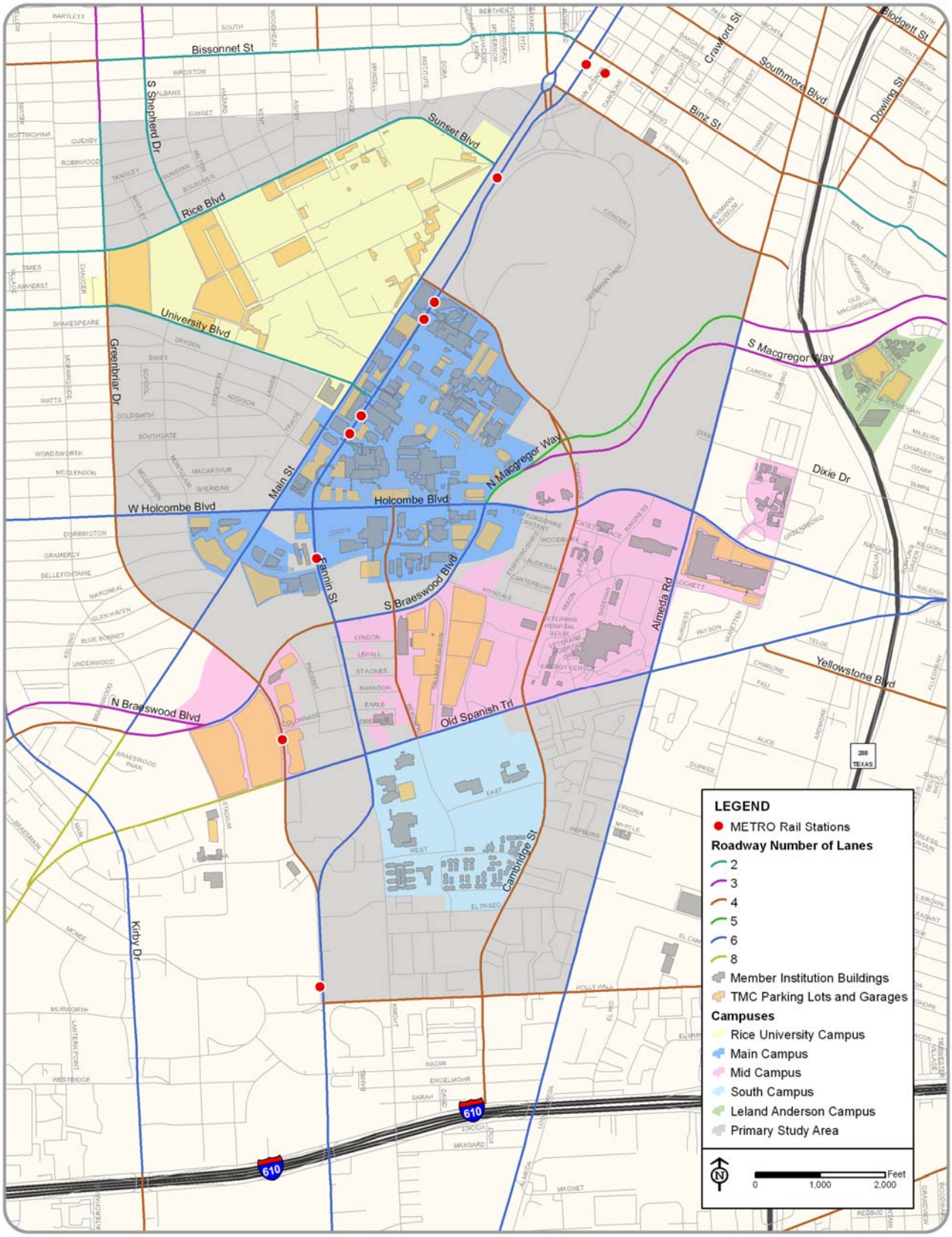

FIGURE 3.2
EXISTING ROADWAY NUMBER OF LANES

3.3.2 Traffic Signals

Several thoroughfare street intersections are controlled using traffic signals in the study area. Figure 3.3 shows a map of 67 traffic signal locations in the primary study area. Fannin Street has several closely spaced signalized intersections. Signal timings and phasings along arterials will be analyzed as part of this study. Main Street, Fannin Street, Holcombe Boulevard and Old Spanish Trail have signal coordination. All signals in the primary study area are equipped for emergency vehicle preemption.

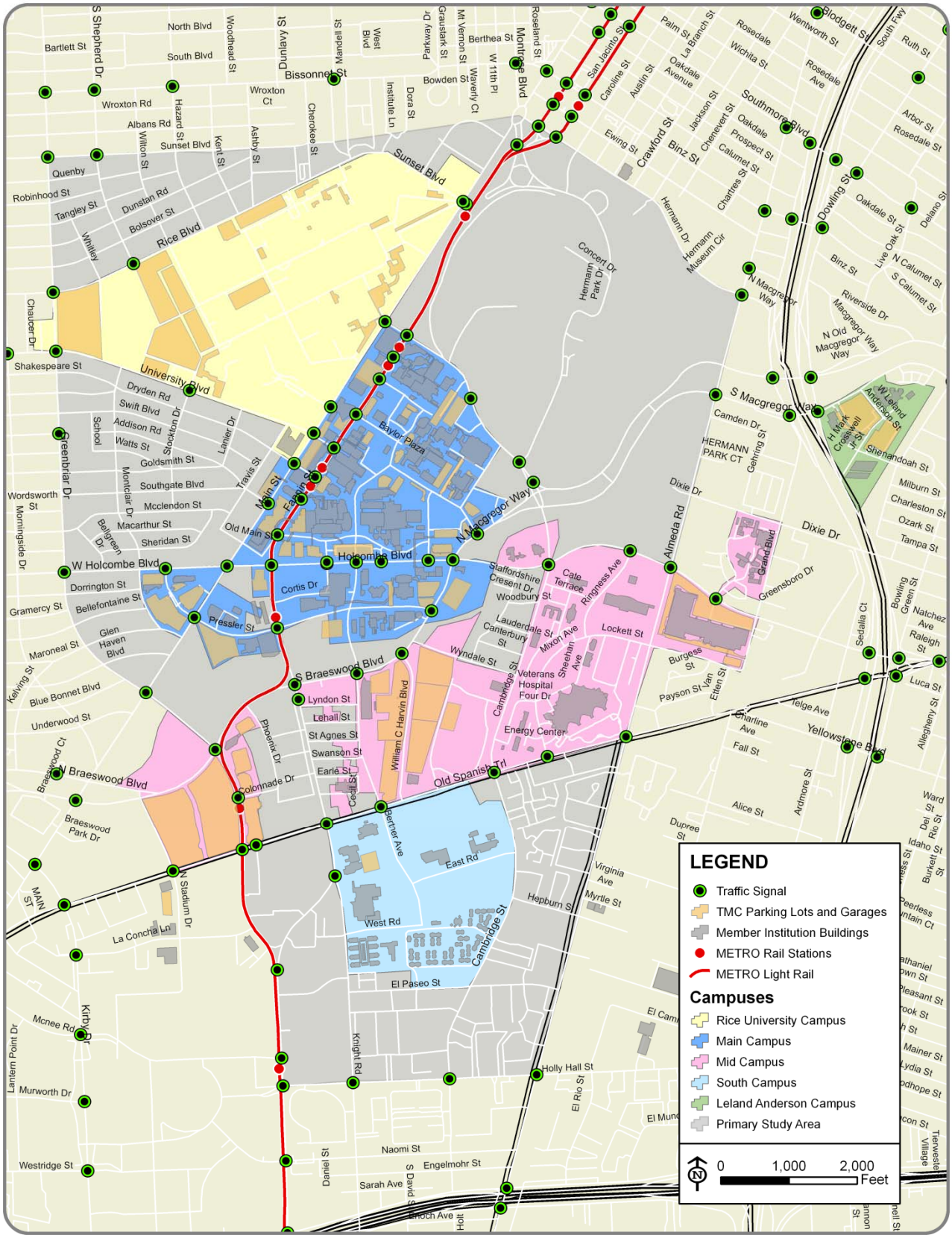

FIGURE 3.3
EXISTING TRAFFIC SIGNAL LOCATIONS

3.4 Programmed and Planned Roadway Improvements

This section describes the planned roadway improvements in the study area.

- Almeda Street is planned for lane additions to make it a six-lane thoroughfare. It is included in the City of Houston's 2013-2017 CIP for improvement from MacGregor to Old Spanish Trail.
- Cambridge Street at IH 610 is currently being studied for connecting to the eastbound frontage road.
- SH 288 Study by TxDOT is 26 miles of State Highway (SH) 288 from US 59 in Harris County to County Road 60 in Brazoria County. The current roadway features 2 to 4 general purpose lanes in each direction separated by a grassy median. Proposed Improvements through this ongoing study include:
    - Construction of toll lanes within the existing grassy median
    - Direct-connector improvements at Interstate Highway 610 and at Beltway 8
    - New overpasses at select existing at-grade intersections
    - Improved access to the Texas Medical Center

4.0 TRAFFIC

4.1 Traffic Volumes

This section of the report includes descriptions of the data collection procedures, traffic volumes, and documentation of existing vehicular traffic patterns.

There are twenty-eight signalized and nine un-signalized intersections in the primary study area. The intersections are part of the following five campuses which comprise the Texas Medical Center:

- Main Campus
- Rice University Campus
- Mid Campus
- South Campus
- Leland Anderson Campus

The study intersections in the primary study area are listed in Table 4.1. Also, a map of the project area identifying the study intersections is presented in Figure 4.1.

4.1.1 Data Collection

The traffic data collection effort included the following items:

- Average Daily Traffic (ADT) volumes provided by the City of Houston.
- New vehicle turning movement counts obtained for the study intersections during both weekday AM and PM peak periods;
- Existing roadway geometry and traffic control information was gathered;
- Acquisition of signal timing provided from the City of Houston; and
- Crash data provided from Houston-Galveston Area Council (H-GAC).

The bi-directional 24-Hour traffic volumes on the roadways in the study area were obtained from the City of Houston Geographic Information & Management System (GIMS) maps.

The AM and PM peak period turning movement counts for the analysis intersections were conducted during December 2012 and January – February 2013. Additional data was obtained from various other sources, such as the MD Anderson Cancer Center Master Plan Report.

The project area field reconnaissance was conducted to gather information such as roadway geometry, intersection traffic control, and general traffic conditions in the study area.

The existing traffic signal timing for the signalized intersections were obtained by contacting City of Houston - Traffic Operations Division.

The crash data for the Years 2007 to 2011 was obtained for the study area roadways by contacting H-GAC staff.

TABLE 4.1
LIST OF STUDY INTERSECTIONS

Main Campus	
1	Fannin @ Cambridge
2	Fannin @ University
3	Fannin @ Ross Sterling
4	Fannin @ John Freeman
5	Fannin @ Dryden
6	Fannin @ Holcombe
7	Fannin @ Pressler
8	Holcombe @ Richard JV Johnson
9	Holcombe @ Bertner
10	Holcombe @ Elliot
11	Holcombe @ MD Anderson
12	Holcombe @ Braeswood
13	Bertner @ Pressler
14	Bertner @ Bates
15	Bertner @ Moursund
16	MD Anderson @ Bates
17	MD Anderson @ Moursund
18	Moursund @ Lamar Fleming
19	Moursund @ Braeswood
20	Main @ Cambridge
21	Main @ University
22	Main @ Holcombe
23	Main @ Pressler
Rice University Campus	
24	Main @ Sunset
25	Fannin @ Sunset
Mid Campus	
26	Almeda @ Holcombe
27	Almeda @ OST
28	Cambridge @ Holcombe
29	Cambridge @ Braeswood
30	Bertner @ OST
31	Fannin @ OST
South Campus	
32	Cambridge @ South Campus Drive (East Road)
33	Knight @ South Campus Drive (West Road)
Leland Anderson Campus	
34	SH 288 NBFR @ N. MacGregor
	SH 288 SBFR @ N. MacGregor
35	SH 288 NBFR @ S. MacGregor
	SH 288 SBFR @ S. MacGregor
36	SH 288 NBFR @ Holcombe
	SH 288 SBFR @ Holcombe
37	SH 288 NBFR @ OST
	SH 288 SBFR @ OST

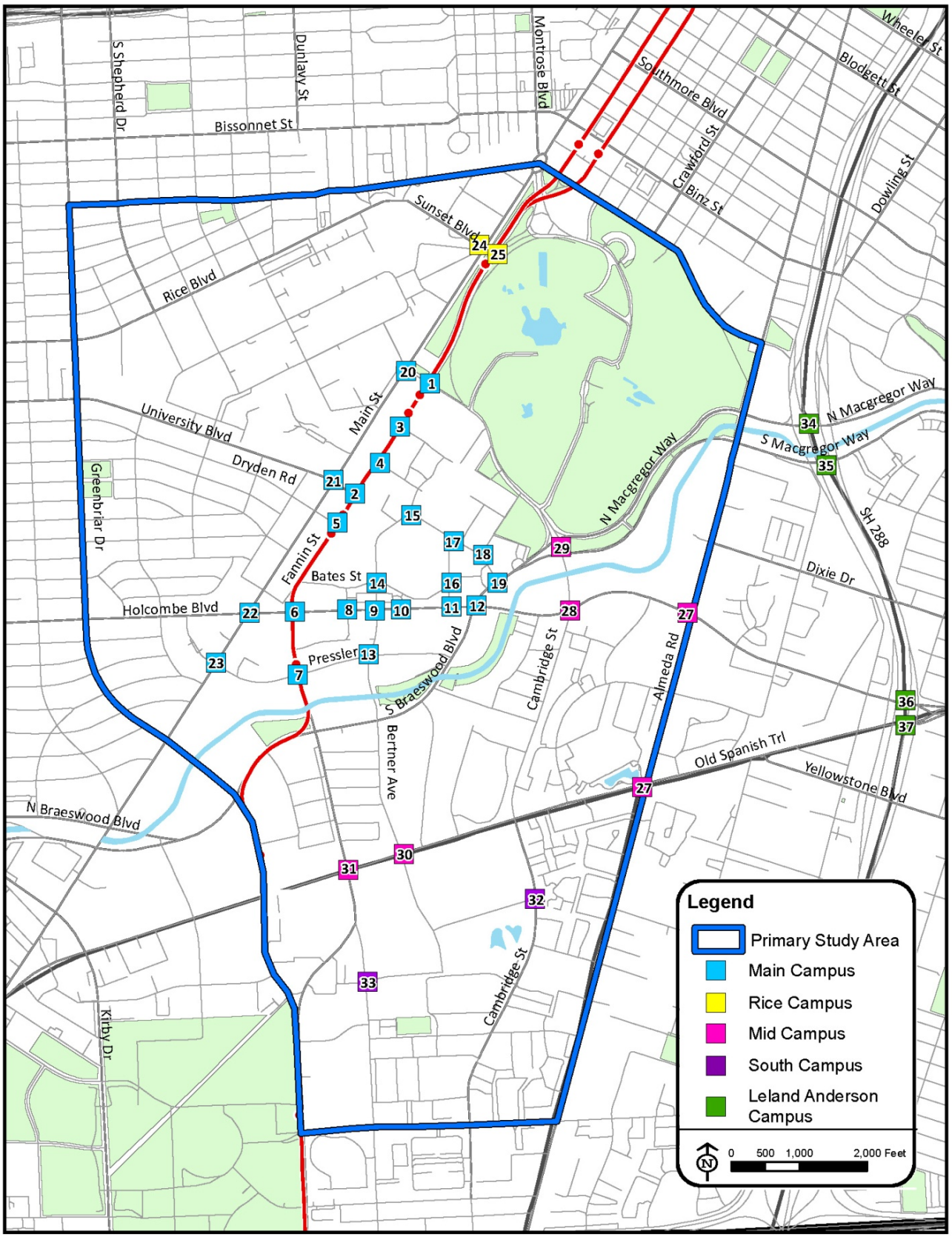

FIGURE 4.1
STUDY INTERSECTIONS

4.1.2 Daily Volume

The Year 2011 bi-directional 24-Hour traffic volumes on the roadways in the study area were obtained from the City of Houston GIMS maps. The 24-Hour traffic counts are summarized in Table 4.2. A map of the study area identifying the count locations is presented in Figure 4.2.

TABLE 4.2A
24-HOUR TRAFFIC COUNTS IN PRIMARY STUDY AREA

S.No.	Street	Location	ADT
1	Main St	North of Sunset Blvd	34,469
2	Main St	South of Sunset Blvd	34,599
3	Main St	South of University Blvd	34,911
4	University Blvd	West of Main St	14,253
5	Holcombe Blvd	West of Greenbriar Dr	31,691
6	Holcombe Blvd	East of Greenbriar Dr	43,509
7	Greenbriar Dr	North of Holcombe Blvd	15,104
8	Greenbriar Dr	South of Holcombe Blvd	9,011
9	Main St	South of Greenbriar Dr	33,957
10	Main St	South of Dryden	34,911
11	Holcombe Blvd	East of Bertner Ave	31,265
12	Braeswood Blvd	East of Fannin St	8,541
13	Fannin St	South of Braeswood Blvd	25,238
14	Kirby Dr	South of Old Spanish Trail	2,957
15	Fannin St	North of Holly Hall St	30,004
16	Fannin St	South of Old Spanish Trail	19,050
17	Fannin St	North of Old Spanish Trail	25,238
18	N. Braeswood Blvd	East of Kirby Dr	6,514
19	S. Braeswood Blvd	East of Kirby Dr	5,643
20	Braeswood Blvd	Northeast of Kirby Dr	10,192
21	Braeswood Blvd	East of Fannin St	8,541
22	MacGregor Dr	North of Holcombe Blvd	19,970
23	Cambridge St	South of Old Spanish Trail	7,421
24	Holly Hall St	East of Cambridge St	7,630
25	Holly Hall St	West of SH 288	13,628
26	Kirby Dr	North of Main St	21,425
27	Kirby Dr	North of Old Spanish Trail	25,769
28	Old Spanish Trail	East of Kirby Dr	25,094
29	Holcombe Blvd	East of Cambridge St	25,064

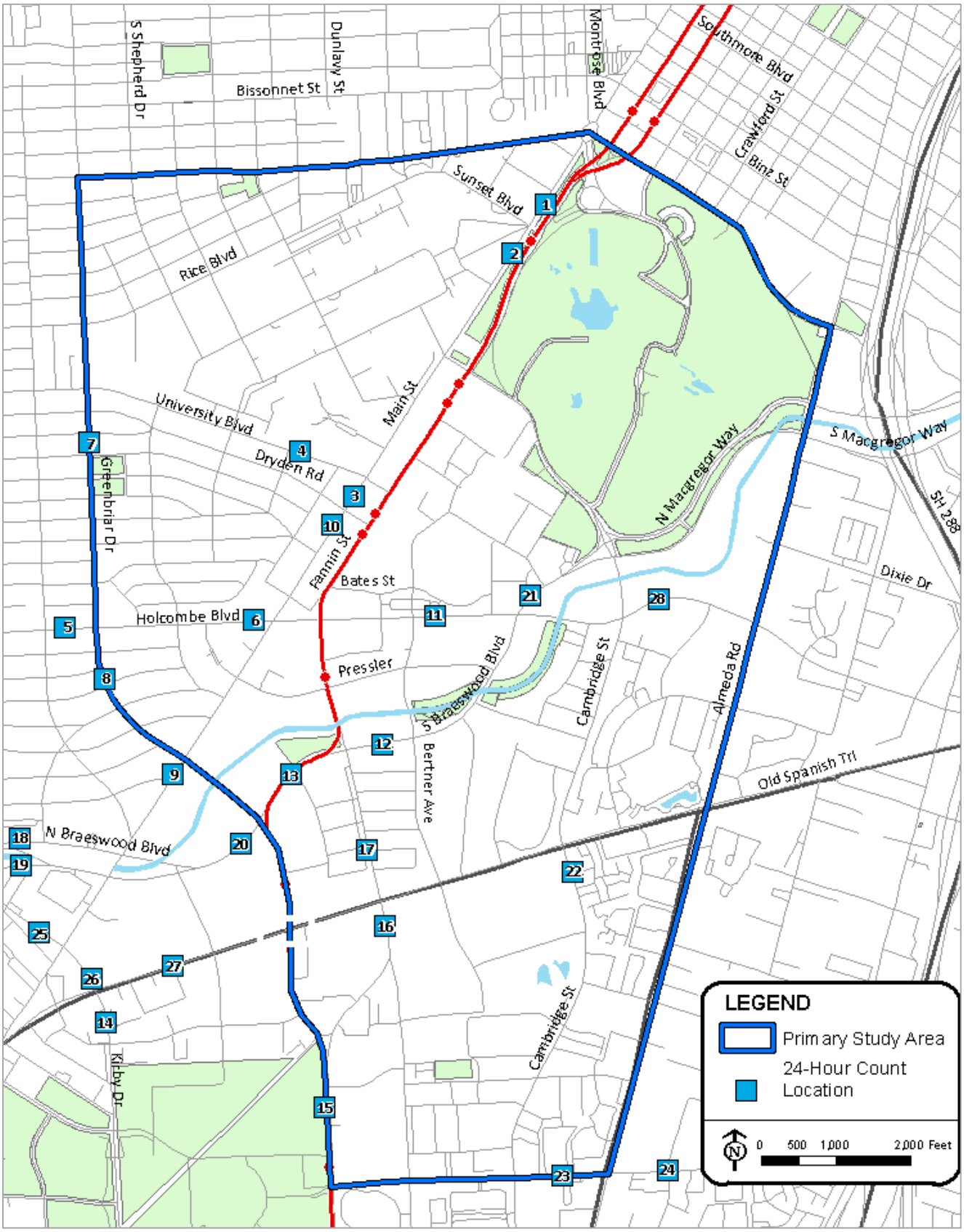

FIGURE 4.2A
24-HOUR COUNT LOCATIONS IN PRIMARY STUDY AREA

TABLE 4.2B
24-HOUR TRAFFIC COUNTS IN GENERAL STUDY AREA

S.No.	Street	Location	ADT
1	Buffalo Speedway	South of Westpark Drive	32,450
2	Buffalo Speedway	North of Braeswood Blvd	11,306
3	Buffalo Speedway	South of Braeswood Blvd	7,014
4	Buffalo Speedway	North of South Loop	10,572
5	Kirby Dr	North of Bissonnet	41,602
6	Kirby Dr	North of Rice	33,722
7	Kirby Dr	South of University Blvd	24,846
8	Kirby Dr	South of Holcombe Blvd	21,259
9	Kirby Dr	North of Main St	21,425
10	Kirby Dr	North of Old Spanish Trail	25,769
11	Kirby Dr	South of Old Spanish Trail	29,576
12	Greenbriar Dr	South of US 59	22762
13	Greenbriar Dr	South of Bissonnet	17,092
14	Greenbriar Dr	South of Sunset Blvd	14,888
15	Greenbriar Dr	South of Rice Blvd	18,294
16	Greenbriar Dr	South of S Main St	9,129
17	Greenbriar Dr	South of S Braeswood	8,547
18	Greenbriar Dr	South of Old Spanish Trail	8,893
19	Shepherd Dr	South of US 59	17,107
20	Shepherd Dr	South of Bissonnet St	11,598
21	Dunlavy St	North of Bissonnet St	2,451
22	Montrose Blvd	North of Bissonnet St	20,139
23	Main St	South of US 59	18,801
24	Main St	South of Kirby Dr	35,079
25	Fannin St	South of Blodgett	12,411
26	Almeda Rd	South of Blodgett	12,104
27	Almeda Rd	South of Calument	13,720
28	Almeda Rd	South of McGregor	14,468
29	Almeda Rd	South of Old Spanish Trail	21,228
30	Wheeler St	West of Almeda Rd	9,013
31	Wheeler St	East of Almeda Rd	6,092
32	Blodgett St	West of Almeda Rd	1,995
33	Southmore Blvd	East of Fannin St	3,555
34	Southmore Blvd	West of Almeda Rd	4,756
35	Southmore Blvd	East of Almeda Rd	11,261
36	Westpark Dr	West of Kirby Dr	8,187
37	Bissonnet St	East of Buffalo Speedway	15,928
38	Bissonnet St	East of Kirby Dr	14,671

39	Bissonnet St	East of Greenbriar Dr	14,256
40	Bissonnet St	West of Montrose Blvd	12,486
41	Binz St	West of Main St	15,079
42	Binz St	East of San Jacinto St	8,667
43	Hermann Dr	East of San Jacinto St	4,796
44	Hermann Dr	West of Almeda Rd	4,749
45	Rice Blvd	West of Greenbriar Dr	7,816
46	University Blvd	West of Greenbriar Dr	10,540
47	Holcombe Blvd	East of Buffalo Speedway	33,096
48	Holcombe Blvd	West of SH 288	25,176
49	N Braeswood Blvd	East of Buffalo Speedway	12,737
50	N Braeswood Blvd	West of Main St	6,514
51	N Braeswood Blvd	East of Main St	5,258
52	S Braeswood Blvd	West of Main St	5,643
53	S Braeswood Blvd	East of Main St	5,488
54	N MacGregor Way	East of SH 288	10,828
55	S MacGregor Way	East of SH 288	10,422
56	Old Spanish Trail	West of Greenbriar Dr	25,094
57	Old Spanish Trail	East of Almeda Rd	26,854
58	Yellowstone Blvd	West of SH 288	6,440
59	Holly Hall St	East of Fannin St	4,499
60	Holly Hall St	West of SH 288	13,628

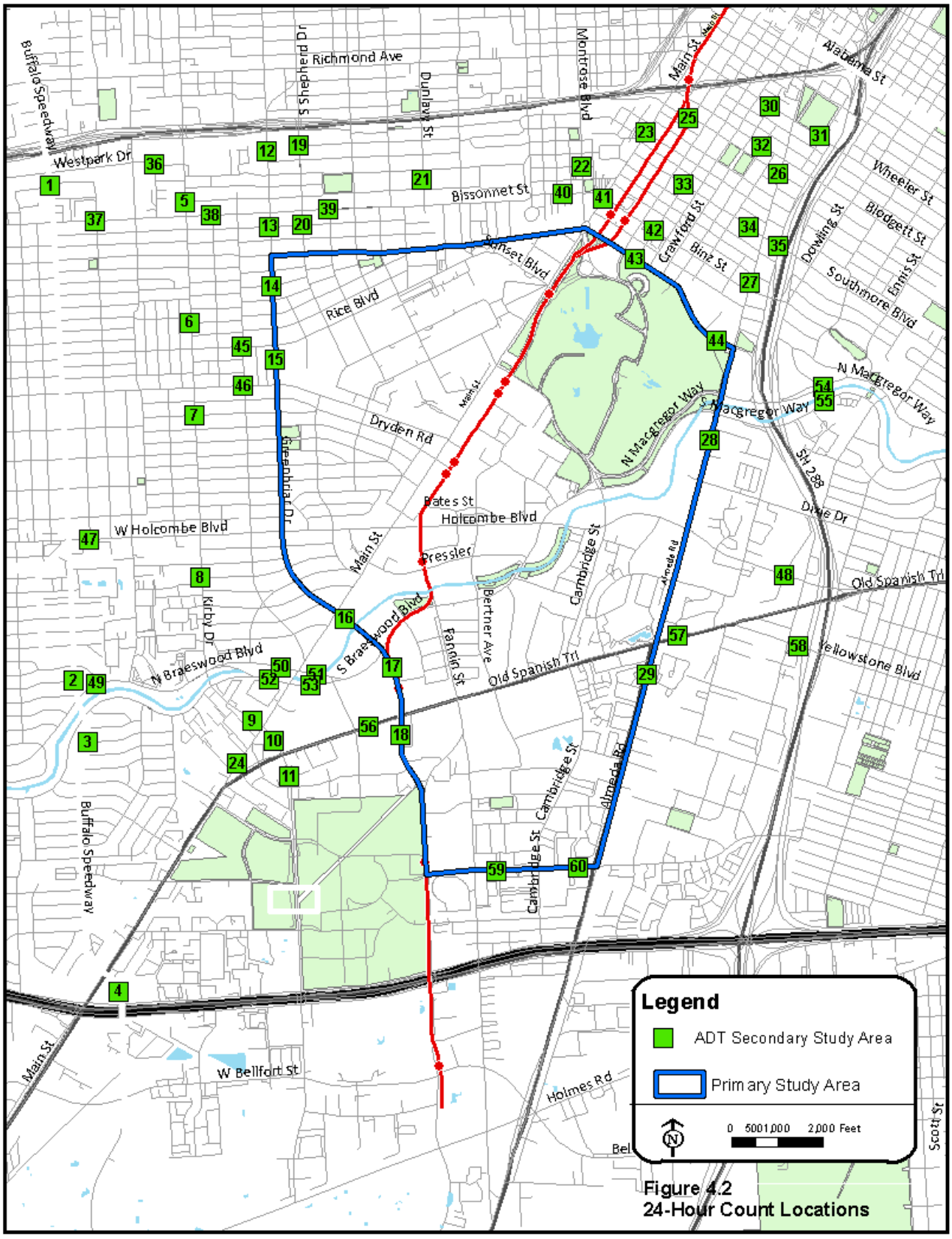

FIGURE 4.2B
24-HOUR COUNT LOCATIONS IN GENERAL STUDY AREA

4.1.3 Intersection Turning Movements

A traffic counting program was undertaken by study team to obtain the existing weekday AM and PM peak hour traffic data at the analysis intersections. Traffic was counted during the AM peak period (7:00 to 9:00 AM) and PM peak period (4:00 to 6:00 PM) on typical weekdays (Tuesday-Thursday). The pedestrian volumes at the study intersections were also collected during the same peak periods. Existing vehicular traffic counts and pedestrian data reports are provided in Appendix section of this report. The lane configurations at each of the study intersections are illustrated in Figures 4.3 to 4.7.

Traffic volumes for all study intersections were compared to determine the study area peak hours within the peak periods. The overall peak hours determined from these counts are as follows:

- AM Peak Hour – 7:15 AM to 8:15 AM
- PM Peak Hour – 4:45 PM to 5:45 PM

The existing AM and PM peak hour intersection traffic data are summarized in Table 4.3 and Table 4.4, respectively.

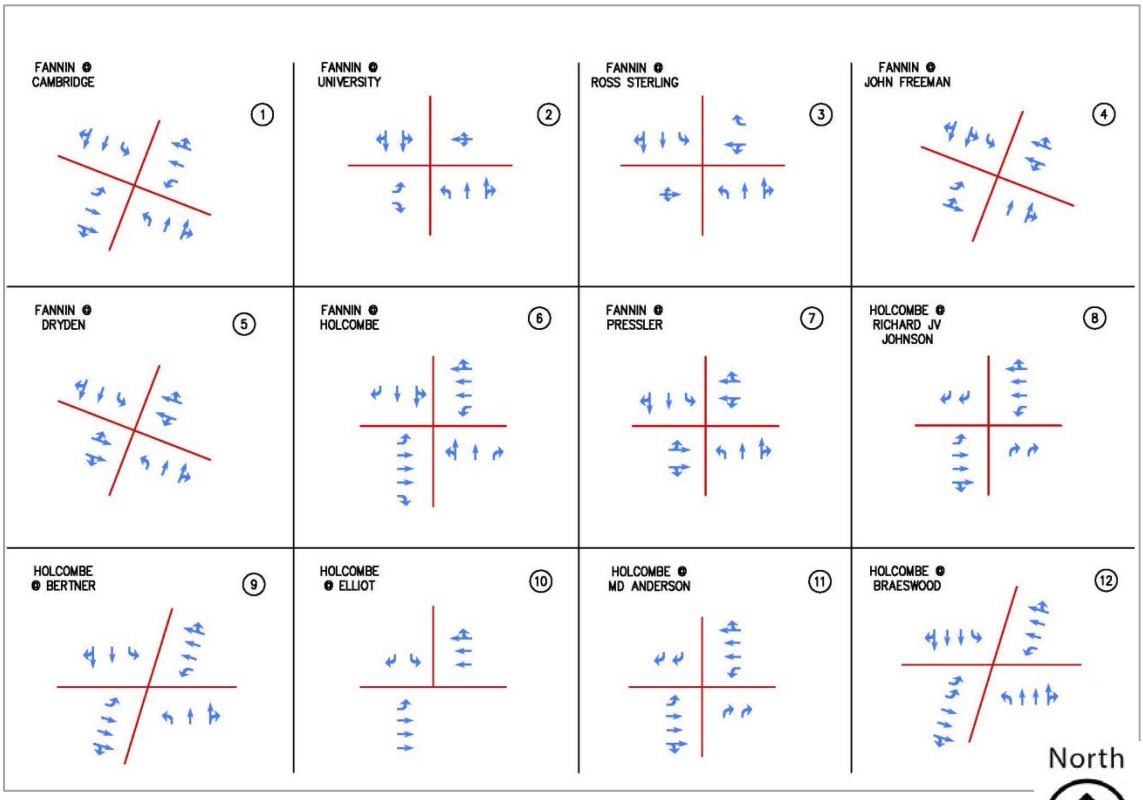

FIGURE 4.3
EXISTING INTERSECTION LANE CONFIGURATIONS – MAIN CAMPUS

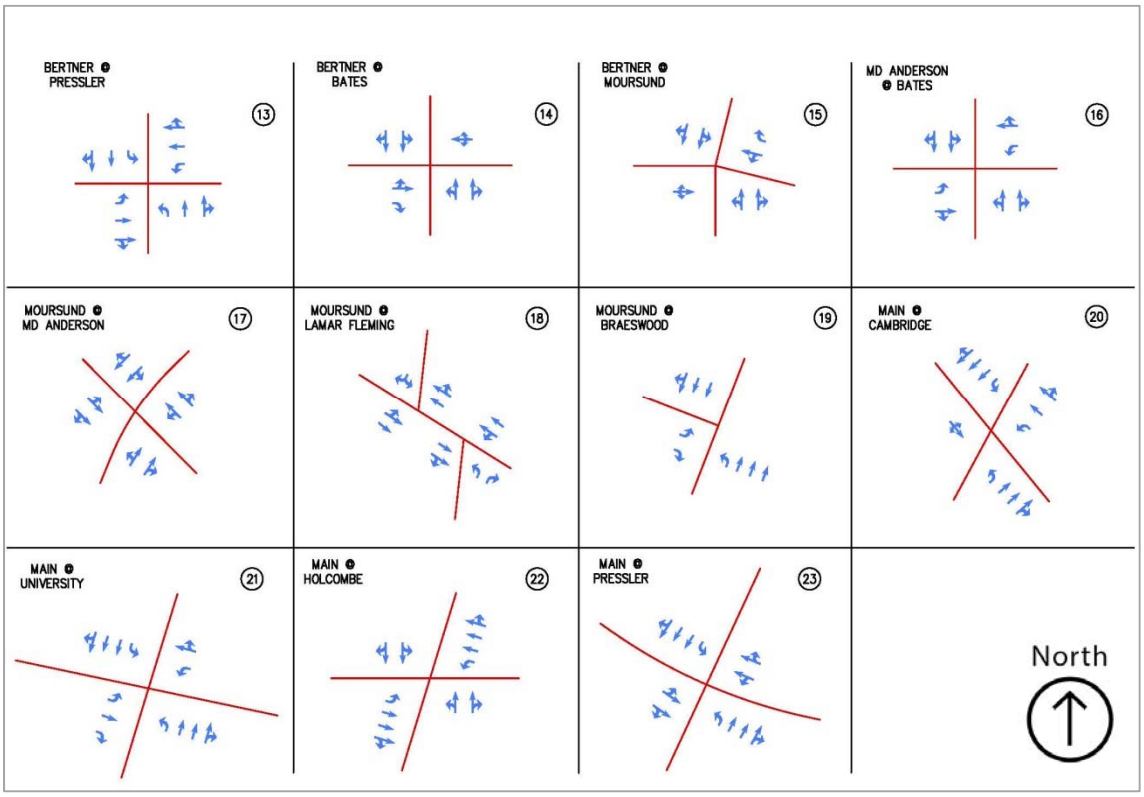

FIGURE 4.4
INTERSECTION LANE CONFIGURATIONS – MAIN CAMPUS contd.

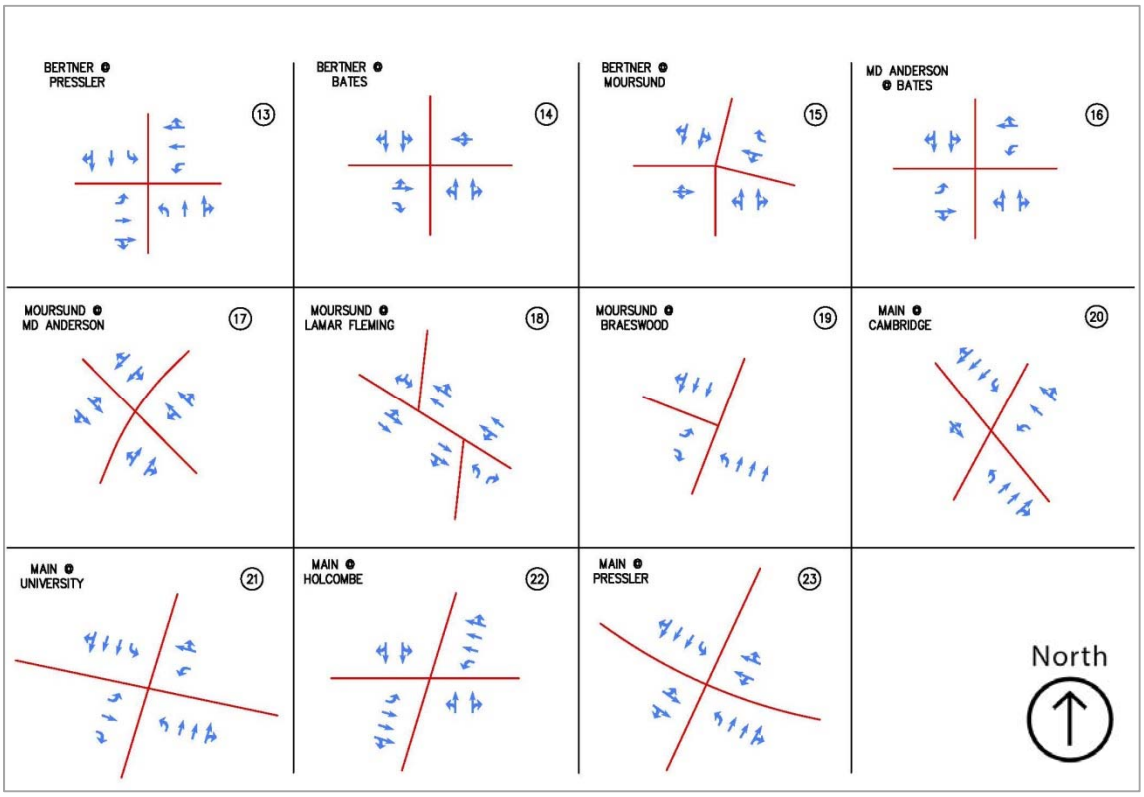

FIGURE 4.5
INTERSECTION LANE CONFIGURATIONS –RICE CAMPUS

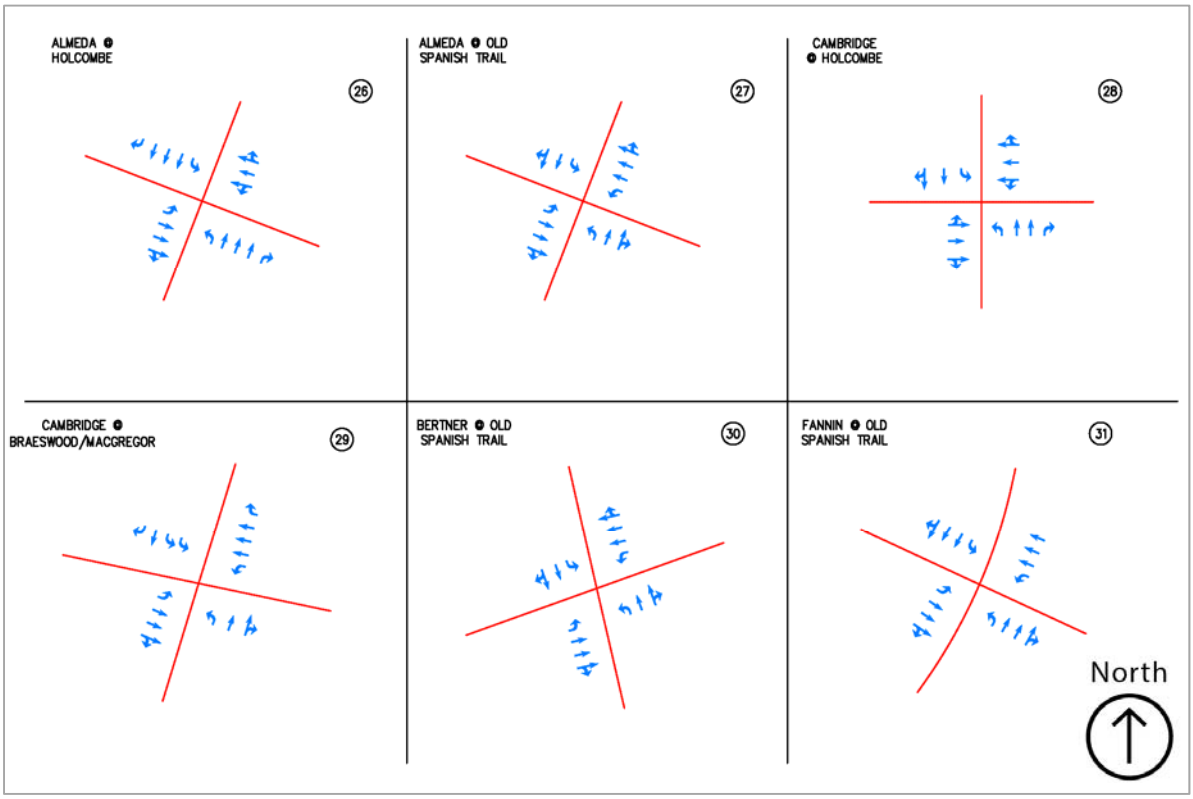

FIGURE 4.6
INTERSECTION LANE CONFIGURATIONS – MID CAMPUS

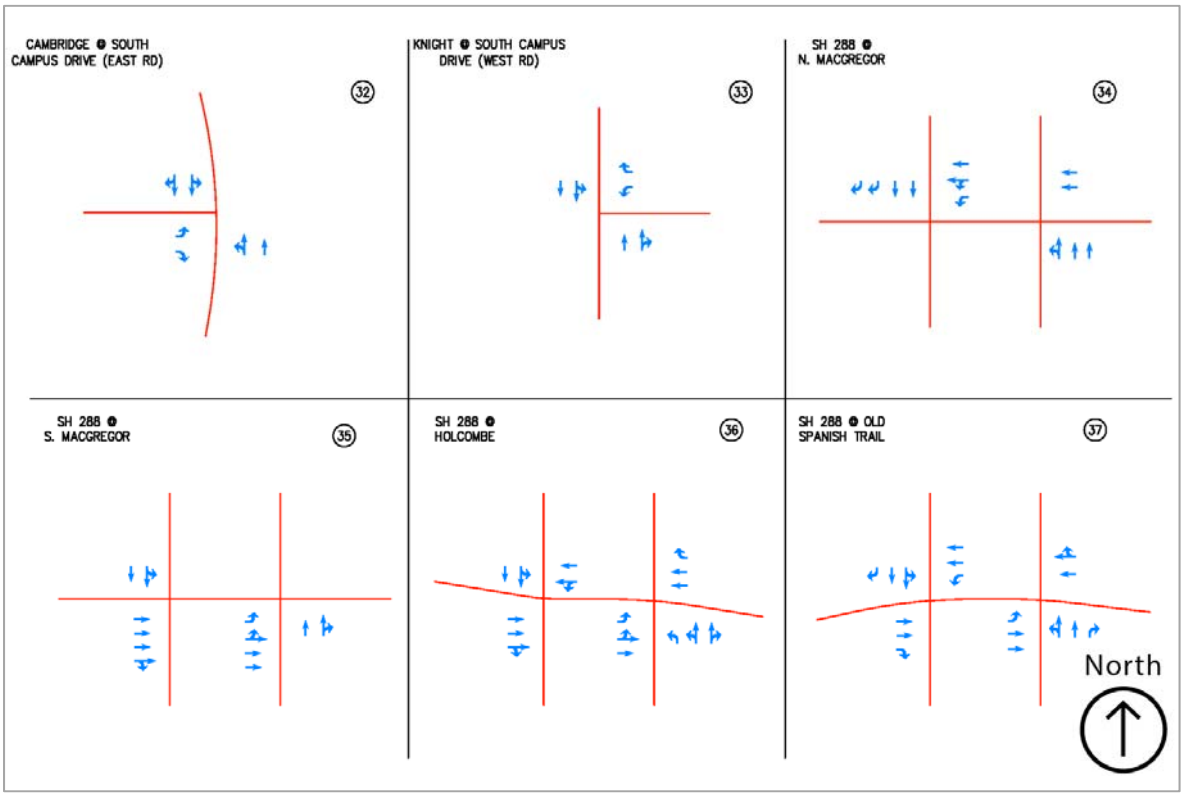

FIGURE 4.7
EXISTING INTERSECTION LANE CONFIGURATIONS – LELAND ANDERSON CAMPUS

TABLE 4.3
WEEKDAY AM PEAK HOUR TURNING MOVEMENT COUNTS

Intersection	Southbound			Westbound			Northbound			Eastbound		
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Main Campus												
Fannin at Cambridge	200	814	39	141	427	66	39	333	87	1	322	75
Fannin at University	-	462	69	6	19	35	127	487	1	135	2	180
Fannin at Ross Sterling	51	701	77	44	6	55	33	411	65	0	0	0
Fannin at John Freeman	79	531	63	85	142	65	2	430	204	13	230	16
Fannin at Dryden	23	570	65	1	94	62	68	528	84	30	73	155
Fannin at Holcombe	95	41	76	209	994	187	122	98	113	207	1617	199
Fannin at Pressler	25	470	44	71	85	33	101	933	108	25	192	189
Bertner at Holcombe	65	185	75	144	741	206	146	195	68	116	897	87
Holcombe at Elliot	131	-	149	-	1,106	126	-	-	-	99	1102	-
Holcombe at MD Anderson	322	1016	9	24	1,099	231	-	-	10	-	-	163
Holcombe at Braeswood	0	2	98	46	792	94	2	0	26	196	802	68
Bertner at Pressler	104	265	57	87	138	67	51	269	113	85	129	69
Bertner at Bates	13	216	57	116	32	33	56	360	70	30	55	67
Moursund at Bertner	0	0	0	119	1	183	1	160	137	135	164	13
Bates at MD Anderson	106	11	32	61	0	3	161	158	227	17	77	64
Moursund at MD Anderson	73	213	47	97	273	146	33	58	179	21	4	0
Moursund at Lamar Fleming East	7	339	92	49	385	21	3	0	16	1	0	0
Moursund at Lamar Fleming West	44	360	-	-	379	10	-	-	-	70	-	150
Moursund at Braeswood	208	-	151	-	-	-	152	213	-	-	1081	319
Main at Cambridge	140	1358	20	359	16	193	14	1,057	225	2	4	11
Main at University	70	1062	110	44	53	59	86	1,458	103	258	287	81
Holcombe at NB Main	-	-	-	-	926	295	27	70	354	405	1614	-
Holcombe at SB Main	231	16	132	237	723	-	-	-	-	-	1800	15
Rice Campus												
Fannin and Main at Sunset	-	792	108	-	-	-	-	430	-	-	-	217
Mid Campus												
Almeda at Holcombe	52	196	223	134	1,020	28	198	513	139	78	350	59
Almeda at Old Spanish Trail	48	189	97	55	924	75	309	954	130	125	418	103
Cambridge at Holcombe	-	-	-	-	-	-	-	-	-	-	-	-
Cambridge at Braeswood	353	167	153	34	1,258	718	55	292	36	60	397	13
Bertner at Old Spanish Trail	64	102	61	17	734	218	19	258	31	200	870	52
Fannin at Old Spanish Trail	0	266	78	107	563	95	176	983	177	177	916	159
South Campus												
Cambridge at South Campus	-	145	86	-	-	-	163	716	-	16	-	44
Leland Anderson Campus												
N. MacGregor at SH 288 NBFR	-	-	-	-	429	371	446	695	-	-	-	-
N. MacGregor at SH 288 SBFR	-	319	1,354	205	668	-	-	-	-	-	-	-
S. MacGregor at SH 288 NBFR	-	-	-	-	-	-	-	667	418	476	578	-
S. MacGregor at SH 288 SBFR	301	221	-	-	-	-	-	-	-	-	751	292
Holcombe at SH 288 NBFR	-	-	-	-	229	366	588	496	-	182	258	-
Holcombe at SH 288 SBFR	147	667	849	0	798	-	-	-	-	-	284	231
Old Spanish Trail at SH 288 NBFR	-	-	-	-	356	2	214	727	281	317	539	
Old Spanish Trail at SH 288 SBFR	64	307	496	84	524	-	-	-	-	-	669	37

TABLE 4.4
WEEKDAY PM PEAK HOUR TURNING MOVEMENT COUNTS

Intersection	Southbound			Westbound			Northbound			Eastbound		
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Main Campus												
Fannin at Cambridge	103	331	57	83	392	105	135	717	139	2	433	68
Fannin at University	-	646	190	15	26	35	70	642	0	174	0	167
Fannin at Ross Sterling	27	542	13	44	2	127	14	858	47	0	0	0
Fannin at John Freeman	81	689	66	102	239	180	0	742	119	27	80	33
Fannin at Dryden	23	792	117	3	130	93	56	609	55	51	13	100
Fannin at Holcombe	144	71	234	147	1,581	148	155	66	72	119	1,063	97
Fannin at Pressler	11	765	45	64	192	68	45	495	38	57	113	124
Holcombe at Elliot	137	-	170	-	986	55	-	-	-	64	1160	-
Holcombe at MD Anderson	118	1047	22	10	837	126	-	-	13	-	-	240
Holcombe at Braeswood	208	811	28	35	585	27	87	187	128	126	214	310
Bertner at Pressler	38	337	72	118	169	147	53	229	38	89	82	73
Bertner at Bates	17	323	71	80	50	40	51	227	20	53	23	169
Moursund at Bertner	4	0	7	100	0	132	1	146	110	121	147	0
Bates at MD Anderson	29	2	38	67	2	10	121	54	63	5	125	45
Moursund at MD Anderson	5	209	37	46	134	15	29	6	105	69	52	48
Moursund at Lamar Fleming East	3	356	13	4	121	1	12	0	39	13	0	2
Moursund at Lamar Fleming West	54	342	-	-	123	14	-	-	-	22	-	57
Moursund at Braeswood	288	-	117	-	-	-	28	395	-	-	456	100
Main at Cambridge	92	991	20	239	12	376	14	1,584	278	26	28	39
Main at University	30	1289	234	214	170	67	141	1,035	57	147	103	105
Holcombe at NB Main	-	-	-	-	1,777	163	119	57	170	179	967	-
Holcombe at SB Main	196	45	318	445	1,461	-	-	-	-	-	946	35
Rice Campus												
Fannin at Sunset at Main	-	503	234	-	-	-	-	807	-	-	-	81
Mid Campus												
Almeda at Holcombe	44	716	105	124	375	48	113	445	107	295	1,337	198
Almeda at Old Spanish Trail	103	903	157	192	498	57	125	346	154	140	1,088	266
Cambridge at Holcombe	-	-	-	-	-	-	-	-	-	-	-	-
Cambridge at Braeswood	676	278	95	74	543	270	13	198	74	155	957	54
Bertner at Old Spanish Trail	203	377	290	19	1,035	38	56	98	34	38	1,146	40
Fannin at Old Spanish Trail	172	982	241	156	1,151	63	140	292	156	78	871	244
South Campus												
Cambridge at South Campus	-	507	47	-	-	-	39	178	-	85	-	241
Leland Anderson Campus												
N. MacGregor at SH 288 NBFR	-	-	-	-	587	243	219	1060	-	-	-	-
N. MacGregor at SH 288 SBFR	-	611	779	279	509	-	-	-	-	-	-	-
S. MacGregor at SH 288 NBFR	-	-	-	-	-	-	-	278	244	1020	621	-
S. MacGregor at SH 288 SBFR	337	529	-	-	-	-	-	-	-	-	1298	447
Holcombe at SH 288 NBFR	-	-	-	-	130	255	126	655	-	713	668	-
Holcombe at SH 288 SBFR	255	265	370	1	251	-	-	-	-	-	1113	646
Old Spanish Trail at SH 288 NBFR	-	-	-	-	636	0	68	260	293	469	546	-
Old Spanish Trail at SH 288 SBFR	49	733	166	150	539	-	-	-	-	-	834	220

4.2 Traffic Level of Service

4.2.1 Analysis Methodology

Intersection Level of Service analyses were performed in accordance with the procedures set forth and recommended by the Highway Capacity Manual (HCM) Level of Service methodologies for evaluation of signalized and unsignalized intersections. The traffic analysis software SYNCHRO was used to evaluate the operations of the study intersections. The Level of Service criteria for signalized and unsignalized intersections are listed below in Table 4.5. The Level of Service is based on delay per vehicle.

Level of Service (LOS) is a quantitative stratification of a performance measure or measures that represent quality of service. The Highway Capacity Manual (HCM) defines six levels of service, ranging from A to F based on a quantitative value of performance measures. LOS A represents the best operating conditions during analysis periods and LOS F represents worst conditions. A change of LOS indicates that roadway performance has transitioned from one given range of traveler-perceivable conditions to another range.

Delay is defined as additional travel time experienced by a driver beyond that required to travel at the desired speed, and is measured in seconds.

Volume to Capacity Ratio (v/c Ratio) is defined as the ratio of flow rate to capacity for a roadway segment.

LOS 'A' is considered as best, free-flow conditions and LOS 'F' is considered failing conditions. LOS 'D' is considered acceptable during the peak hours to City of Houston.

TABLE 4.5
LEVEL OF SERVICE (LOS) CRITERIA FOR INTERSECTIONS

LOS	Signalized Intersection	Unsignalized Intersections
	Delay (sec/veh)	Delay (sec/veh)
A	0-10	0-10
B	>10-20	>10-15
C	>20-35	>15-25
D	>35-55	>25-35
E	>55-80	>35-50
F	>80	>50

The base SYNCHRO model network was developed using the field collected data, which includes lane configuration, traffic control at the intersections, speed limits on streets in the study area. The peak hour traffic volumes, pedestrian volumes and peak hour factors, were entered as input.

The model was then calibrated based on the observations made during the field visit. Variables such as bus blockages etc. for the study intersections were adjusted in order to represent the field conditions.

4.2.2 Intersections

The existing AM and PM peak hour levels of service of the analysis intersections are summarized in Table 4.6, while detailed level of service analysis are included in Appendix of this report. As presented in Table 4.6, some of the study intersections are presently operating at levels of service D or better. Some

intersections are operating at level of service E or F. Figures 4.8 and 4.9 show the operational LOS as indicated by Synchro analysis at study intersections.

The following section provides an overview of the critical intersections in the study area:

Main campus

Fannin at University was observed to be operating at LOS F in the AM peak hour and LOS E during PM peak hour. The northbound and southbound traffic was observed to be moderate. However, the westbound left turning traffic is experiencing high delays during AM peak hour and eastbound left turning traffic was observed to be heavy during PM peak hour.

The intersection of Fannin at Holcombe was observed to be operating at LOSF during both AM and PM peak hours. The eastbound and westbound left turn volume was high and experiencing high delays.

Main at Cambridge was observed to be operating at LOS E during both AM and PM peak hours. During the AM peak north and southbound traffic was heavy and in the PM peak hour southbound and westbound left turning movements were heavy.

The intersection of Fannin at Holcombe was observed to be operating at LOSF during both AM and PM peak hours. The eastbound traffic was heavy during AM peak hour and westbound traffic was high and experiencing high delays during PM peak hour.

The intersection of Holcombe at Richard JV Johnson was operating at LOS F during AM peak hour. The eastbound left movement has high volume and is experiencing delays.

Mid Campus

Almeda Road at Old Spanish Trail intersection is operating at LOS E during AM peak hour and LOS F during PM peak hour. The northbound approach and westbound left turn volumes were high during AM peak hour. During PM peak, eastbound approach had heavy traffic volume and the left turning vehicles at all four approaches were experiencing delays.

Holcombe at Cambridge was observed to be operating at LOS E during both AM and PM peak hours. During the AM peak hour eastbound left turn movement was heavy and is experiencing delays, and in the PM peak northbound approach was heavy.

The intersection of Holcombe at Almeda Road was operating at LOS F during AM peak hour. The eastbound approach was experiencing delays.

Cambridge at Braeswood intersection was operating at LOS E during AM peak hour. High delay was observed for the southbound left movement.

The intersection of Fannin at Old Spanish Trail was observed to be operating at LOS E during AM peak hour. The traffic along Old Spanish Trail in both eastbound and westbound direction was heavy. Also, the left turning movements in all directions were experiencing high delays.

Leland Anderson Campus

The intersection of Holcombe at SH 288 northbound frontage road was observed to be operating at LOS F during both AM and PM peak hours. The delays were due to heavy northbound left turning volume during AM peak hour and eastbound left turning volume during PM peak hour.

The intersection of SH 288 southbound frontage road at N. Macgregor Way was operating at LOS F during AM peak hour. The southbound right movement has very high volume during AM peak hour.

SimTraffic – Progression Observations

AM Peak Hour

- Progressive traffic flow was observed along Main Street in both north and southbound directions, with the exception at University Boulevard where traffic in both directions encountered red signal.
- Southbound Fannin Street had a break in progression at the intersections of Cambridge and John Freeman. However, the progressive traffic flow was observed along Northbound Fannin Street through the Main campus.
- Along eastbound Old Spanish Trail the traffic flow was progressive. In the westbound direction the traffic flow was not progressive. The traffic had to stop at Almeda, Bertner Street, and Fannin Street.
- Along eastbound Holcombe Boulevard progressive traffic flow was observed except for a slight delay at Bertner Street. In the westbound direction the traffic flow was not progressive. The traffic had to stop at Almeda, Braeswood, Bertner, and Main.

PM Peak Hour

- Progressive traffic flow was observed along Main Street in southbound direction, with the exception at University Boulevard. Southbound and Northbound progression along Main Street stops at North Braeswood.
- Southbound Fannin Street progression stops at John Freeman, but flows smoothly south of the John Freeman intersection. Between John Freeman and Sunset, along northbound Fannin Street, traffic flow was not continuous and delays were observed. The traffic was observed to be stopping at each signal in this segment.
- Progressive traffic flow was observed along eastbound Holcombe between Fannin Street and Braeswood Street. In the westbound direction traffic flow was observed to be progressive in the study area. However, the field observations indicated that traffic was heavy along westbound Holcombe and spilling back into upstream intersections between Fannin and MD Anderson Blvd.
- Progressive traffic flow was observed along Old Spanish Trail in both east and westbound directions, with the exception at Bertner Street where traffic in both directions had to stop.

The following paragraphs describe field observations made by the study team at study intersections.

Main Campus

AM Peak Hour

- Westbound traffic along Holcombe Boulevard was observed to be heavy at Fannin Street, but in other directions traffic flow was lower and flowing smoothly.

- All-way stop control intersection of MD Anderson Boulevard at Moursund Street observed some back up, mainly due to parking garage entry traffic.

- Cambridge Street at Hermann Park was observed to be congested during the spring break. Heavy back-ups were observed at Cambridge/Hermann Drive intersection.

- Overall traffic operation at the intersection of Fannin and Pressler was satisfactory in spite of the presence of the METRO transit center and heavy pedestrian activity. However, high delays were observed for the southbound left turn movement of the intersection due to the presence of the METRO Rail LRT station north of the intersection. It was observed that the southbound left turn phase is prohibited when the train is detected in either direction and is not released until the train leaves the station. In the scenario where northbound train checks in before the southbound train checks out of the station the delay for the southbound left turn movement extended up to five minutes.

- The intersection of Fannin at University experiences heavy delays during the AM peak hour.

- The traffic along Main Street in both northbound and southbound directions was observed to be operating at or below capacity.

- The intersections along Main Street at Cambridge and Holcombe Boulevard were observed to be operating with no significant delays.

- Sunset Drive at Main Street was observed to have poor pedestrian operating conditions. The pedestrian ramps need to be reconstructed to meet ADA standards.

PM Peak Hour

- During PM peak hour, Holcombe eastbound traffic flow observed to be smooth; however, westbound traffic spilled back into upstream intersections.

- High delay was observed at the eastbound left turn movement from Holcombe to northbound Fannin.

- Progressive traffic movement was observed along northbound Fannin Street between Holcombe Blvd. and John Freeman Blvd.

- Between John Freeman and Sunset, along northbound Fannin Street, traffic flow was not continuous and delays were observed. The traffic was observed to be stopping at each signal in this segment.

- The level of service at the intersections along Fannin within Main Campus were observed to have slight delay in the field, however the traffic analysis results show heavy delays. The traffic on the northbound and southbound through movements did not spill back into upstream intersections. Field observations indicated that delay was better than LOS D and no queues were observed.

- The unsignalized intersections within the Main Campus were observed to be operating at acceptable levels of service, and no major back-ups were seen.

- During PM peak hour, northbound Main Street has heavy traffic flow.

- Northbound Main Street traffic was observed to be spilling back into upstream intersections from Cambridge to Southgate.

Mid Campus

AM Peak Hour

- Almeda at South Macgregor – the southbound left turn lane storage length is not sufficient.
- Almeda Road is planned to be expanded to six lanes throughout; however, bridges will remain four lanes, causing bottleneck back up issues at each of the intersections of Almeda at North and South Macgregor.
- Cambridge at Macgregor pedestrian crossing was observed to have discontinuous sidewalks. South of Macgregor, Cambridge has sidewalks as well as pedestrian ramps; however, after the crosswalk and pedestrian ramps, there are no pedestrian facilities connecting to the existing sidewalk on the southwest corner of the intersection.
- Almeda at Holcombe and Almeda at Old Spanish Trail were observed to have poor traffic operations.
- Almeda at Holcombe in the northbound direction appeared to operate above capacity, while other directions were operating smoothly.
- The westbound traffic along Old Spanish Trail was observed to be heavy.

PM Peak Hour

- Southbound traffic on Greenbriar Drive was observed to be queued to south of Pressler.

South Campus

- In general, the roadways in South Campus were observed to be carrying low volumes.

General Study Area:

- Traffic along Southbound Fannin Street at IH 610 was observed to be experiencing heavy delays
- The field observations at the intersection of Fannin @ IH 610 Eastbound Feeder Road field indicated heavy traffic. Long queues were observed at eastbound IH 610 feeder road.
- Southbound traffic on Almeda was observed to be queued up from IH 610 to Holly Hall Drive

PEDESTRIAN LEVEL OF SERVICE

The pedestrian counts were conducted at the same time as the vehicular turning movement counts for the study intersections. Utilizing the pedestrian counts, pedestrian level of service for the intersections in the Texas Medical Center area was estimated using SYNCHRO 8 traffic software which supports HCM 2010 methodology for calculating pedestrian levels of service. However, pedestrian levels of service for every study intersection were not available due to the requirements and limitations of the HCM 2010 methodology, such as intersection configuration. It was observed that the pedestrian level of service for all movements was C or better.

TABLE 4.6
WEEKDAY PEAK HOUR INTERSECTION LEVELS OF SERVICE – EXISTING CONDITIONS

	Intersection	AM				PM			
		LOS	Delay	V/C Ratio[1]	V/C Movement	LOS	Delay	V/C Ratio[1]	V/C Movement
Main Campus									
1	Fannin @ Cambridge	C	30.2	0.86	SBL	C	30.6	0.79	NBL
2	Fannin @ University	F*	93.9*	2.39*	EBL	E*	63.4*	1.99*	EBL
3	Fannin @ Ross Sterling	B	14.3	0.66	SBL	C	23.7	0.59*	SBL
4	Fannin @ John Freeman	C*	34.7*	0.86*	WBT/WBR	C*	32.2*	0.60*	SBL
5	Fannin @ Dryden	C*	33.0*	1.29*	NBL	C*	29.3*	1.16*	NBL
6	Fannin @ Holcombe	F*	151.9*	4.53*	NBL/NBT	F*	135.7*	3.21*	NBT/NBL
7	Fannin @ Pressler	B	12.6	0.64	NBT/NBR	B	11.3	0.48	SBR
8	Holcombe @ Elliot	N/A	40.6	0.51[1]	SBL	A*	15.0*	1.44*	SBL
9	Holcombe @ MD Anderson	D*	44.0*	2.06*	EBL	D*	42.3*	2.06*	EBL
10	Holcombe @ Braeswood	C	29.9	0.78	SBL	C	30.8	0.77	SBL
11	Bertner @ Pressler	C	18.2	0.60	NBT/R	C	19.5	0.65	SBT
12	Bertner @ Bates	C	15.7	0.57	NBT/L	C	15.4	0.54	SBT/R
13	Bertner @ Moursund	B	10.7	0.44	EB	B	11.5	0.48	SB
14	MD Anderson @ Bates	A	9.1	0.25	NBT/L	A	9.1	0.25	NBT/L
15	MD Anderson @ Moursund	A	9.7	0.22	EBTR	A	9.9	0.24	EBT/R
16	Moursund @ Lamar Flemming	A	9.0	0.33	EBT	A	9.0	0.33	EBT/L
17	Moursund @ Braeswood	C	25.3	0.92	EBL	C	20.8	0.86	EBL
18	Main @ Cambridge	E	62.0	1.04	NBT/NBR	E	73.5	1.09	WBR
19	Main @ University	D	45.2	0.95	EBL	D	49.7	1.05	WBL
20	Main @ Holcombe	F*	313.0*	2.31*	WBT/WBR	F*	390.68*	2.30*	WBT/WBR
21	Main @ Pressler	D	35.9	0.79	SBL	D	35.3	0.77	NBL
Rice Campus									
22	Main @ Sunset	C*	23.3*	0.71*	NBL	C*	33.3*	0.81*	NBT/NBR
23	Fannin @ Sunset	C*	32.0*	0.71*	SBT	C*	24.0*	0.66*	NBT

1 Volume to Capacity Ratio

* HCM 2000 Used (HCM 2010 Unavailable)

** Volumes Unavailable

TABLE 4.6 (Contd.)
WEEKDAY PEAK HOUR INTERSECTION LEVELS OF SERVICE – EXISTING CONDITIONS

	Intersection	AM				PM			
		LOS	Delay	V/C Ratio[1]	V/C Movement	LOS	Delay	V/C Ratio[1]	V/C Movement
Mid Campus									
24	Almeda @ Holcombe	F	80.8	1.69	WBL	C	24.2	1.34	EBR
25	Almeda @ OST	E	55.5	1.05	WBR	F	95.6	1.27	EBR
26	Cambridge @ Holcombe	E	68.6	1.18	SBR	F	144.1	1.27	NBT
27	Cambridge @ Braeswood	E*	60.8*	1.46*	SBL	D*	45.8*	0.93*	SBL
28	Bertner @ OST	C	30.4	1.07	EBL	D	41.8	1.06	SBR
29	Fannin @ OST	E	65.0	1.12	EBL	D	51.6	0.97	EBR
South Campus									
30	Cambridge @ South Campus Drive (East Road)	A*	2.3*	N/A	N/A	N/A	5.8	N/A	N/A
31	Knight @ South Campus Drive (West Road)	A*	0.1*	N/A	N/A	N/A	0.6	N/A	N/A
Leland Anderson Campus									
32	SH 288 NBFR @ N. MacGregor	B	16.8	5.01	NBL	B	19.7	0.72	WBT
	SH 288 SBFR @ N. MacGregor	F*	239.4*	1.85*	SBR	C*	23.5*	0.82*	SBT
33	SH 288 NBFR @ S. MacGregor	B*	17.2*	0.69*	NBT/NBR	B*	14.7*	0.49*	EBL
	SH 288 SBFR @ S. MacGregor	B	16.7	0.90	EBR	C	23.9	4.21	SBL
34	SH 288 NBFR @ Holcombe	F*	454.6*	2.77*	NBL	F*	134.5*	1.87*	NBT
	SH 288 SBFR @ Holcombe	C*	32.3*	0.92*	WBT/WBL	F*	103.3*	1.23*	EBT/EBR
35	SH 288 NBFR @ OST	D*	44.0*	0.81*	NBT/NBL	E*	66.5*	1.18*	EBL
	SH 288 SBFR @ OST	D*	41.1*	0.89*	WBT	D*	49.7*	1.44*	WBL

1 Volume to Capacity Ratio
* HCM 2000 Used (HCM 2010 Unavailable)
** Volumes Unavailable

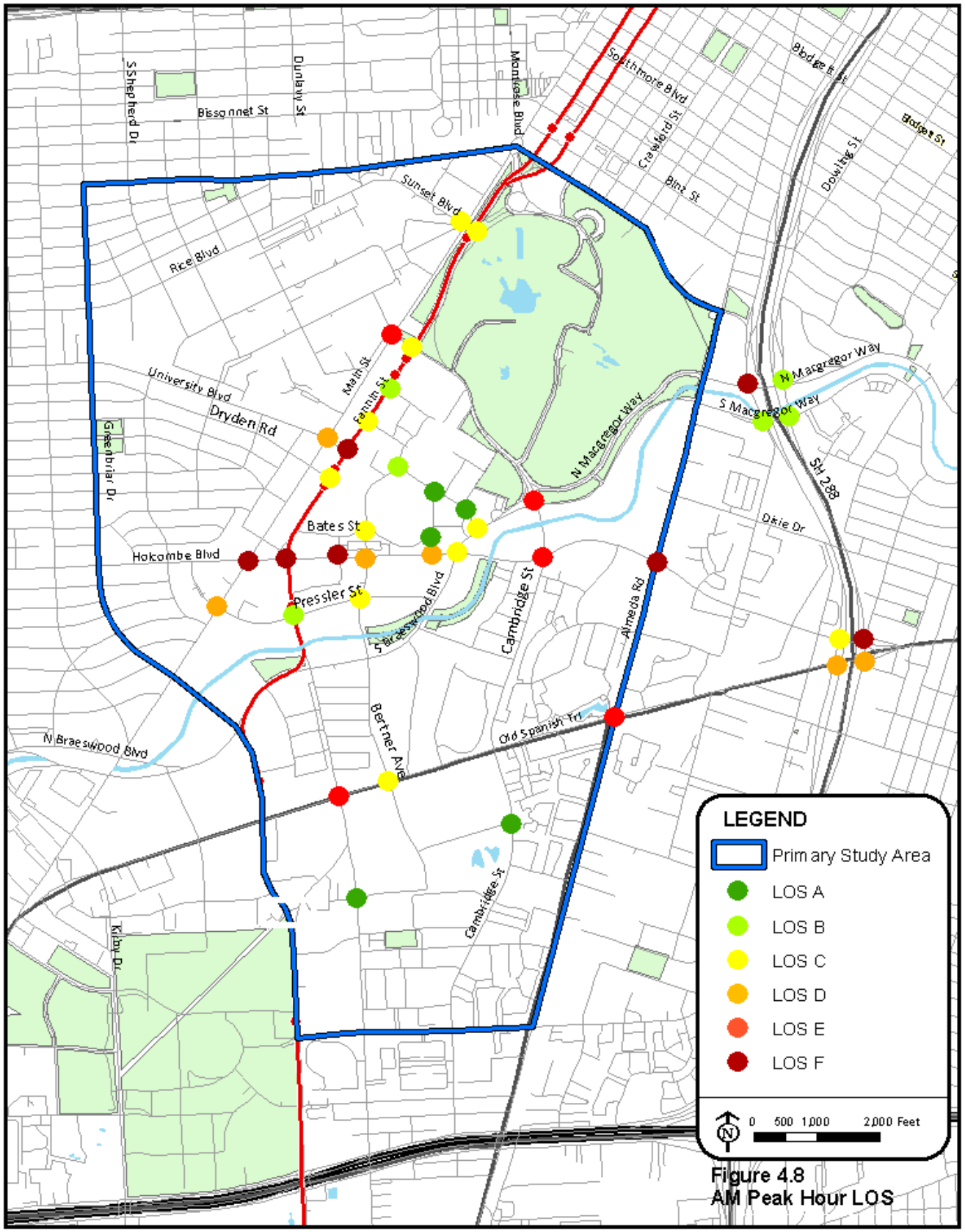

FIGURE 4.8
WEEKDAY AM PEAK HOUR LEVEL OF SERVICE AT STUDY INTERSECTIONS

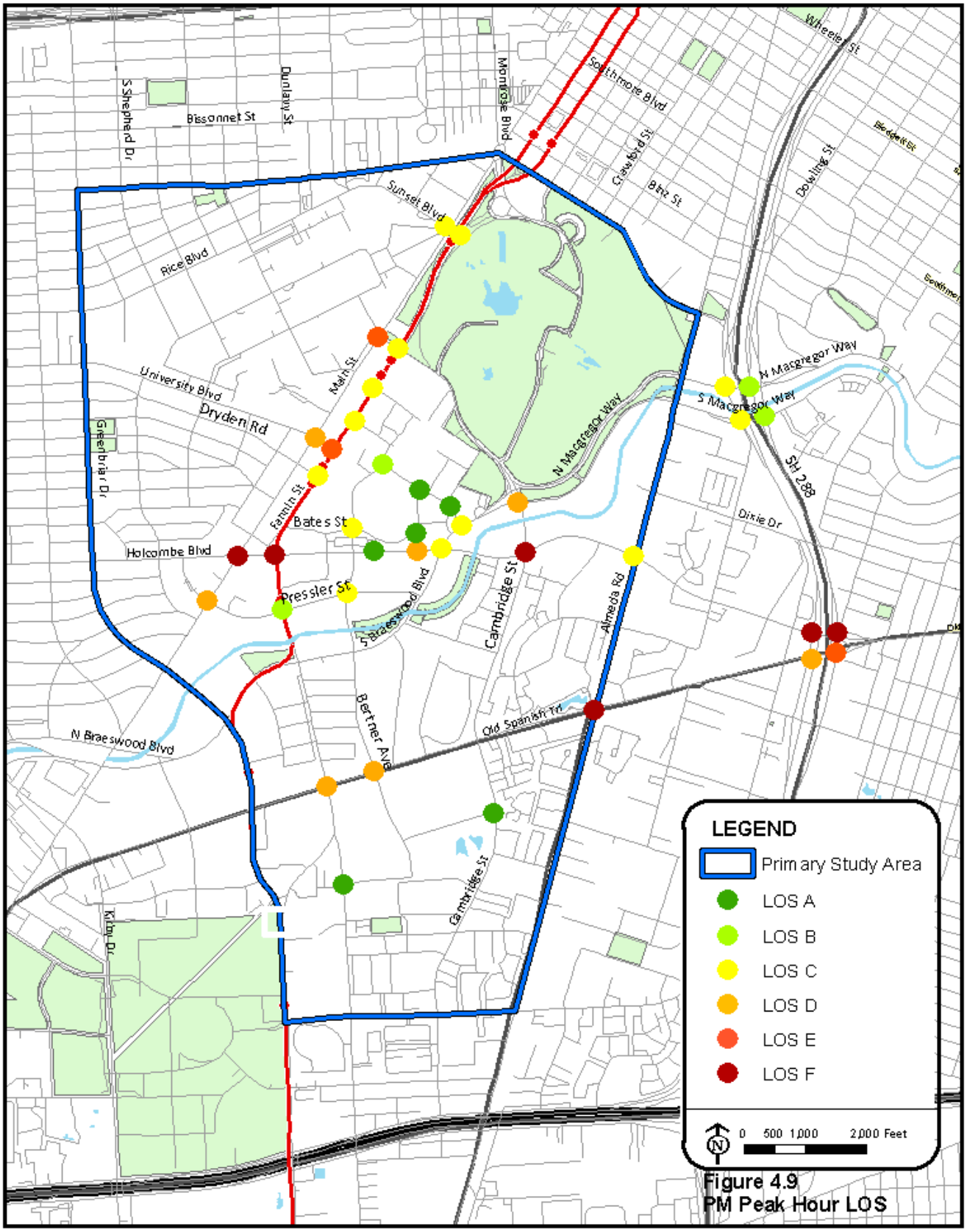

FIGURE 4.9
WEEKDAY PM PEAK HOUR LEVEL OF SERVICE AT STUDY INTERSECTIONS

4.3 Crash Experience

Crash data from 2007 to 2011 was obtained from the Houston Galveston Area Council (H-GAC) for the Texas Medical Center area. These data came from TxDOT's Crash Records Information System (CRIS). The data came from police reports from crashes where the crash resulted in a fatality, injury, or at least $1,000 in property damage. These crashes represent traffic accidents with a fatality, an injury or property damage with one or more vehicles having to be towed.

The crashes were selected using a set of streets located within the study area. The study area comprises a dense street network out of which 30 streets were chosen to query from, primarily based on what was surmised as containing a significant amount of traffic, based on existing traffic patterns. It is estimated that approximately 95 percent of the crashes were captured. Table 4.7 shows the list of streets for which the crash data was queried for.

TABLE 4.7
STREETS ANALYZED FOR CRASHES

Streets		
Greenbriar	Holcombe	Hazard
S. Shepherd	Braeswood	Main
Rice	Bertner	Hermann Park
University	Holly Hall	Hermann Drive
Montclair	Lanier	Old Spanish Trail
Stockton	Sunset	Moursund
Travis	Caroline	Southgate
Cambridge	El Paseo	Ashby
Almeda	Pressler	Wilton
MacGregor	Knight	

Data were queried for a street as both a Primary street location for a crash and a Secondary street location for a crash. Based on the results of the query, the list for each street was picked first by address range and then by intersecting street. It should be noted that some smaller streets in the study area were not included in the crash analysis query; therefore, it is possible that crashes occurred on these smaller streets, but were not included in the analysis. A series of crashes for which records could not be verified, such as streets without block numbers or no intersecting street provided, were not accounted in the crash data.

Table 4.8 presents the summary of crashes in the vicinity of intersections in the primary study area. The number of crashes in the table includes all the crashes within the limits of the Texas Medical Center study area for the years 2007 to 2011. The Figure 4.10 illustrates the magnitude of crashes at intersections in the primary study area.

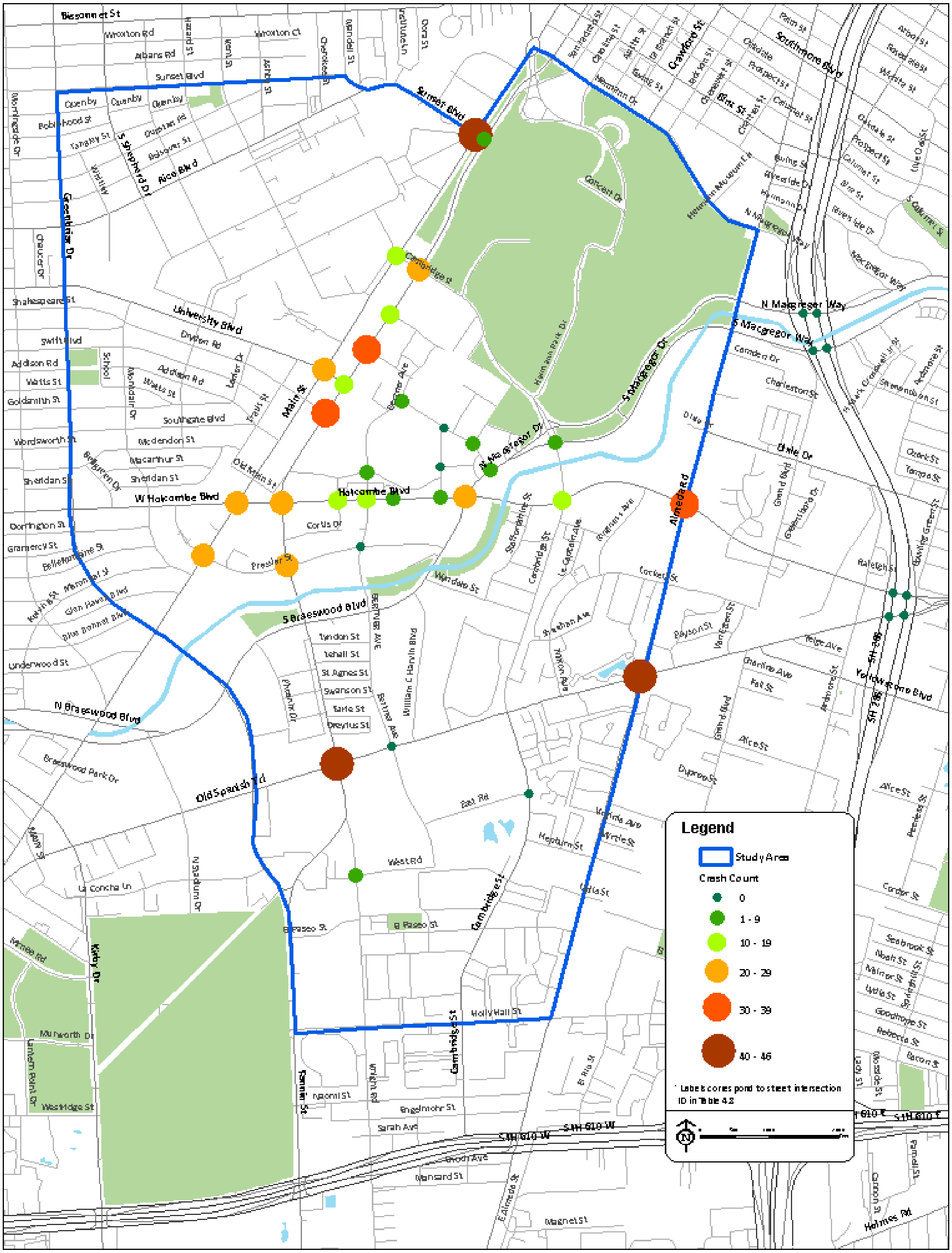

FIGURE 4.10
NUMBER OF CRASHES AT STUDY INTERSECTIONS FROM 2007 TO 2011

4.3.1 Crash Rate Analysis

Crash frequency alone is often inadequate when comparing multiple intersections or prioritizing locations for improvement. Crash rates can be an effective tool to measure the relative safety at a particular intersection. The ratio of crash frequency (crashes per year) to vehicle exposure (number of vehicles entering the intersection) results in a crash rate. The formula used in this study to determine the intersection crash rate is shown below:

$$R = \frac{1{,}000{,}000 \times C}{365 \times N \times V}$$

Where:
R = Crash rate for the intersection expressed as crashes per million entering vehicles (MEV)
C = Total number of intersection-related crashes in the study period
N = Number of years of data
V = Traffic volumes entering the intersection daily

Utilizing the crash data for the years 2007 to 2011 obtained from City of Houston, the crash rates for the study intersections were calculated and presented in Table 4.9. The computed crash rates for the study intersections for the year 2007-2011, range from 0.06 to 0.81 crashes per Million Entering Vehicles (MEV).

The Texas Department of Transportation limits the computation of statewide average crash rates by segments only. Hence the crash rates are compared with in the study area as shown in Table 4.8.

TABLE 4.8
CRASH DATA BY INTERSECTION FROM 2007 TO 2011

ID	INTERSECTION	NUMBER OF CRASHES	CRASH RATE (MEV)
Main Campus			
1	Fannin @ Cambridge	28	0.50
2	Fannin @ University	11	0.26
3	Fannin @ Ross Sterling	11	0.30
4	Fannin @ John Freeman	30	0.59
5	Fannin @ Dryden	36	0.81
6	Fannin @ Holcombe	27	0.32
7	Fannin @ Pressler	28	0.57
8	Holcombe @ Richard JV Johnson	12	0.23
9	Holcombe @ Bertner	16	0.25
10	Holcombe @ Elliot	2	0.03
11	Holcombe @ MD Anderson	9	0.14
12	Holcombe @ Braeswood	28	0.47
13	Bertner @ Pressler	0	0.00
14	Bertner @ Bates	6	0.25
15	Bertner @ Moursund	3	0.15
16	MD Anderson @ Bates	0	0.00
17	MD Anderson @ Moursund	0	0.00
18	Moursund @ Lamar Fleming	2	0.10
19	Moursund @ Braeswood	7	0.15
20	Main @ Cambridge	13	0.16
21	Main @ University	22	0.28
22	Main @ Holcombe	20	0.13
23	Main @ Pressler	24	0.80
Rice University Campus			
24	Main @ Sunset	41	0.42
25	Fannin @ Sunset	2	
Mid Campus			
26	Almeda @ Holcombe	30	0.35
27	Almeda @ OST	42	0.48
28	Cambridge @ Holcombe	14	0.22
29	Cambridge @ Braeswood	1	0.01
30	Bertner @ OST	0	0.00
31	Fannin @ OST	46	0.47
South Campus			
32	Cambridge @ South Campus Drive (East Road)	0	0.00
33	Knight @ South Campus Drive (West Road)	1	0.06

5.0 TRANSIT

Public transportation within the project study area consists primarily of services provided by the Metropolitan Transit Authority of Harris County (METRO), which operates bus and light rail routes serving the area, including the Texas Medical Center. The TMC also is served by a Fort Bend County Transit express bus route, and by TMC Transportation shuttle buses. Figure 5.1 shows a map of all bus routes and light rail routes currently serving the TMC area.

5.1 Existing Routes

5.1.1 Metro Bus

Bus service within the larger study area consists mainly of routes that serve at least part of the Texas Medical Center area. Four exceptions include three east-west routes that connect with the light rail (Red Line) Wheeler Station, and a north-south route on Kirby Street. Routes serving the Wheeler Station are the 25 Richmond, 60 South MacGregor, and 65 Bissonnet. Route 18 Kirby terminates to the north in the Houston Central Business District, and to the south at the Fannin South Park & Ride light rail station.

Most routes that directly serve the TMC include a stop at the TMC Transit Center, which is located in the northwest quadrant of the intersection of Fannin Street and Pressler Street. Exceptions are METRO Route 1 Hospital and 11 Almeda/Nance. Route 1 serves the VA Medical Center area from the Main Street corridor to the north; its routing through the TMC is via Cambridge Street, which takes it to the east of the Transit Center. METRO Route 11 runs along Almeda Road and includes a stop serving the VA Medical Center. There are 17 bus routes using the TMC Transit Center; they include 11 local routes, four park & ride routes (express routes that originate at Park & Ride transit centers), and two enhanced-service limited-stop local routes, 402 Quickline Bellaire, and 426 Swiftline, which operates between the TMC Transit Center and the Southeast Transit Center.

5.1.2 Metro LRT

METRO's light rail Red Line, not to be confused with the TMC Red Shuttle (a bus route), is a 7.5-mile line operating between the University of Houston Downtown campus just north of the Central Business District and the Fannin South terminal station south of IH-610. Figures 5.1A and 5.1B depict all the METRO bus routes, rail routes and bus stops in the general study area and primary study area respectively. Trains operate every six minutes on weekdays from inception of service at 4:30 AM until 7:30 PM, every 12 minutes until 9 PM, and then every 20 minutes until the close of service. On weekends, trains operate every 15 minutes until 10 AM, every 12 minutes until 9 PM, and then every 20 minutes until the close of service. Service ends at midnight on Sunday through Thursday, and at 2:20 PM on Friday and Saturday. Red Line ridership is discussed in Sections 1.2.2 and 1.2.3, below.

A vital feature of the Red Line is a station adjacent to the TMC Transit Center, which provides an important distribution function for bus passengers, for travel between the Transit Center and other Red Line stops in the vicinity including those along Fannin at Dryden Road, and between Ross Sterling Avenue and Cambridge Street.

Another vital function performed by the Red Line is to link the TMC with the TMC Smith Lands remote parking facility. The Smith Lands site has 3,517 parking spaces, which are available to designated TMC institution staff. Almost all of the 6,600 passengers who board or alight at the Smith Lands station on a typical weekday are TMC staff who park there. Additional park-and-ride trips, many related to the TMC, are provided by the Red Line at its terminal station, Fannin South.

Future use of the Red Line will be affected by light rail system expansion. The Red Line extension 5.3 miles to the north to a new terminus at Northline Transit Center is nearing completion, with initiation of

revenue passenger service scheduled for December 2013. The METRORAIL 6.6-mile Southeast Line and 3.3-mile East End Line, which share a route crossing the Red Line in downtown Houston, ara also in advanced stages of construction, with opening planned in 2014.

Further into the future, the ten-mile University Line is to be added to the METRORAIL system, pending approval of new funding sources. At the Red Line Wheeler Station, the University Line will extend westward along Richmond Avenue and Westpark Drive to the Hillcroft Transit Center, providing connections with bus routes serving western and southwestern Houston. The University Line's Bellaire Station will interconnect with a planned Uptown Intermodal Transit Terminal, accommodating passenger interchange with the US 59 HOV facility bus routes and the future Post Oak Boulevard Transitway. The four-mile Transitway will serve Uptown Houston and connect with the Northwest Transit Center. East of the Red Line Wheeler Station, the University Line will serve Texas Southern University and University of Houston. The route will share track for a short distance with the METRO Southeast Line and terminate at the existing Eastwood Transit Center.

5.1.3 Ft. Bend Express

Another route not making direct use of the TMC Transit Center is the Fort Bend Express, which is routed along a loop through the main TMC campus, including a stop near the Transit Center, and ending at the VA Medical Center. This service is operated by Fort Bend County, and links the Medical Center with three park & ride locations along US 59 in Fort Bend County east of SH 6, including at the Fort Bend County Fairgrounds in Rosenberg, the University of Houston Sugar Land campus, and the AMC Theatre First Colony, also in Sugar Land. The express service is predominantly one-way inbound during the morning and outbound in the afternoon, but provides limited reverse-commute service as well.

Given the extent of 24-hour staffing within the TMC, one might expect greater demand for extended service hours and more reverse-commute service, but it appears that the primary attractiveness of the Fort Bend Express is to provide an alternative to driving during the directionally-congested periods of highway travel. According to August 2012 timetables, there were eleven inbound trips arriving at Main & Cambridge streets between 5:40 AM and 9:04 AM, one noonday round trip, and eleven outbound trips leaving Main & Cambridge between 3:20 PM and 7:08 PM. There were six reverse commute trips during each peak period; leaving Main & Cambridge outbound between 5:40 AM and 7:29 PM, and arriving at Main & Cambridge inbound between 4:55 PM and 7:08 PM. Intervals between bus trips range between 15 and 30 minutes.

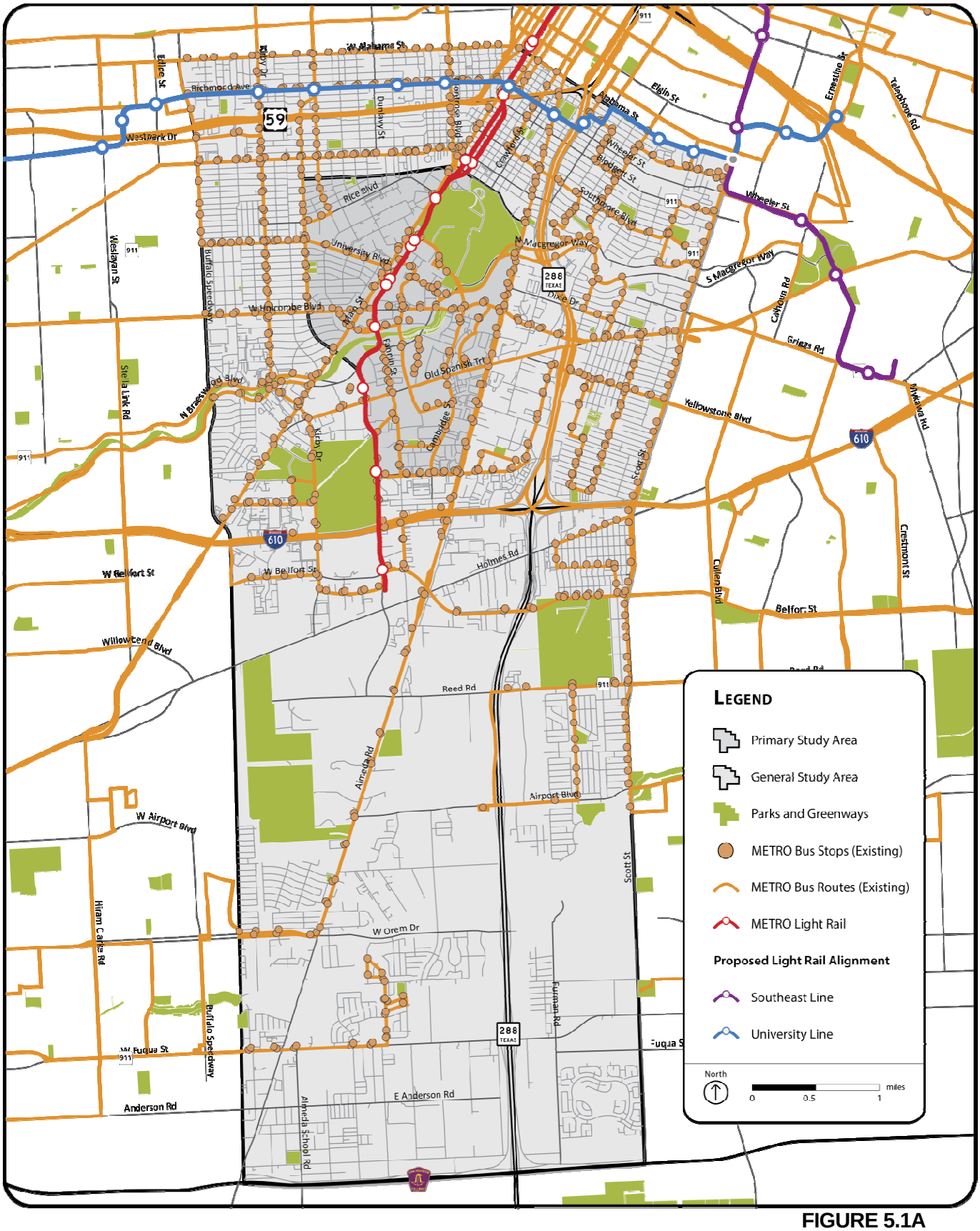

FIGURE 5.1A
EXISTING TRANSIT ROUTES MAP – GENERAL STUDY AREA

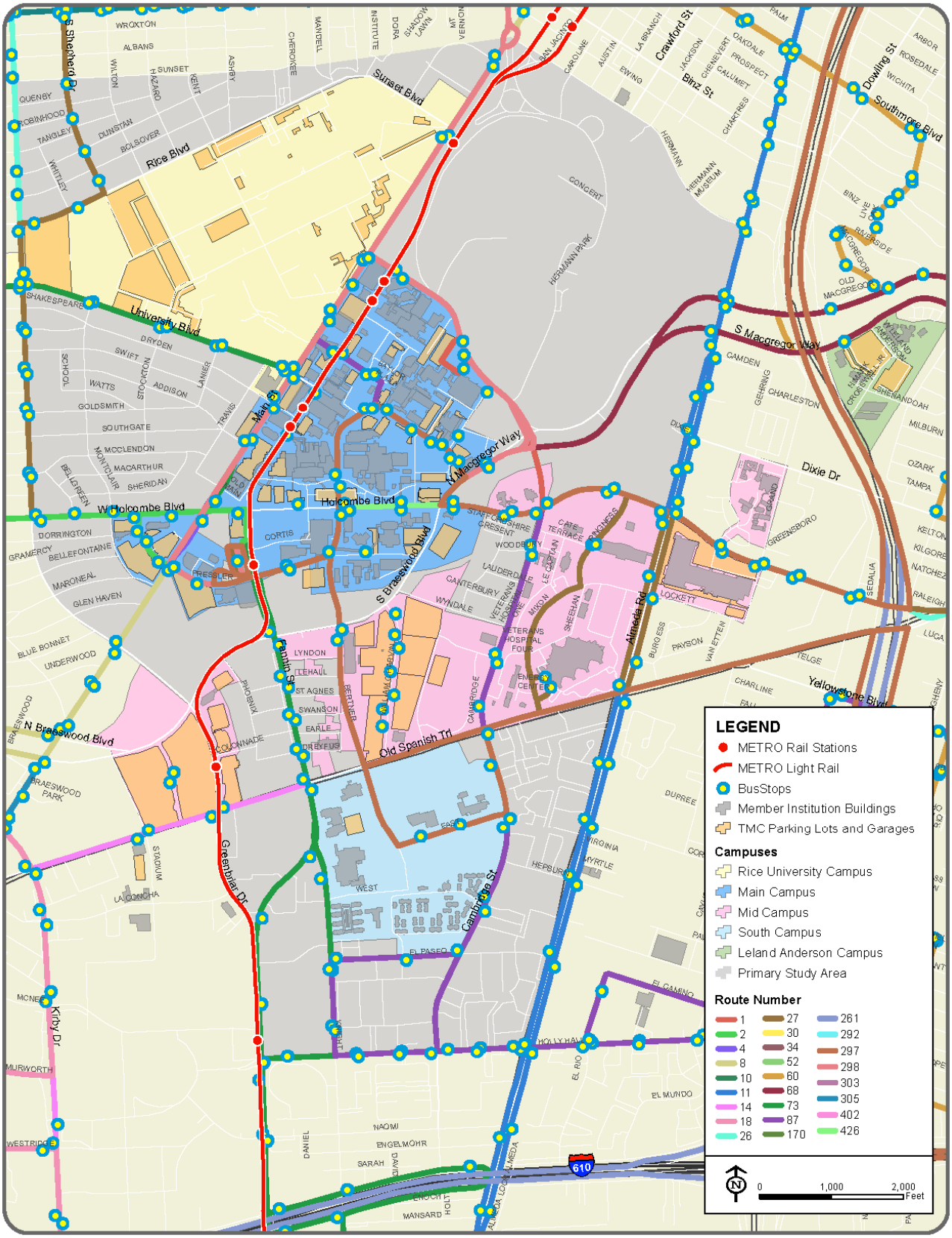

FIGURE 5.1B
EXISTING TRANSIT ROUTES MAP – PRIMARY STUDY AREA

5.1.4 TMC Shuttles

Texas Medical Center Transportation, a unit of the TMC, provides TMC Shuttle Service. This complimentary service for patients, visitors, and employees provides bus routes that interconnect TMC parking sites and the main campus institutions. There are two shuttle routes, which are operated by a contractor, Horizon Coach Lines. The TMC Red Shuttle, which operates from 6 AM to 6 PM, serves the Smith Lands remote parking facility and has five stops along its route through the TMC main campus. The routing is via Fannin Street, John Freeman Boulevard, Bertner Avenue, and Braeswood Boulevard. The TMC Blue Shuttle operates from 4:30 AM until midnight, along a figure-eight loop with 12 stops distributed through a broader area of the TMC main campus including two stops on Fannin Street in common with the TMC Red Shuttle.

MD Anderson Cancer Center also provides shuttle services for employees only. There are frequent shuttles operating on four routes for employees only namely Red, Black, Blue and Gray shuttle. Additionally, there is one patient shuttle. These shuttles transport employees from one building to another. Figure 5.2 shows the MD Anderson bus shuttle routes.

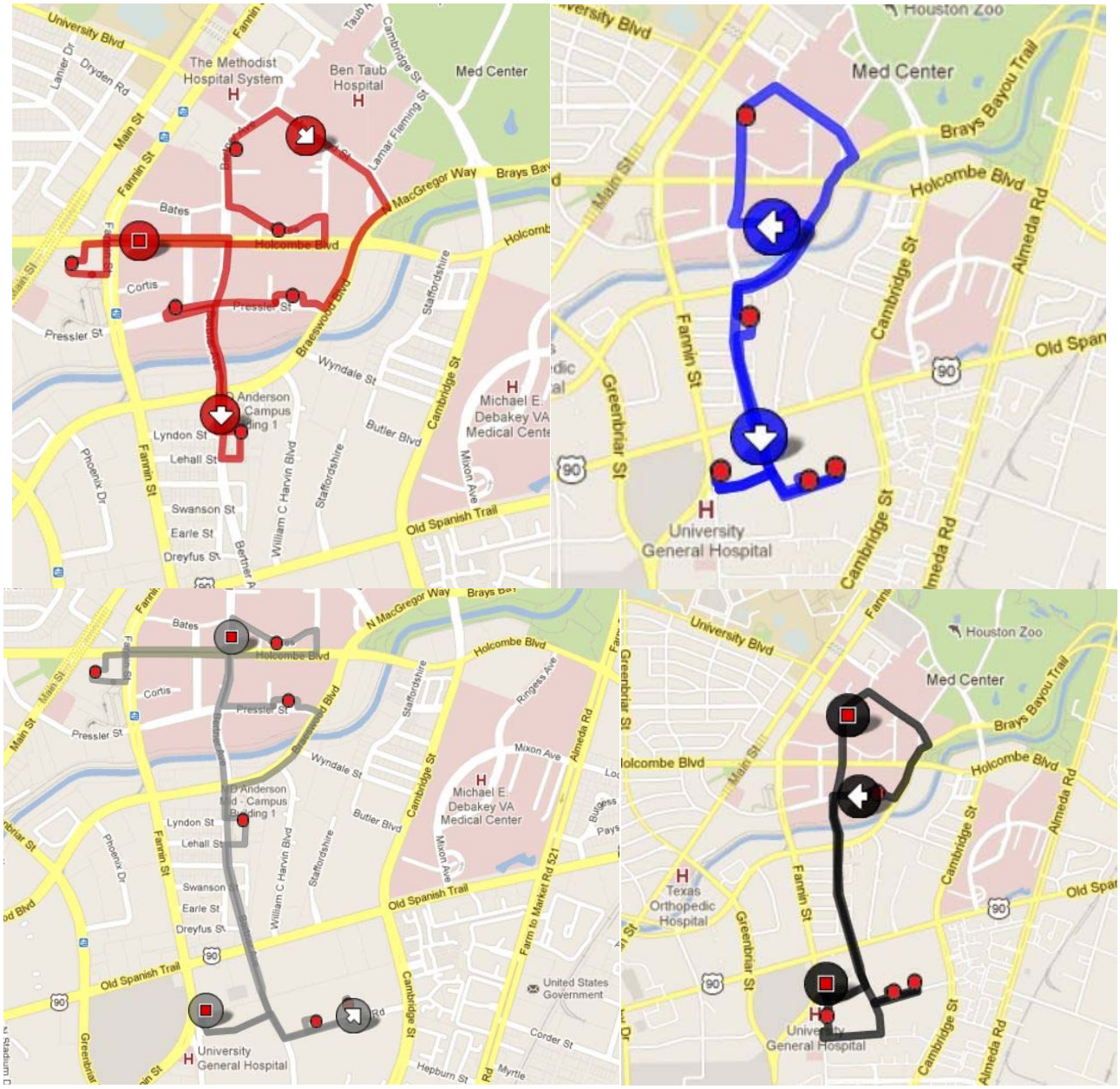

FIGURE 5.2
MD ANDERSON SHUTTLE ROUTES

5.2 Transit Use

5.2.1 Metro Transit Passenger O-D Survey

A system-wide transit passenger origin-destination (O-D) survey conducted during April through July 2011 provides a data source for information on transit use within the TMC study area. The survey encompassed certain non-METRO services including the Fort Bend Express TMC service, which is contained within the summary results given in this report. As extracted from the survey database, there were 64,900 weekday person trips to or from the General Study Area. Of these, 45,900 used bus as the dominant mode, 15,300 used light rail (the METRO Red Line) primarily, and 3,700 used TMC shuttle

routes. A large proportion of these trips, 44,100 in all, were to, from, or within the Primary Study Area, including 35,600 to or from locations outside the General Study Area, 4,000 entirely within the Primary Study Area, and 4,500 traveling between the Primary and General Study Areas.

One-third of the trips to, from, or within the General Study Area were made by persons with no vehicle in their household, and 59 percent did not have a vehicle available for their trip (there was no vehicle in the household, or there were one or more vehicles being used by someone else.

The geographic distribution of transit travel related to the TMC study areas has been broadly summarized by defining eight sectors (northwest, north central, northeast, etc.) encircling the General Study Area. These sectors were defined by extension of the northern, eastern, southern, and western boundaries of the General Study Area. Total year 2011 weekday transit person trips between each sector and the study areas are as shown in Table 5.1, which also indicates travel volumes within the General Study Area, further subdivided to break out the Primary Study Area.

TABLE 5.1
GEOGRAPHIC DISTRIBUTION OF TMC STUDY AREA
WEEKDAY TRANSIT PASSENGER TRIPS, YEAR 2011

Geographic Sectors		TMC General Study Area		
		Primary Study Area	Rest of the Study area	Total General Study area
TMC Study Area	Primary	4,001		
	Secondary	4,460	2,568	
	Sum	8,461	2,568	11,029
Outside the Study Area	Northwest	627	209	837
	North	110	43	153
	Northeast	1,118	425	1,543
	East	2,359	2,074	4,433
	Southeast	3,877	1,415	5,292
	South	10,037	5,019	15,056
	Southwest	10,750	5,611	16,361
	West	6,725	3,443	10,168
Totals		44,065	20,808	64,873

Source: Extracted from METRO 2011 Transit Passenger O-D Survey File

The distribution of trip purposes is generally as one would expect except for the relatively small number of medical and visitor trips, considering that the TMC is the overwhelmingly dominant activity within the General Study Area. This, however, suggests that patients and their visitors are much less likely to be familiar with or comfortable in using transit than are those who are employed within the study area. The combined origins and destinations of trips by purpose are shown in Figure 5.3. In the figure, trips with

origin, destination, or both origin and destination within the Primary Study Area are those designated as "Primary".

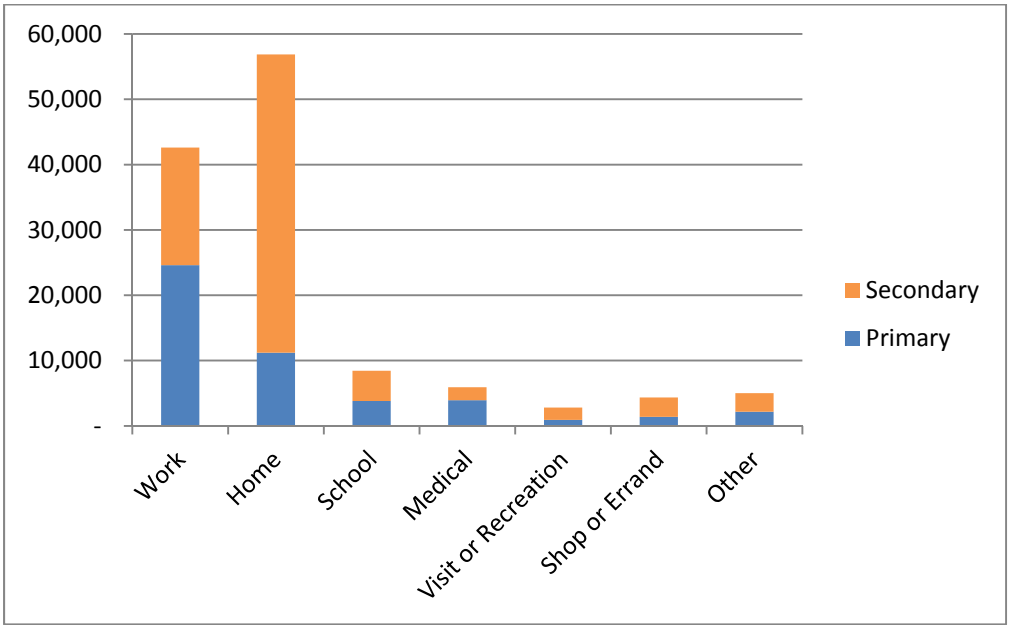

FIGURE 5.3
PURPOSES OF TRANSIT PASSENGER TRIP ORIGINS AND DESTINATIONS IN THE TMC GENERAL STUDY AREA

5.2.2 Transit Boardings and Alightings

Another indicator of the role played by transit within the study area is the number of passengers using bus stops and light rail stations. Total weekday stop and station activity is shown in Table 5.2. Most of the data are taken from METRO ride checks carried out during July 2011, except for one of the TMC Shuttle routes, which was surveyed in April 2011. The light rail (Red Line) data are from September 2011. For the Fort Bend Express, September 2012 results are shown; this route, which began service in June 2010 has experienced rapid ridership growth, increasing from 166 passengers per day in September 2011 to the tabulated 388 passengers a year later.

The table also indicates passenger boarding and alighting results for the TMC Transit Center, which accounts for 45 percent of those shown for the entire Primary Study Area. The TMC Transit Center totals include light rail passengers at the TMC Transit Center Station.

TABLE 5.2
CURRENT TRANSIT PASSENGERS BOARDING AND ALIGHTING
AT TMC PRIMARY STUDY AREA BUS STOPS AND LRT STATIONS

Route	Entire Primary Study Area	TMC Transit Center
1 Hospital	2,070	-
2 Bellaire	2,352	2,096
4 Beechnut	1,747	1,633
8 South Main	1,060	824
10 Willowbend	717	710
14 Hiram Clarke	1,601	1,401
26-27 Loop	1,710	718
34 Montrose	276	187
68 Brays Bayou	2,071	1,191
73 Bellfort	1,680	1,208
87 Sunnyside	2,116	-
402 Bellaire Quickline	421	421
426 TMC Swiftline	251	251
METRO Commuter Routes (170, 292, 297, 298)	6,146	6,146
Total, METRO Bus	**24,218**	**16,786**
METRO Rail	**17,227**	**7,705**
TMC Shuttle 320	7,884	-
TMC Shuttle 321	1,990	-
TMC Shuttle 322	2,298	-
Total, Shuttles	**12,173**	-
Fort Bend TMC Express (September 2012)	**388**	-
Grand Total	**54,005**	**24,491**

At the time of data collection (2011), there were three TMC shuttle routes; since May 2012 they have been reconfigured as two routes.

Looking more closely at the ridership of the METRO Red Line (see Figure 5.3), it will be seen that the TMC General Study Area accounts for about half of all passengers using light rail. The most-used station, Dryden, is in the TMC, and the three "TMC Destination" stations are in the top five Red Line stations. Figure 5.5 shows passenger activity during the afternoon peak hour, by direction, and further illustrates the prominence of the TMC as a light rail ridership source.

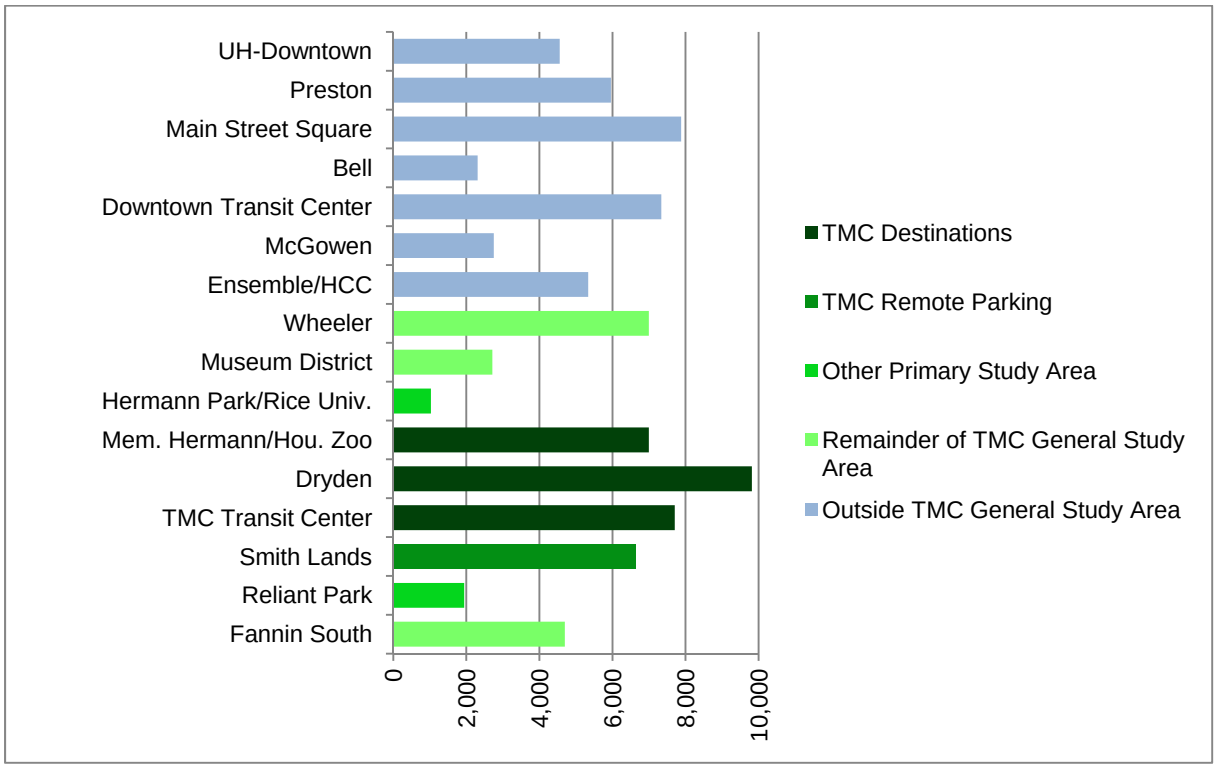

FIGURE 5.4
METRO RED LINE STATIONS WEEKDAY ON AND OFF PASSENGERS

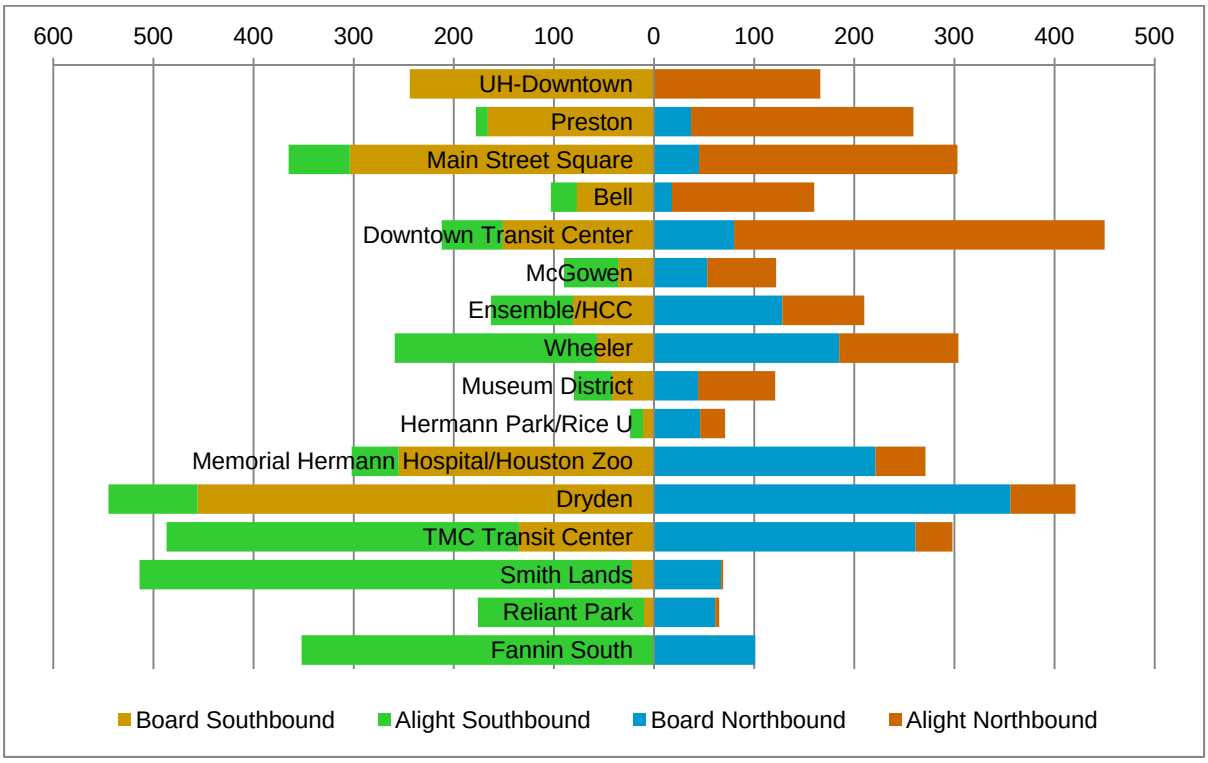

FIGURE 5.5
METRO RED LINE STATIONS WEEKDAY PM PEAK HOUR ON AND OFF PASSENGERS, BY DIRECTION

5.2.3 Passenger Flow Characteristics (Light Rail)

Passenger volumes carried by the Red Line contribute substantially to the total person movement within the north-south corridor through the TMC General Study area as well as northward to the Houston Central Business District. This is illustrated for the afternoon peak hour in Figure 5.6, which shows that the Red Line's largest PM peak hour flow volume occurs southbound between the TMC Transit Center Station and the Smith Lands Station. Also evident is the extended high-volume flow northbound, from the TMC as far as the Downtown Transit Center Station.

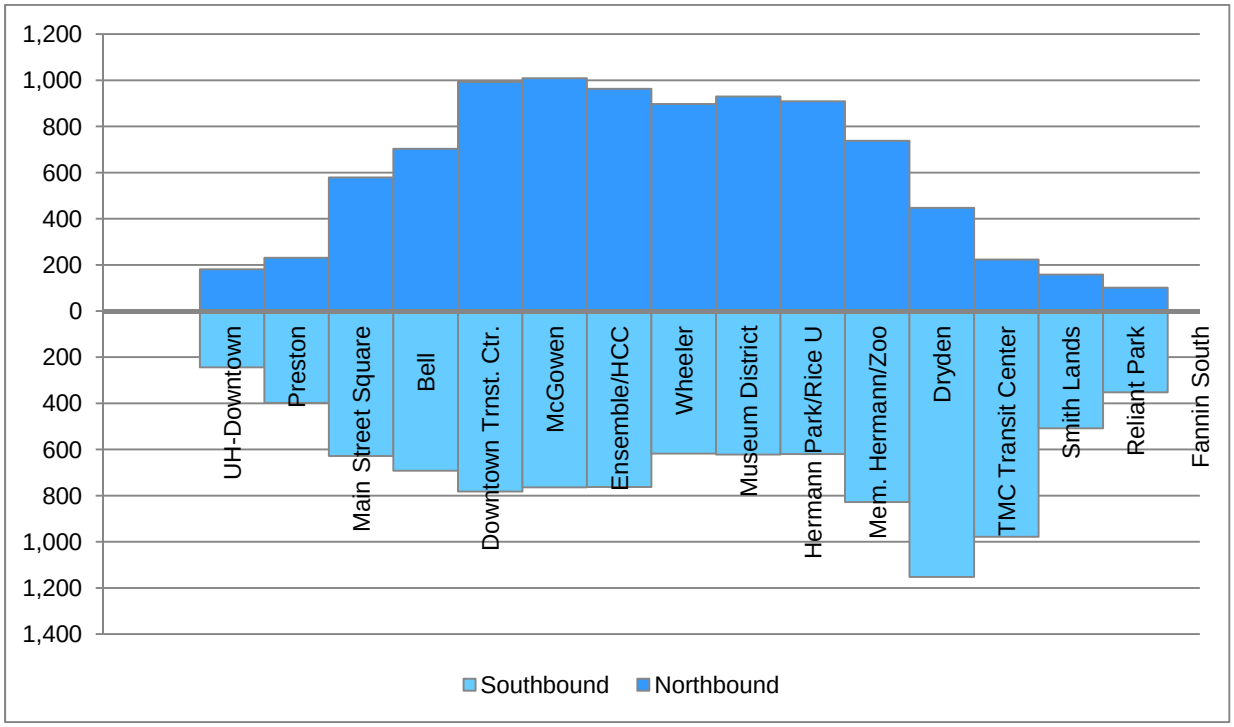

FIGURE 5.6
METRO RED LINE WEEKDAY PM PEAK HOUR PASSENGER FLOW

The weekday time-distribution of trips that results in these peak passenger flow characteristics is shown in Figure 5.7, below, as taken from September 6, 2011 data between Dryden Station and the TMC Transit Center Station.

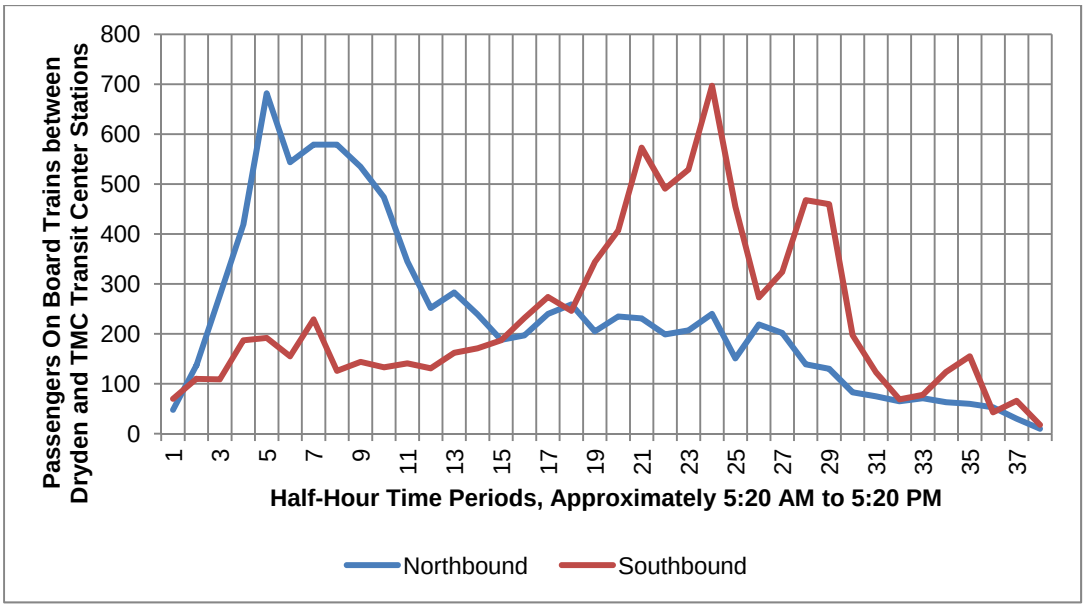

FIGURE 5.7
METRO RED LINE WEEKDAY HALF-HOURLY PASSENGER DISTRIBUTION, SEPTEMBER 2011

5.3 Operating Performance

General operating characteristics of the transit systems that serve the TMC area are documented in Table 5.3 for bus services, and Table 5.4 for METRO's light rail Red Line. The data for this purpose have been selected from the Federal Transit Administration FY 2011 National Transit Database. The TMC Shuttles have recently been changed to contracted service operated by Horizon Coach Lines; operating performance data is not currently available. The current two routes, TMC Red Shuttle and TMC Blue Shuttle, consolidate the service provided by three previous routes.

TABLE 5.3
OPERATING PERFORMANCE OF BUS SYSTEMS THAT SERVE THE TMC AREA

OPERATIONS MEASURES (2011)	METRO Directly-Operated Bus	METRO Contracted Bus	Fort Bend Transit
Boardings per Revenue Vehicle Hour	23.5	22.4	6.9
Passenger Miles per Revenue Vehicle Mile	10.4	9.8	4.6
Average Passenger Trip Length (miles)	6.38	6.60	17.41
Equivalent Weekdays, Revenue Vehicle Miles	290.41	345.97	250.97
Equivalent Weekdays, Revenue Vehicle Hours	291.27	352.49	250.60
Equivalent Weekdays, Boardings	284.19	342.54	250.88
Equivalent Weekdays, Passenger Miles	272.73	311.85	251.02
Revenue Vehicle Miles per Gallon Diesel	3.28	3.50	3.92
Average Miles per Hour, Revenue Service	14.38	15.12	25.85
O&M Cost per Revenue Vehicle Hour	$ 123.508	$ 83.918	$ 77.145
O&M Cost per Boarding	$ 5.246	$ 3.749	$ 11.241
O&M Cost per Passenger Mile	$ 0.822	$ 0.568	$ 0.646
Average Fare per Boarding	$ 0.943	$ 0.828	$ 2.398
Average Fare per Passenger Mile	$ 0.148	$ 0.126	$ 0.138
Farebox Ratio	0.180	0.221	0.213

Source: FY 2011 National Transit Database

These results are broadly typical of bus transit systems in the United States. METRO's higher cost effectiveness of contracted service, compared with that of directly operated service, also is typical.

The Fort Bend Transit data are for park & ride express routes exclusively, and are affected by the characteristics of that type of service, which for the most part is limited to peak-period, peak-direction trips made on weekdays only. This requires more unproductive operation, such as deadhead (out-of-service) trips, compared with the local service that dominates METRO bus operations.

TABLE 5.4
OPERATING PERFORMANCE OF THE METRO LIGHT RAIL RED LINE

OPERATIONS MEASURES (2011)	METRO Red Line (LRT)
Boardings per Revenue Train Hour	167.3
Boardings per Revenue Rail Car Hour	143.0
Passenger Miles per Revenue Rail Car Mile	27.4
Average Passenger Trip Length (miles)	2.33
Equivalent Weekdays, Revenue Train Miles	304.93
Equivalent Weekdays, Revenue Train Hours	312.71
Equivalent Weekdays, Boardings	299.79
Equivalent Weekdays, Passenger Miles	306.20
Kwh per Rail Car Mile	7.69
Average Miles per Hour, Revenue Service	11.84
O&M Cost per Revenue Train Hour	$ 275.715
O&M Cost per Boarding	$ 1.648
O&M Cost per Passenger Mile	$ 0.709
Average Fare per Boarding	$ 0.529
Average Fare per Passenger Mile	$ 0.227
Farebox Ratio	0.321

Source: FY 2011 National Transit Database

5.4 Transit Infrastructure

5.4.1 LRT Stations

The METRO Red Line has sixteen stations, of which six are within the TMC (the Primary Study Area) and three within the secondary portion of the General Study Area. The width of the platforms at the LRT stations was observed to be eight feet.

5.4.2 Bus Transit Center

The TMC Transit Center is located in the northwest quadrant of the Fannin Street – Pressler Street intersection. This location has the advantage of being adjacent to the Red Line light rail alignment, which includes the TMC Transit Center Station, providing convenient passenger interchange via an aerial pedestrian bridge.

5.4.3 Park-n-Rides

Within the General Study Area there are park & ride provisions at the Red Line Fannin South Station. Both METRO and Fort Bend Transit operate express bus routes that originate at park & ride sites outside the General Study Area, supporting transit trip-making that does not bring more motor vehicles into the TMC area. The TMC's Smith Lands remote parking facility intercepts employees who commute by automobile; the TMC Red Shuttle (bus) and the METRO RED Line (LRT) link Smith Lands parking with the TMC main campus.

5.4.4 Bus Stops

There are more than 900 bus stops within the General Study Area. Of these, the TMC Transit Center and 119 on-street bus stops are within the Primary Study Area. Recorded use of the bus stops varies widely, ranging from more than 11,000 weekday passengers boarding or alighting at the TMC Transit Center and nearly 1,900 at the busiest on-street bus stop, to two stops with no recorded weekday use. Table 5.5 identifies the ten most-used bus stops, on an annual basis. Note that the sequence would be slightly different if the stops were ranked on the basis of average weekday use.

TABLE 5.5
TEN MOST-USED TMC BUS STOPS – AVERAGES IN FY2011

	Board + Alight			
Bus Stop	Weekdays	Saturdays	Sundays	Days-weighted sum
Bertner Avenue at Bates Street (9962)	1,878	64	34	9,488
Bertner Avenue at Moursund Street (9965)	1,090	60	33	5,543
William C. Harvin Blvd. at Old Spanish Trail (9391)	1,063	-	-	5,315
Lamar Fleming Avenue at MacGregor Way (63)	976	-	-	4,880
Ross Sterling Avenue at Fannin Street (11208)	850	88	29	4,367
Bertner Avenue at Bates Street (11552)	800	81	40	4,121
Veterans Memorial Hospital (11274 - Northbound)	725	185	113	3,923
Veterans Memorial Hospital (11274 - Southbound)	569	184	124	3,153
William C. Harvin Blvd. at Old Spanish Trail (9390)	630	-	-	3,150
William C. Harvin Blvd. at Braeswood Blvd. (9387)	591	-	-	2,955

Source: Houston METRO 1109 Ridership Report

5.5 Programmed and Planned Transit Improvements

METRO is engaged in light rail system expansion, including routes under construction, and other planned future additions to the network. The existing Red Line is being extended beyond its present northern terminus at the UH Downtown Station to a station adjacent to the Houston Community College campus at Northline Commons, just north of Crosstimbers Street. An eastern light rail line, with two branches, will cross the Red Line within downtown Houston (see Figure 5-1). The Southeast Line (Purple Line), one of the two eastern branches, is to run in part along Scott Street, and therefore touches the northeastern edge of the TMC Mobility Study's larger area. A future light rail project, the University Line (Blue Line), will cross the northern portion of the Study's larger area and provide ten stations including a transfer station adjacent to the Red Line Wheeler Station. To the east, the University Line will share a short length of the Purple Line route on Scott Street.

5.6 Current Transit Service Implications and Issues

Transit-User Sectors outside the General Study Area: Transit accounts for 53,800 weekday passenger trips to or from the TMC General Study Area, including 35,600 to or from the Primary Study Area. Of the 53,800 trips, 77 percent are to or from the west, southwest, and south sectors. This indicates a need to promote attractive transit services in those sectors, which face substantial future growth and already suffer from traffic congestion. Transit improvements should address longer trips as well as closer-in trips. Also, it is noted that there is no direct service between the TMC and Hobby Airport. Recognizing the significance of medical visits from locations outside the metropolitan Houston area, a limited-stop or express service might be worth trying, possibly as an extension of Route 426 Swiftline.

The Role of the TMC Transit Center: It may be worthwhile to make periodic reviews of passenger transferring at the TMC Transit Center, to evaluate possible interlining of routes that terminate there (there are 4,000 weekday passenger transfers between buses at the Transit Center). Routes with similar headways and significant passenger transfer volumes would be candidates for interlining. Bus-rail transfers (2,100 weekday passengers) augment passenger distribution within the TMC main campus; this will remain a vital function of the Transit Center. Off-street passenger delivery to the main campus rather than access exclusively via on-street bus stops is a definite advantage provided by the Transit Center.

The Role of the Red Line: At present, the Red Line performs an important passenger distribution function along Fannin Street for approximately 2,100 weekday passengers who transfer from buses at the TMC Transit Center. Together with the TMC Red Shuttle (bus route), it is also a vital link between the TMC main campus and Smith Lands remote parking (approximately 6,600 weekday rail passenger trips), as well as Fannin South Park and Ride (4,700 weekday rail passenger trips). The Red Line, currently and more so in the future, is a major transit passenger carrier from the north and especially the western area of metropolitan Houston (15,800 weekday passengers on trains just north of the Memorial Hermann Hospital/Houston Zoo Station). The person-movement capacity contribution provided by the Red Line along Fannin Street, with a total of 24,500 daily passenger trips using the three TMC main campus stations, and 1,150 weekday peak-hour peak-direction passengers between Dryden Station and the TMC Transit Center Station, seems a worthwhile use of road space, especially with continued growth in TMC activity levels. The introduction of a grade-separated people mover, depending upon its routing, might reduce the use of the Red Line as a distribution link between the TMC Transit Center and TMC main campus destinations, leaving the available capacity of the Red Line for longer-distance trips, which will increase in number once the University Line (Blue Line) is built and opened to service. An expressed view of stakeholders, however, is that people mover alignment opportunities are greatly limited by existing development, and this would result in inferior service compared with possibilities for optimal local shuttle bus routes. It is recognized also that a people mover could be expensive and difficult to build.

Market Implications of the Red Line Location: It is evident that there is not likely to be a better location for the Red Line's function in passenger distribution to TMC main campus destinations than the present route and stations on Fannin Street, including destinations and bus-rail transfers at the TMC Transit Center. Nevertheless, it is reasonable to investigate ways to augment general traffic capacity on Fannin Street, with a view toward maintaining or improving transit passenger distribution as well as easing traffic movement and vehicular access along Fannin Street.

Future Light Rail System Expansion: The future University Line (Blue Line) will bring more transit riders from the already-important western sector of metropolitan Houston. In addition, its connection with the Southeast Line in the University of Houston area will strengthen transit linkage between the TMC and eastern Houston. This will add to passenger demand on the Red Line between Wheeler Station and the TMC main campus.

6.0 PARKING

The mission of Texas Medical Center's Parking Operations and Transportation is to provide a positive parking and mobility experience for patients, visitors, and employees of the Texas Medical Center in the most cost-effective manner.

Texas Medical Center (TMC) operates one of the largest parking systems in the country with more than 160,000 visitors, patients, employees, students and volunteers coming to the TMC daily.. There are 20 TMC garages and 23 surface parking lot facilities located throughout the study area that offer easily accessible and convenient parking to all Texas Medical Center institutions. There are also 50 private parking facilities conveniently located in the proximity of the member institution buildings. Rice University Campus parking facilities include two underground garages and 20 surface lots. Designated handicapped parking spaces are available in all locations. Figure 6.1 shows the location of the Texas Medical Center public and private parking facilities.

Texas Medical Center offers two options for a pre-paid SmartChip for regular parking users. The first option consists on paying $52 and received $60 in parking value; the other option consists on paying $100 and received $115 in parking value; a maximum of $12 is deducted from the Pre-paid SmartChip each calendar year and include unlimited in-and-out privileges. Pre-paid SmartChips can be purchased at different locations throughout the public parking garages within the TMC area. Figure 6.2 shows the capacity of the parking garages based on data collected from TMC Parking Management Association.

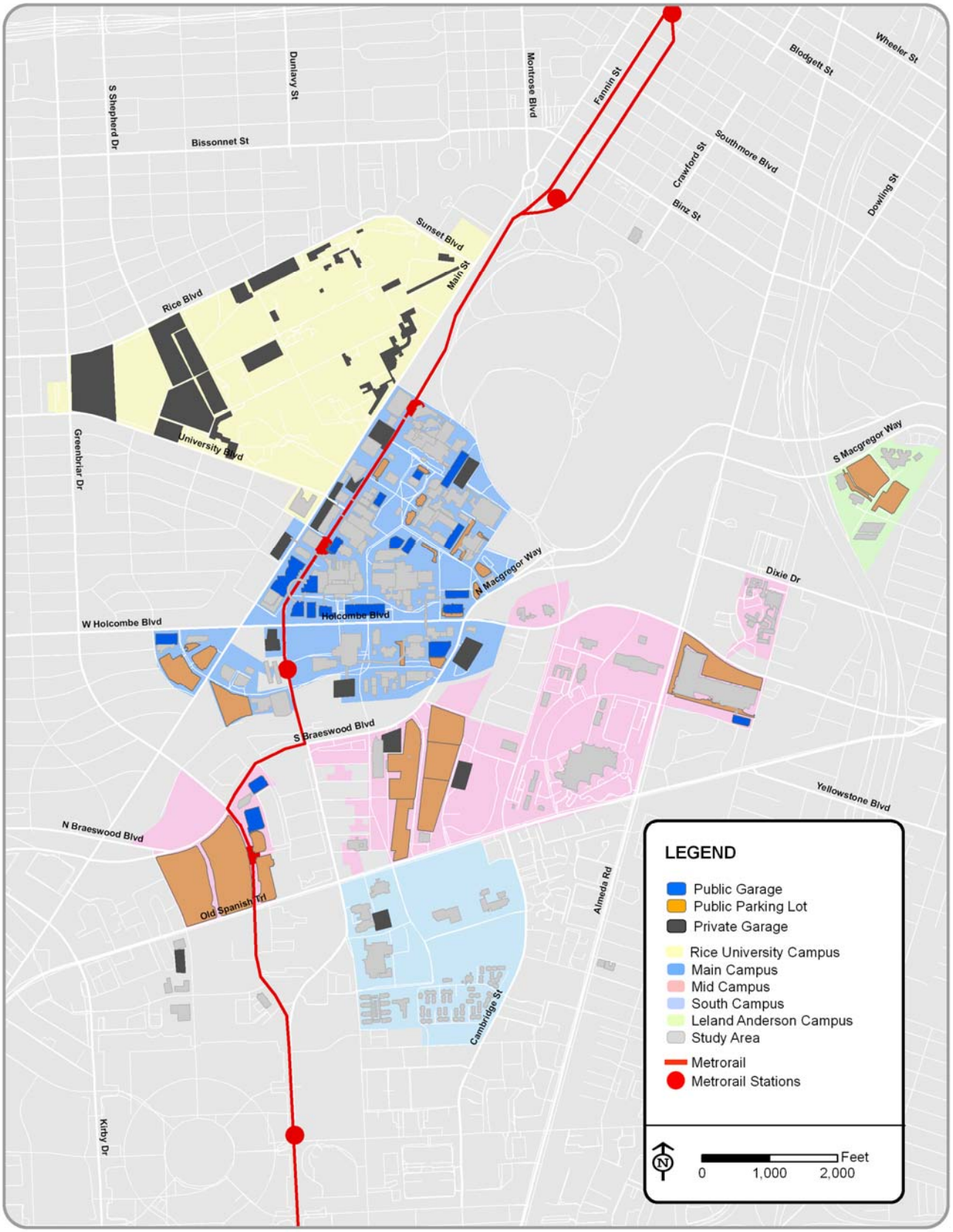

FIGURE 6.1
EXISTING TMC PARKING LOCATIONS

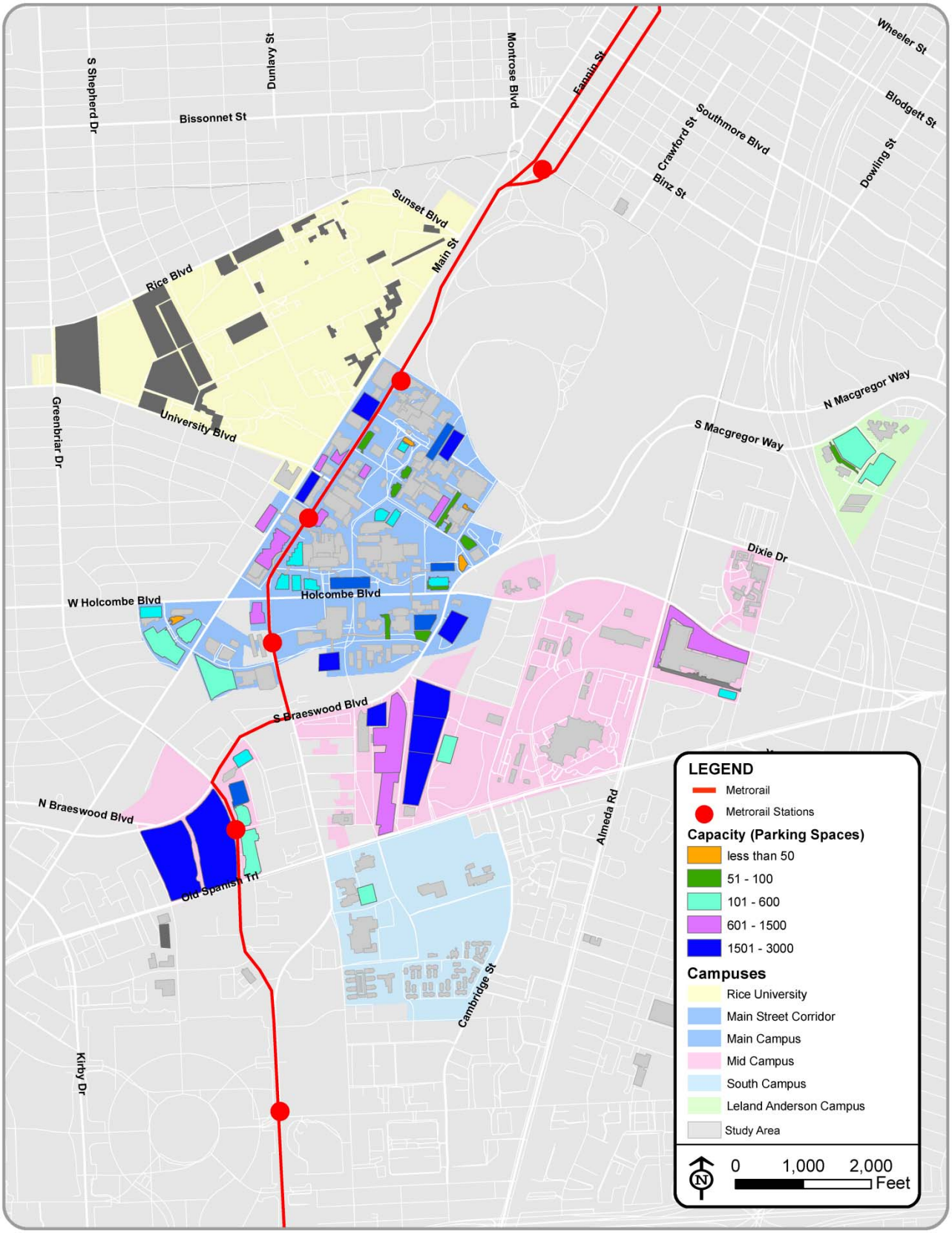

FIGURE 6.2
EXISTING TMC PARKING CAPACITY

6.1 Main Campus

Main Campus is the historic core of Texas Medical Center offering multiple locations for patient care, education and research. The majority of the medical facilities that are part of Texas Medical Center are located in this area which translates into a high number of employees, patients, students, and visitors to these facilities and a high demand for parking.

6.1.1 Inventory

As shown in Table 6.1, there are 17 public garages and 15 public surface parking lots operated by Texas Medical Center and located trough the Main Campus area with a total of 16,351 parking spaces. Twenty-two private parking facilities operated by TMC member institutions are located in the main campus area serving the adjacent member institution buildings with a total of 21,172 parking spaces. Table 6.2 shows the details of private parking facilities in Main Campus.

6.1.2 Utilization/Revenue

The public surface parking lot facilities located towards the south west of the Main Campus area adjacent to Main Street and serving the Hornberger Conference Center and the Coleman College for Health Science buildings operate at or near capacity with a weekday peak utilization ranging from 81 percent to 93 percent. The public parking garage facilities located in the proximity of main buildings such as the UT Health Medical School, the St. Luke's Episcopal Hospital and the M.D Anderson Cancer Center operate at or near capacity with a weekday peak utilization ranging from 91percent to 99 percent. In general, as shown in Figure 6.3, the majority of the public parking facilities located in the Main Campus area have a weekday peak utilization close to 80 percent which indicates a deficiency of available parking compared to the parking demand in this area.

The public surface parking lot facilities located along Main Street offer a monthly parking fee of $63.50 per month which suggests that these public parking lots exhibiting a high utilization percentage are mainly occupied by employees and/or students. Garage 8 offers a reduce rate of $8 maximum daily fee. The parking rates for the other public parking facilities in the Main Campus area are common for all parking garages and surface parking lots with a minimum fee of $2 per 20 minutes and a maximum fee of $12 daily.

TABLE 6.1
EXISTING PUBLIC PARKING FACILITIES - MAIN CAMPUS

Building Served	Garage / Parking Lot	Capacity	Weekday Peak Utilization Percentage	Saturday Peak Utilization Percentage	Sunday Peak Utilization Percentage	Rate (20 min – 24 hrs)
Memorial Hermann TMC Baylor College of Medicine UT Health Medical School	Garage 4	1657	78	65	60	$2 - $12 Smart Chip - $ 52 /$100
UTHSC-H Medical School	Lot A	70	79	12	18	$2 - $12
HAM-TMC JJ Library/ UTHSC	Garage 3	107	99	14	12	$2 - $12 (Smart Chip - $ 52 /$100
Baylor College of Medicine UT Health Medical School	Garage 7	875	82	59	53	$2 - $9 Smart Chip - $ 52 /$100
The Methodist Hospital St. Luke's Episcopal Hospital Texas Children's Hospital	Garage 1	1132	83	68	65	$2 - $12 Smart Chip - $ 52 /$100
Texas Children's Hospital West Tower	Garage 12	181	94	80	83	$2 - $12 Smart Chip - $ 52 /$100
Clinical Care Center	Garage 16	453	73	11	9	$2 - $12 Smart Chip - $ 52 /$100
Texas Children's Hospital BCM Children's Nutrition Research Center	Garage 9	169	45	6	6	$2 - $12
Texas Children's Hospital Feigin Center	Garage 11	373	91	11	9	$2 - $12
St. Luke's Episcopal Hospital MD Anderson Cancer Center Texas Children's Hospital	Garage 2	2302	81	66	64	$2 - $12 Smart Chip - $ 52 /$100
Baylor College of Medicine UT Health Medical School	Garage 6	1073	78	33	14	$2 - $12 Smart Chip - $ 52 /$100

TABLE 6.1
EXISTING PUBLIC PARKING FACILITIES - MAIN CAMPUS Contd.

Building Served	Garage / Parking Lot	Capacity	Weekday Peak Utilization Percentage	Saturday Peak Utilization Percentage	Sunday Peak Utilization Percentage	Rate (20 min – 24 hrs)
TIRR Memorial Hermann	Lot DD	86	95	50	60	$2 - $12 Smart Chip - $ 52 /$100
John P. McGovern TMC Commons	Garage 15	496	50	13	11	$2 - $12
TCH Neurological Research Institute	Garage 20	102	39	10	8	$2 - $12
MD Anderson Cancer Center	Garage 10	1596	91	28	23	$2 - $12 Smart Chip - $ 52 /$100
MD Anderson Cancer Center	Garage 5	584	41	4	3	$2 - $12
Texas Children's Hospital						
College of Pharmacy	Lot RR	40	62	14	17	$2 - $12
MD Anderson Cancer Center	Garage 17	1810	74	10	9	$2 - $12
TECO Main Plant	Lot P1	59	73	4	<1	$2 - $12
UT Health School of Public Health	Lot P3	62	71	8	8	$2 - $12
HAM TMC Library	Lot B	33	N/A	N/A	N/A	$2 - $12
Baylor College of Medicine	Lot E	63	N/A	N/A	N/A	
TIRR Memorial Hermann	Lot EE	16	N/A	N/A	N/A	
MD Anderson Cancer Center	Lot 5	99	N/A	N/A	N/A	
UH School of Pharmacy	Lot GG	80	N/A	N/A	N/A	
Texas Children's Pavilion for Women	Garage 21	947	40	36	39	
Coleman College for Health Science	Lot AU	553	83	13	5	
Baylor College of Medicine	Lot D	59	N/A	N/A	N/A	
Hornberger conference center / TAMU-JBT	Garage 8	415	60	11	9	$2 - $6
	Lot SM	577	93	<1	<1	$63.50 /month
	Lot AM	31	34	7	11	$63.50 / month
	Lot M	251	81	4	3	$63.50 / month

TABLE 6.2
EXISTING PRIVATE PARKING FACILITIES - MAIN CAMPUS

Building Served	Garage / Parking Lot	Capacity	Weekday Peak Utilization Percentage	Saturday Peak Utilization Percentage	Sunday Peak Utilization Percentage	Rate
MDA Fannin Building	MDA Fannin Garage (Contract/Visitor Side)	637	96	N/A	N/A	$95 - $106 / month
MDACC Faculty Tower, Pickens Tower	Braeswood Garage	2474	123	N/A	N/A	$65- $110 (based on salary grades)
MDA Mays Clinic	Pressler Garage	1572	135	N/A	N/A	$135 / month
HCHD Ben Taub General Hospital	HCHD Ben Taub Garage	1538	N/A	N/A	N/A	$10 Daily
The Health Museum	The Health Museum	115	N/A	N/A	N/A	$8 (general public)
MDACC Rotary House	MDACC Rotary House Surface Lot	58	N/A	N/A	N/A	$15 Flat rate
MDACC Radiology Outpatient Center	MDACC Radiology Outpatient Center	30	N/A	N/A	N/A	N/A
MDACC Houston Main	MDACC Houston Main Surface Lot	339	N/A	N/A	N/A	N/A
UTHSC-H Old Mental Sciences Institute	MDACC Mental Sciences Institute	104	N/A	N/A	N/A	N/A
MHHS Heart & Vascular Institute	MHHS Heart & Vascular Institute	174	N/A	N/A	N/A	N/A
Texas Children's Hospital	TCH Bellows Concourse Surface Lot	22	N/A	N/A	N/A	N/A
TMH Neurosensory	TMH Neurosensory Garage	69	N/A	N/A	N/A	N/A
UTHSC-H School of Nursing	UTHSC-H School of Nursing	52	N/A	N/A	N/A	N/A
UTHSC-H Medical School	UTHSC-H Medical School Loading Dock	6	N/A	N/A	N/A	N/A
UTHSC-H Professional	UTHSC-H Professional Garage	1513	N/A	N/A	N/A	$4 - $10 (1 hr - 24 hrs)
TMH Outpatient Care Center	TMH Outpatient Care Center	1392	N/A	N/A	N/A	$2 - $5 (0 min - 120 min)
TMH Smith Tower	TMH Smith	1432	N/A	N/A	N/A	$2 - $5 (0 min - 120 min)
TMH Scurlock Tower	TMH Scurlock	1682	N/A	N/A	N/A	$2 - $5 (0 min - 120 min)
PVAMU/UT Professional	PVAMU Nursing/UT Professional	947	N/A	N/A	N/A	$4 - $10 (1 hr - 24 hrs)
HCC Coleman College	HCC Surface Lot	47	N/A	N/A	N/A	No charge (employees & students) $3/visit - guests
MHHS Medical Plaza	MHHS Medical Plaza	2400	N/A	N/A	N/A	$13 daily
Shriners Hospital	Shriners Hospital	214	N/A	N/A	N/A	No charge (patients and family)
SLEH O'Quinn Medical Tower	SLEH O'Quinn Medical Tower Garage	1217	N/A	N/A	N/A	N/A
SLEH Baylor Clinic	SLEH Baylor Clinic Garage	1163	N/A	N/A	N/A	N/A
SLEH	SLEH Main Surface Lot	40	N/A	N/A	N/A	N/A
TMH/TWU	TWU/TMH Main Garage	1047	N/A	N/A	N/A	N/A

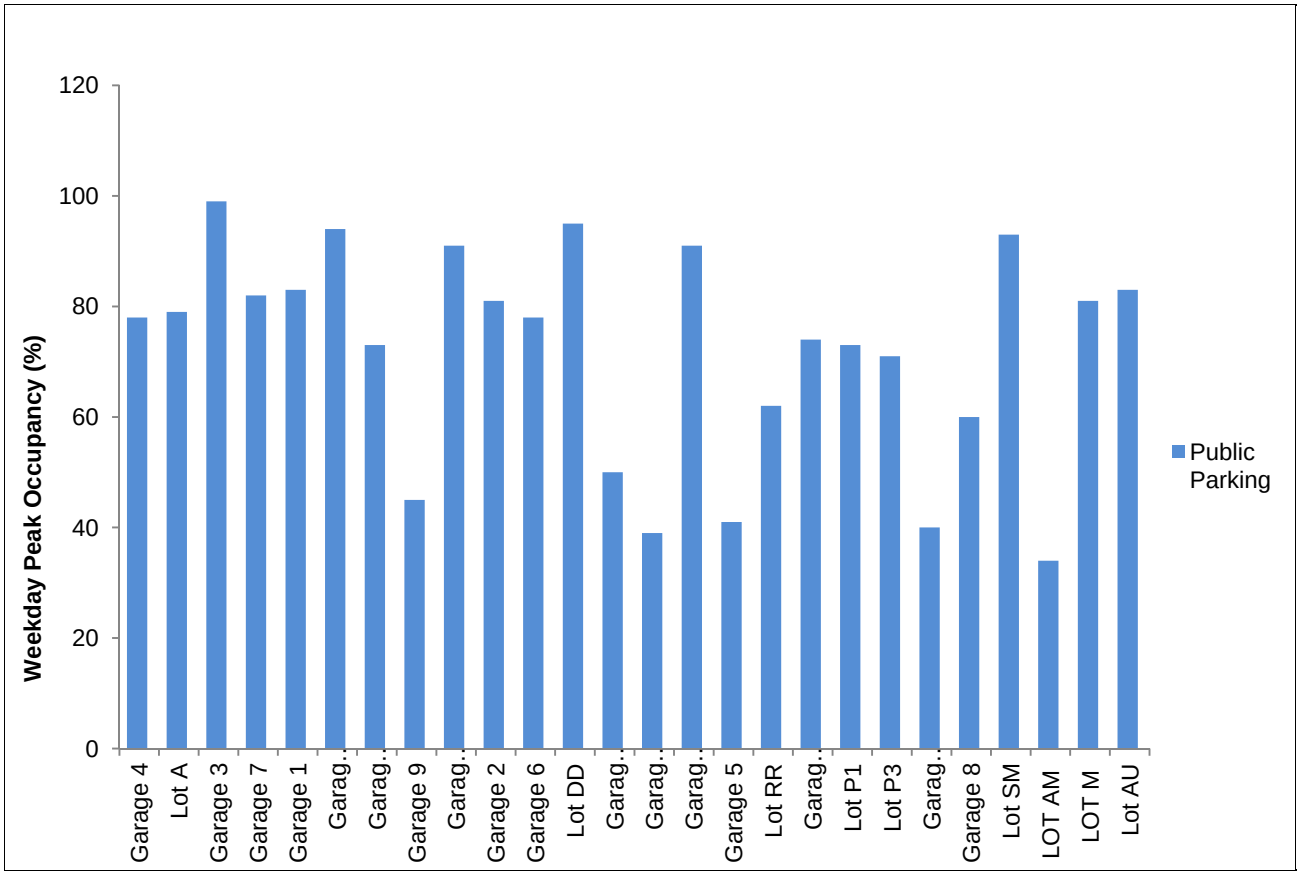

FIGURE 6.3
EXISTING PUBLIC PARKING UTILIZATION – MAIN CAMPUS

6.2 Mid Campus

The Mid Campus area brings together emerging large land development areas with established uses with focus on patient care, research, retail, office and housing.

6.2.1 Inventory

As shown in Table 6.3, there are three public garages and eight public surface parking lots operated by Texas Medical Center located in the Mid Campus area with a total of 11,731 parking spaces. Ten private parking facilities operated by TMC member institutions are located in the Mid Campus area serving the adjacent member institution buildings. Table 6.4 shows the details of private parking facilities in Mid Campus.

6.2.2 Utilization/Revenue

The public surface parking facilities located in the proximity of the Texas Children's Hospital Meyer Building operate at or near capacity with a weekday peak utilization of 100 percent as shown in Figure 6.4. Adjacent to these high utilization parking surface lots facilities, Garage 19 also exhibits a high weekday peak utilization of 76 percent. In general, the public parking facilities located to the west of the Mid Campus area have a high weekday peak utilization percent which indicates that there is a deficiency of available parking compared to the parking demand in the proximity to the Texas Children's Hospital Meyer Building.

The parking rates for the public parking facilities in the Mid Campus area are common for all public parking garages and public surface parking lots with a minimum fee of $2 per 20 minutes and a maximum fee of $12 daily.

TABLE 6.3
EXISTING PUBLIC PARKING FACILITIES – MID CAMPUS

Building Served	Garage/Parking Lot	Capacity	Weekday Peak Utilization Percentage	Saturday Peak Utilization Percentage	Sunday Peak Utilization Percentage	Rate (20 min - 24 hrs)
Texas Hospital Meyer Building	Garage 14	381	25	<1	<1	$2 - $12
	Garage 19	1839	76	3	3	$2 - $12
	Meyer Lot North	157	102	4	3	$2 - $12
	Meyer Lot South	411	43	37	37	$2 - $12
	Smith Lands Parking Lot East	1923	100	2	2	$2 - $12
City of Houston Department Of Health & Human Services	Smith Lands Parking Lot West	1615	67	<1	<1	$2 - $12
Baylor College of Medicine Hospital & Clinic / BMC Medical Building	South Extension Lot A, B, C	2346	36	1	1	$2 - $12
Mid Campus Building	South Extension Visitor Lot	1106	52	3	1	$2 - $12
The Methodist Hospital Annex	South Extension Lot D	648	2	<1	<1	$2 - $12
Joseph A. Jachjmcyzk Forensic Center of Harris County						
Texas Medical Center John P. McGovern Campus	Lot 2450-JPM Campus	824	64	8	5	$2 - $12
TMC JPM Campus	Garage 18	481	73	<1	<1	$2 - $12

TABLE 6.4
EXISTING PRIVATE PARKING FACILITIES – MID CAMPUS

Building Served	Garage/Parking Lot	Capacity
Blimpie, Dental Office	VA Strip Center	154
VA Hospital	VA Medical Center	3581
BMC	BMC Doctors Lot	30

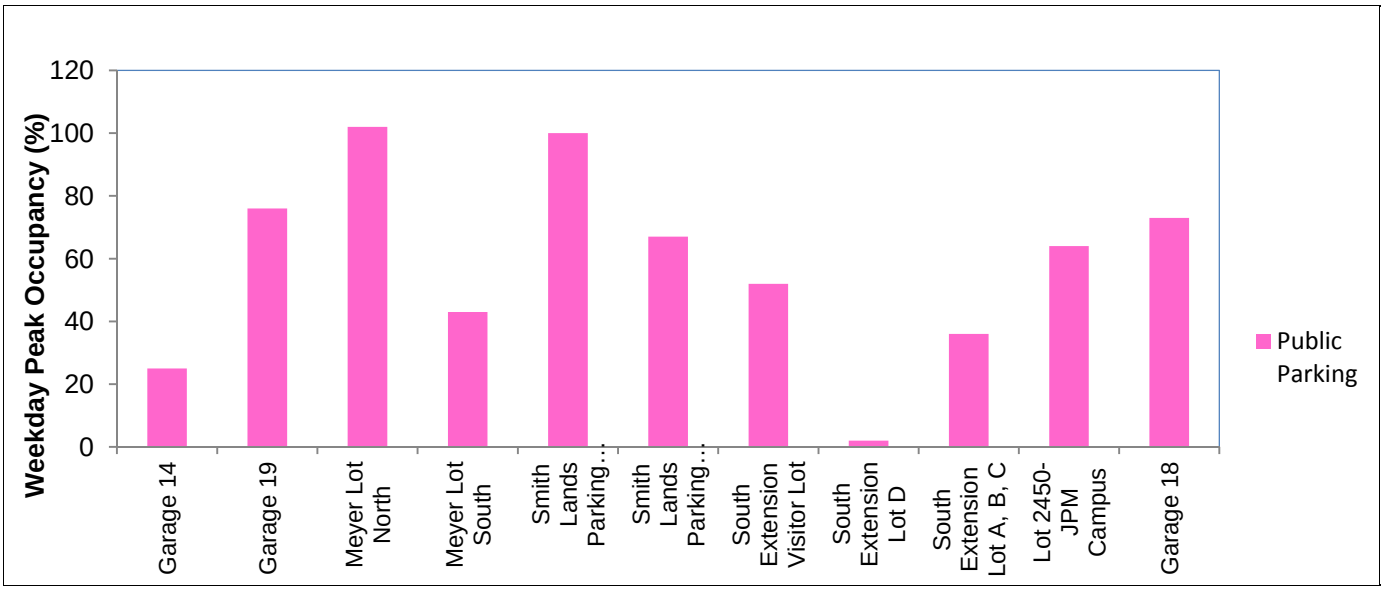

FIGURE 6.4
EXISTING PUBLIC PARKING UTILIZATION – MID CAMPUS

6.3 South Campus

The South Campus area of the Texas Medical Center is considered a premier world-class cancer research and treatment cancer center. Established uses include student housing, recreation center, police administration, and parking.

6.3.1 Inventory

As shows in Table 6.5, there are nine private parking facilities operated by TMC member institutions in the South Campus area serving the adjacent member institution buildings. The capacity of these private facilities varies from 19 to 1149 parking spaces.

6.3.2 Utilization/Revenue

Utilization and parking fee information is currently not available for the majority of the private parking facilities in South Campus.

TABLE 6.5
EXISTING PRIVATE PARKING FACILITIES – SOUTH CAMPUS

Building Served	Garage/Parking Lot	Capacity	Weekday Peak Utilization Percentage	Saturday Peak Utilization Percentage	Sunday Peak Utilization Percentage	Rate
South Campus Research Building	South Campus Garage	446	102	N/A	N/A	$65 / month
MDACC R.E. Bob Smith Research	MDACC R.E. Bob Smith Research	376	N/A	N/A	N/A	N/A
MDACC Radiation Proton Therapy	MDACC Radiation Proton Therapy Surface Lot	65	N/A	N/A	N/A	N/A
MDACC South Campus Research # 3	MDACC South Campus Research # 3	27	N/A	N/A	N/A	N/A
MDACC South Campus Research # 1	MDACC South Campus Research # 1	19	N/A	N/A	N/A	N/A
UTHSC- H Behavioral & Biomedical Sciences	UTHSC-H Behavioral & Biomedical Sciences	205	N/A	N/A	N/A	N/A
UTHSC-H Health School of Dentistry	UTHSC-H Health School of Dentistry	353	N/A	N/A	N/A	N/A
UTHSC-H Recreation Center	UTHSC-H Recreation Center	326	N/A	N/A	N/A	N/A
UT University Housing	UT University Housing	1149	N/A	N/A	N/A	N/A

6.4 Rice University Campus

Rice University is a private research university located on a 295-acre adjacent to the Texas Medical Center. The university is organized into eleven residential colleges and eight schools of academic study; the student body consists on nearly 6,000 students and a ratio of student-to-faculty of less than 6-to-1.

6.4.1 Inventory

The existing parking facilities are summarized in Table 6.6. There are a total of 8,000 parking spaces divided in 2 underground garages and 20 surface parking lots trough campus.

6.4.2 Utilization/Revenue

The parking facilities in the Rice Campus area operate at or near capacity the majority of the school year with a weekday peak utilization of 90 percent for the facilities located to the east and central area of campus and a weekday peak utilization of 60 percent for the facilities located to the west of Rice Campus University as shown in Figure 6.5. The existing weekday utilization suggests that the available parking is insufficient with respect to the parking demand in this area.

The parking rates are also shown in Table 6.6 with a minimum parking fee of $1 per 20 minutes for the parking facilities located to the west and a minimum parking fee of $1 per 12 minutes for the parking facilities located to the east; the maximum daily fee of $11 applies for all the parking facilities within the Rice University Campus.

TABLE 6.6
EXISTING PARKING FACILITIES – RICE CAMPUS

Area Served	Garage/Parking Lot	Restriction	Weekday Peak Utilization Percentage	Rate
West of Entrance 18	1 Surface Lot	Visitor	60	$1 - $ 11 (20 min - 24 hrs)
	1 Surface Lot	Visitor	60	$1 / entry/ day
	1 Surface Lot	Resident Students	60	$1 - $ 11 (20 min - 24 hrs)
	2 Surface Lots	Faculty/Staff	60	$1 - $ 11 (20 min - 24 hrs)
East of Entrance 18	Underground Garage	Visitor	90	$1 - $11 (12 min - 24 hrs)
	7 Surface Lots	Faculty/Staff	90	$1 - $11 (12 min - 24 hrs)
	4 surface Lots	Resident Students	90	$1 - $11 (12 min - 24 hrs)
	4 Surface Lots	Visitor	90	$1 - $11 (12 min - 24 hrs)
Off-campus	Underground Garage	Visitor	90	$1 - $11 (12 min - 24 hrs)

6.5 Leland Anderson Campus

The Leland Anderson campus is located to the west of the Texas Medical Center adjacent to a residential neighborhood with a high school for health professions and a child-care center. Established uses include mental health facilities, community health care education, child-care services and parking.

6.5.1 Inventory

As shows in Table 6.7, there are three public surface parking lots operated by Texas Medical Center located in the Leland Anderson Campus area with a total of 1,026 parking spaces. Two private parking facilities operated by TMC member institutions are located in the Leland Anderson campus area serving the adjacent member institution buildings. Table 6.8 shows the details of private parking facilities in Main Campus.

6.5.2 Utilization/Revenue

In general as shown if Figure 6.5 the public parking facilities located in the Leland Anderson campus area operates at a 56 percent weekday peak utilization which indicates that there is an adequate balance of available parking compared to the parking demand in the area.

The parking rates for the public parking facilities in the Leland Anderson Campus area are common for all public parking garages and public surface parking lots with a minimum fee of $2 per 20 minutes and a maximum fee of $12 daily.

TABLE 6.7
EXISTING PUBLIC PARKING FACILITIES – LELAND ANDERSON CAMPUS

Building Served	Garage / Parking Lot	Capacity	Weekday Peak Utilization Percentage	Saturday Peak Utilization Percentage	Sunday Peak Utilization Percentage	Rate
The Rise School YMCA Child Care Center UT Health Harris County Psychiatric Center Michael E. DeBakey High School For Health Professions	Lot LA	466	56	24	23	$2 - $12 (20 min - 24 hrs)
UT Health Harris County Psychiatric Center YMCA	Lot LAC	480	23	3	<1	$2 - $12 (20 min - 24 hrs)
YMCA	Lot CCC	80	N/A	N/A	N/A	$2 - $12 (20 min - 24 hrs)

TABLE 6.8
EXISTING PRIVATE PARKING FACILITIES – LELAND ANDERSON CAMPUS

Building Served	Garage / Parking Lot	Capacity	Weekday Peak Utilization Percentage	Saturday Peak Utilization Percentage	Sunday Peak Utilization Percentage	Rate
Harris County Psychiatric Center	Harris County Psychiatric Center	30	N/A	N/A	N/A	N/A
TCH Rise School	TCH Rise School Surface Lot	24	N/A	N/A	N/A	N/A

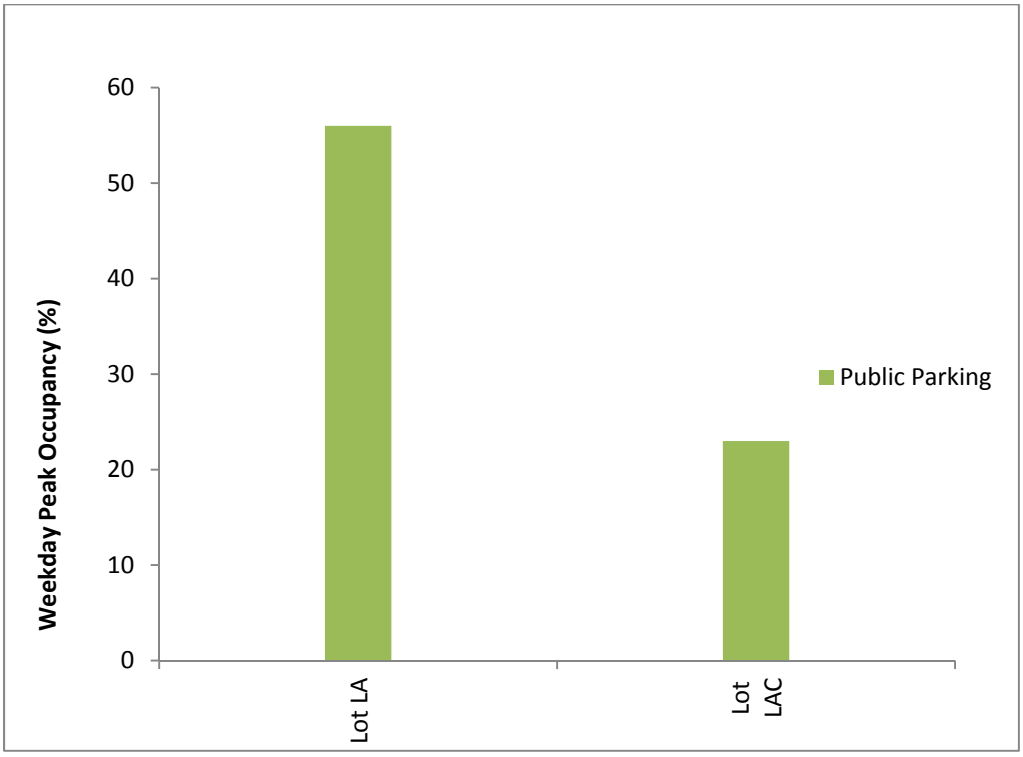

FIGURE 6.5
EXISTING PUBLIC PARKING UTILIZATION – LELAND ANDERSON CAMPUS

Figure 6.6 summarizes parking utilization for each campus and shows the percentage occupancy in all the parking garages where available.

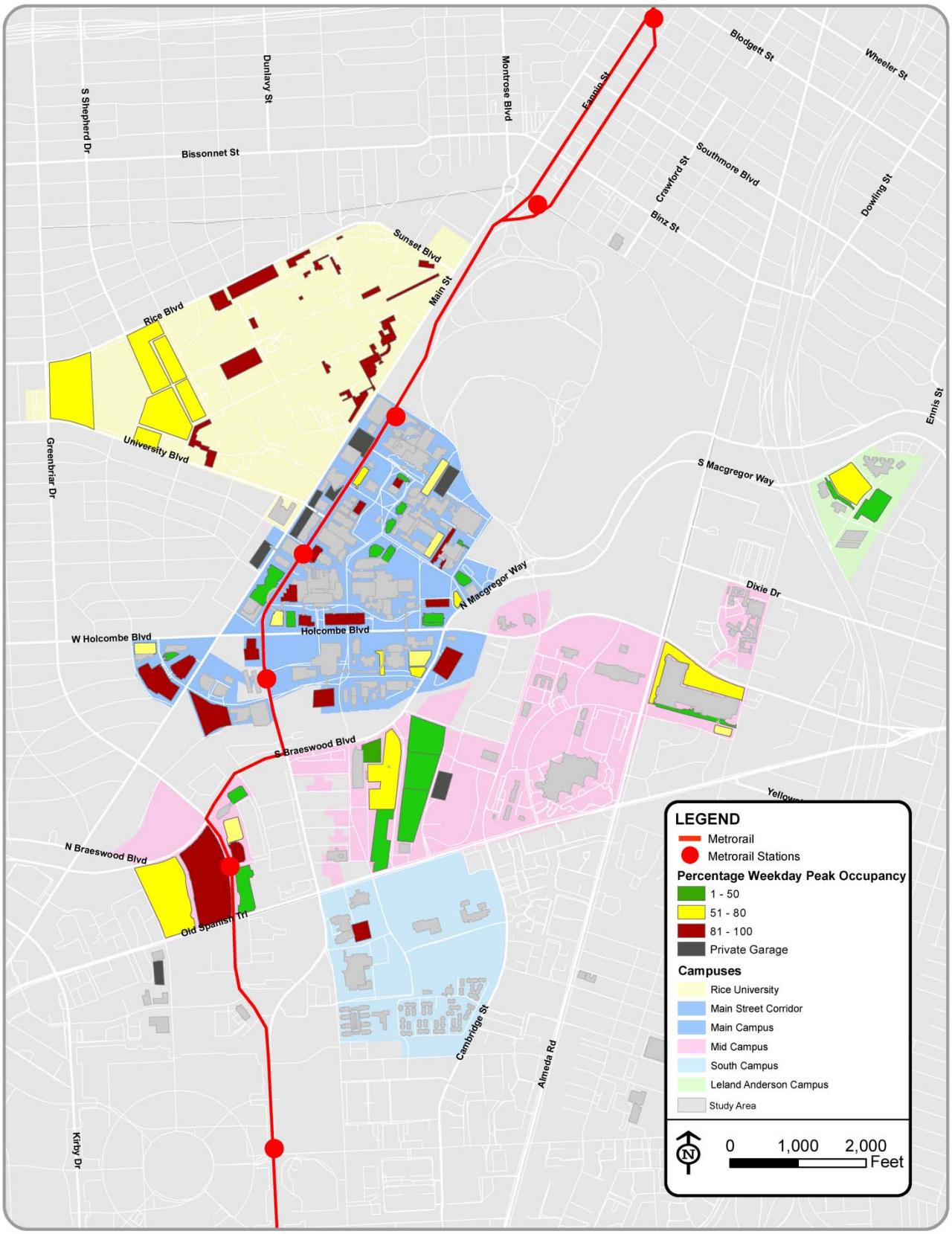

FIGURE 6.6
EXISTING TMC PARKING OCCUPANCY

7.0 PEDESTRIAN AND BICYCLE FACILITIES

The Regional Bikeway Plan was prepared by H-GAC in 2010. This Plan identifies TMC as the employment center with highest number of bicyclists in the region. According to the 2000 census, walking and biking trips represented 0.9% and 0.8% respectively of all work trips. The TMC has the highest concentration of bicyclist trips within a census tract in the region (even greater than Downtown Houston), and the third highest concentration of walking trips in the region (after downtown and the University of Texas Medical Branch in Galveston). The number of commuter bicyclists for 2010 census is not precisely known. The H-GAC Plan summary indicated based on observations that over 1,000 bicyclists now commute to the TMC on a daily basis.

7.1 Pedestrian Facilities

Pedestrian mobility is often an overlooked aspect of transportation in an auto-oriented community. Walking trips are an essential component to the overall transportation system, encouraging healthier and active lifestyles. Specifically, within the TMC study area, walking and biking are important modes of travel for patrons to and from campus buildings. The TMC area is well served with sidewalks and skybridges to accommodate safe, efficient travel throughout the five campuses. This section describes the existing bicycle and pedestrian infrastructure.

7.1.1 Sidewalk Locations

The sidewalks located within the Texas Medical Center (TMC) study area are generally contiguous with little to no gaps. The width of the crosswalks was observed to be 4 feet or less along most public streets. The sidewalks provide convenient access to open spaces and institutions throughout the TMC. Figure 7.1 depicts the location of the existing sidewalks within the Main Campus in the TMC area.

7.1.2 Crosswalk/Pedestrian Signal Locations

Crosswalks are generally located at each signalized intersection within the study area. Pedestrian signals were located at all the study intersections and were observed to be operating in good condition.

7.1.3 Pedestrian Bridges/Underpasses and Internal Building Connections

Figure 7.1 shows the location of sidewalks, skybridges and cross walk locations within the Main Campus. Data for other campuses will be collected as part of this study. Pedestrian data will be analyzed to identify gaps, capacity issues and to prioritize connections.

7.1.4 Pedestrian Field Observations

The following field observations were made related to pedestrian facilities in the primary study area:

- In general the pedestrian sidewalk surfaces were observed to be in good condition.
- On west side of the Main Street, jogging trail was present between Sunset Blvd and Cambridge.
- On the east side of the Main Street, sidewalk was in good condition throughout the study area.
- At a few intersections the wheel chair ramps were observed to be in bad condition. (Example: At the northeast corner of the intersection of Main at Cambridge, the wheel chair ramp was observed to be in a bad condition)
- The sidewalks along Fannin Street in the study area are in good condition.
- It was observed that the pedestrians were jay-walking across Fannin in the Main campus.

- The sidewalks along Holcombe Blvd., Old Spanish Trail and Cambridge Street were observed to be in good condition.
- Along Braeswood Boulevard, between Greenbriar Drive and Fannin Street, sidewalk was disconnected.
- Also, it was observed that the sidewalk was less than 4 feet wide along south side of Braeswood Boulevard between Fannin Street and Bertner Street.
- Along Cambridge Street, the sidewalk on the east side between Braeswood Boulevard and Hermann Park Drive was of mixed character (partly dirt trail and partly concrete).

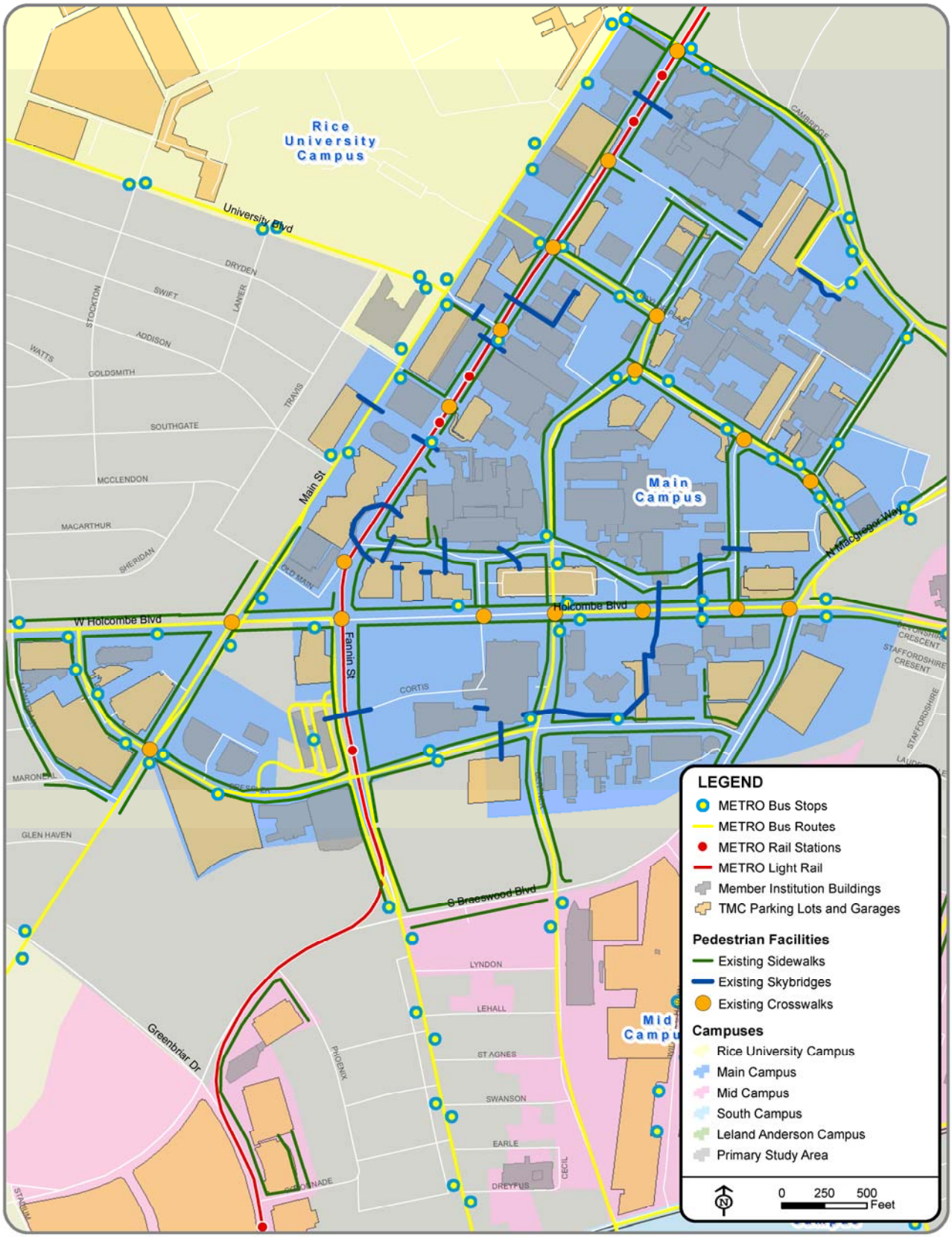

FIGURE 7.1
EXISTING PEDESTRIAN FACILITIES

7.2 Bicycle Facilities

The amount of bicycle trips for work, non-work and recreational purposes in the TMC study area is not precisely known.

Bicycle access within the TMC study area is provided along several major roads and local routes that travel through the TMC campuses. The bicycle network includes a range of designated bicycle facilities. Some facilities are exclusively bicycle lanes while others are designed to accommodate multiple modes of transportation, including automobile and driving. Based on a review of GIS data provided by the City of Houston, the bicycle facilities include multi-use trails, on-street bike lanes, signed routes, shared lanes, and greenway trails. The city currently boasts nearly 722 miles of bicycle facilities.

Collectively, there are approximately 40 miles of bicycle facilities serving the TMC study area, which represents 6 percent of the city's total bicycle facilities lineage. Figure 7.2 illustrates the location of the existing bicycle facilities.

7.2.1 Bicycle Lanes, Shared Lane Markings and Shared Use Paths

The H-GAC region identifies four different types of bicycle facilities and has adopted this nomenclature. These are explained below.

- Bicycle Lane or Bike Lane – A portion of a roadway which has been designated by striping, signing and pavement markings for the preferential or exclusive use of bicycles.

- Signed Shared Roadway (Signed Bike Route) – A shared roadway which has been designated by signing as a preferred route for bicycle use.

- Shoulder – The portion of the roadway contiguous with the traveled way for accommodation of stopped vehicles, for emergency use and for lateral support of sub-base, base and surface courses. [In Texas, bicyclists are permitted to ride on the roadway's shoulder, and shoulders may be signed as bike routes.]

- Shared Use Path – A bikeway physically separated from motorized vehicular traffic by an open space or barrier and either within the highway right-of-way or within an independent right-of-way. Shared use paths may also be used by pedestrians, skaters, wheelchair users, joggers, and other non-motorized users

As depicted in Figure 7.2, there are a number of bicycle facilities that serve the TMC study area, which include dedicated bicycle lanes, shared lane markings, and shared use paths. The bicycle lanes are located along Morningside Drive [between Dryden Rd and W. Holcombe Rd), Cambridge Street (between US HWY 90/Old Spanish Trail and Holly Hall St), Westpark Drive (between Buffalo Speedway and Wake Forest St), and Yellowstone Boulevard (Ardmore St and Scott St). Bike lanes allow riders to travel at their own speed without interference from vehicular traffic.

Shared-use paths within the study area are located along Holly Hall Street, Almeda Road, and east of Ennis Street.

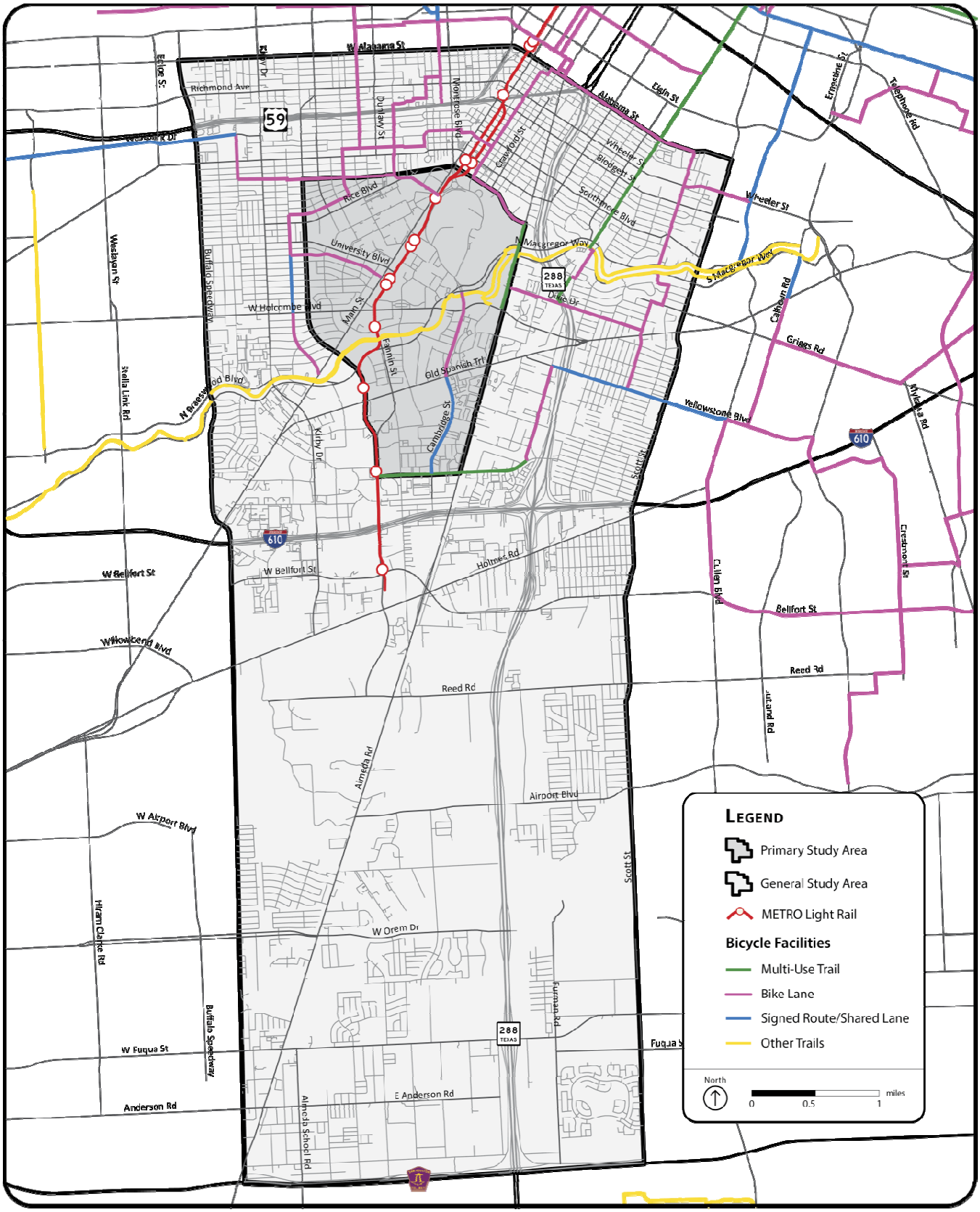

FIGURE 7.2
EXISTING BICYCLE FACILITIES

7.2.2 Bicycle Storage Provisions (long term bike parking)

Houston B-cycle is a "bike sharing" program that works as an additional transportation alternative for people living and visiting Houston. Major sponsors and supporters for implementation of this program in Houston include the City of Houston, Downtown District, Bike Houston, Bike Barn and Blue Cross Blue Shields.

At its core, a public bike sharing system is intended to be used for short trips in and around downtown Houston and surrounding urban areas. Houston B-cycle members can pick up a bike at any B-station and return it to that same station or any other B-station when they're done. Membership to the system can be purchased online or at any kiosk. Members can use their credit card or B-card to unlock a bike in seconds. Current expansion plans for Houston's B-Cycle bike share system call for 21 new stations. A map accompanying a Houston Chronicle blog post indicated one new station in the vicinity of the Texas Medical Center at the Houston Zoo.

Some buildings in the TMC have bike racks for storage. Table 7.1 shows the number of bike storage spaces identified predominantly in the Main and Mid Campus areas. These are accessible to employees only.

TABLE 7.1
EXISTING BIKE STORAGE IN TMC AREA

Garage	Bike Rack Spaces
Mid Campus Building Bike Storage Center	49
Pickens Academic Tower Bike Storage Center	32
Garage 2	10-20
Garage 10	3-5
Pressler Garage	14-22
El Rio	3-5
Fannin Holcombe Building	5-8
Main Dock Area at ETV Building	15-21
MD Anderson School Old Library Area	22-45
Mitchell Building	24-52
Radiation Oncology Parking	40-72
South Campus Research Building 1 & 2	21-33
South Campus Research Building 3	7-11
South Campus Research Building 4	11-16
Smith Research Building	12-25
UT Police Station	3-5
UT School of Public	25

7.2.3 Bicycles on METRO

Table 7.2 shows annual bike boardings on METRO buses and TMC shuttles for routes serving the TMC area. The data used was obtained from METRO between October 2011 and September 2012.

The Route 1, Hospital route is one of the top ten bike boarding routes for the month of September 2012 with a monthly average of 489 bike boardings, and 3.3% of the total all-route bike boardings. The 1-Hospital route makes stops at Ben Taub Hospital and Cambridge Street and Fannin Street along its route from the VA Hospital to Downtown and the Northside.

TABLE 7.2
ANNUAL BIKE BOARDINGS ON METRO BUSES

Route	Annual Number of Bike Boardings (Oct 2011 – Sept 2012)
1 Hospital	3,493
2 Bellaire	3,495
4 Beechnut	1,700
8 South Main	2,139
10 Willowbend	306
14 Hiram Clarke	1,036
26-27 Loop	3,540
34 Montrose	368
68 Brays Bayou	1,501
73 Bellfort	2,916
87 Sunnyside	451
402 Bellaire Quickline	320
426 TMC Swiftline	13
METRO Commuter Routes (170, 292, 297, 298)	79
Total, METRO Bus	**21,357**
METRO Rail Shuttle / Bus Bridge	**18**
TMC Shuttle 320	1
TMC Shuttle 321	1
TMC Shuttle 322	1

8.0 TRAVEL DEMAND MANAGEMENT

The Texas Medical Center Corporation offers commuting solutions as part of its traffic demand management strategy to provide short-term congestion relief for local commuters. Among the member institutions that have joined the Commute Solutions Program are:

- St. Luke's Episcopal Health System
- Texas Children's Hospital
- The Methodist Hospital
- Michael E. DeBakey Veterans Affairs Medical Center
- The University of Texas M.D. Anderson Cancer Center
- The University of Texas Medical Branch at Galveston

The Commute Solutions Program was developed by the Houston–Galveston Area Council's (H-GAC's) as part of its Regional Commute Alternatives Program, in partnership with the Metropolitan Transit Authority (METRO), the Texas Department of Transportation (TxDOT), Brazos Transit System, Colorado Valley Transit, Gulf Coast Center, City of Galveston Island Transit and the region's Transportation Management Organizations (TMOs), which include Bay Area Transportation Partnership, Central Houston "Downtown in Motion," North Houston Association and TREK.

The purpose of the Commute Solutions Program is to provide a "one-stop" alternative transportation resource in the Houston-Galveston area for both commuters and businesses. The objectives of the program are:

- Move more people in fewer vehicles.
- Use transportation that does not contribute to congestion and pollution.
- Reduce the number of people commuting during rush hours.
- Reduce the number of single occupant vehicles.
- Eliminate the need to commute to work.

8.1 Overall Strategies

The Texas Medical Center Corporation provides incentives to employees who participate in the different travel demand management programs available. The purpose of this strategy is to reduce Single Vehicle Occupancy (SVO) commuting, traffic volume and parking demand as well as help reduce emissions to the environment. The following commuting solutions have been implemented:

- Employees using METRO bus or vanpool services receive a benefit of $40 pre-taxed once a month
- Employees who carpool receive a benefit of $40 taxable income once a month
- Flexible work schedules
- Employees with a TMC parking contract received a benefit of $30 pre-taxed once a month

Clean Air Champions are businesses or organizations with operations in the Houston Galveston Brazoria nonattainment region that are actively taking steps to improve the region's air quality. At present there are

six TMC member institutions that are recognized as Clean Air Champions for the implementation of travel demand management strategies that include vanpooling and transit subsidies and flexible schedules.

- St. Luke's Episcopal Health System
- Texas Children's Hospital
- The Methodist Hospital
- Michael E. DeBakey Veterans Affairs Medical Center
- The University of Texas M.D. Anderson Cancer Center
- The University of Texas Medical Branch at Galveston

8.2 Carpool/Vanpool and Transit Programs

Carpool/vanpool programs have been implemented by many of the TMC member institutions as an incentive to employees to help reduce SOV commuting. The carpool/vanpool programs provide monthly assistance that varies from $70 to $230 to those employees vanpooling; some member institutions also offer pre-tax vanpool paycheck deductions. Transit users are also eligible for receiving monthly assistance that varies from $70 to $150 per month.

The following Member Institutions offer vanpool and transit assistance program:

- St. Luke's Episcopal Health System provides $70-$100 per month towards the cost of vanpool and paid METRO Q-Cards.
- Texas Children's Hospital provides $75 per month towards the cost of transit or vanpool and full payment for the METRO bus cost, Woodland express bus cost, and Fort Bend Express bus cost.
- The Methodist Hospital provides $70 per month towards the cost of vanpool and $150 per month towards the cost of transit.
- The Michael E. DeBakey VA Medical Center provides up to $230 a month towards the cost of transit or vanpool.
- The University of Texas MD Anderson Cancer Center provides $120 per month towards the cost of transit or vanpool.
- Baylor College of Medicine provides 60 percent subsidies for bus passes and up to $40 per month for vanpoolers.
- Memorial Hermann provides subsidies for bus passes
- The University of Texas Health Science center at Houston subsidies 65 percent of each participant bus pass or vanpool up to $55 per month.

8.3 Other Strategies

8.3.1 Staggered Work Hours

Flexible work hours programs have been implemented as part of other travel demand management strategies by the TMC member institutions to reduce trips and hence traffic volume and parking demand at the different campuses.

Member Institutions such as Baylor College of Medicine, MD Anderson Cancer Center and Memorial Hermann have joined the H-GAC Regional Telework Program; this program replaces travel to, from and for work with telecommunications technologies that allow employees working from home and still have access to the employer network and communication systems.

The following TMC member institutions offer a flexible work hours program:

- Baylor College of Medicine employees work compressed work weeks (4/40s and 9/80s); also offers telecommuting on full-time or part-time basis.
- MD Anderson Cancer Center employees work compressed work weeks; telecommuting options are also offered.
- Rice University offers flexible work schedules.
- St. Luke's Episcopal Health System offers work compressed work weeks with an estimated of 40 percent of employees working 3/12 schedule. An estimated 2 % of employees telework one day a week.
- Texas Children's Hospital offers work compressed work hours with 23 percent of employees working 3/12 schedule.

There are other travel demand strategies that have been implemented as part of the travel demand management strategies in the Texas Medical Center, and include:

- Ride Match Program to connect employees and help finding alternative commuting options.
- Transportation fairs where employees can learn about commuting options.

9.0 SOCIO-ECONOMICS

9.1 General Population

Population, employment and household data for the general study area was obtained from the 2010 census data. The existing zip code study conducted by Texas Medical Center shows the distribution of residents traveling for employment at buildings at the TMC. Figure 9.1 shows where the employees from the TMC area live and the number of employees per each zip code area. The figure indicates that majority of the employees live in the Pearland and Sugarland areas.

Table 9.1 shows a summary of the 2010 Census data for the general study area. Figures 9.2 shows a map population by census block group in the general study area.

TABLE 9.1
SOCIO-ECONOMIC DATA FROM 2010 CENSUS FOR TMC GENERAL STUDY AREA

2010 Demographic	Number
Population	133,084
Households	68,967
Employment	170,602

9.1 Employment

The total employment in 2010 in the General Study Area is approximately 170,602. Figure 9.5 shows a map of all the study area employment by census block group.

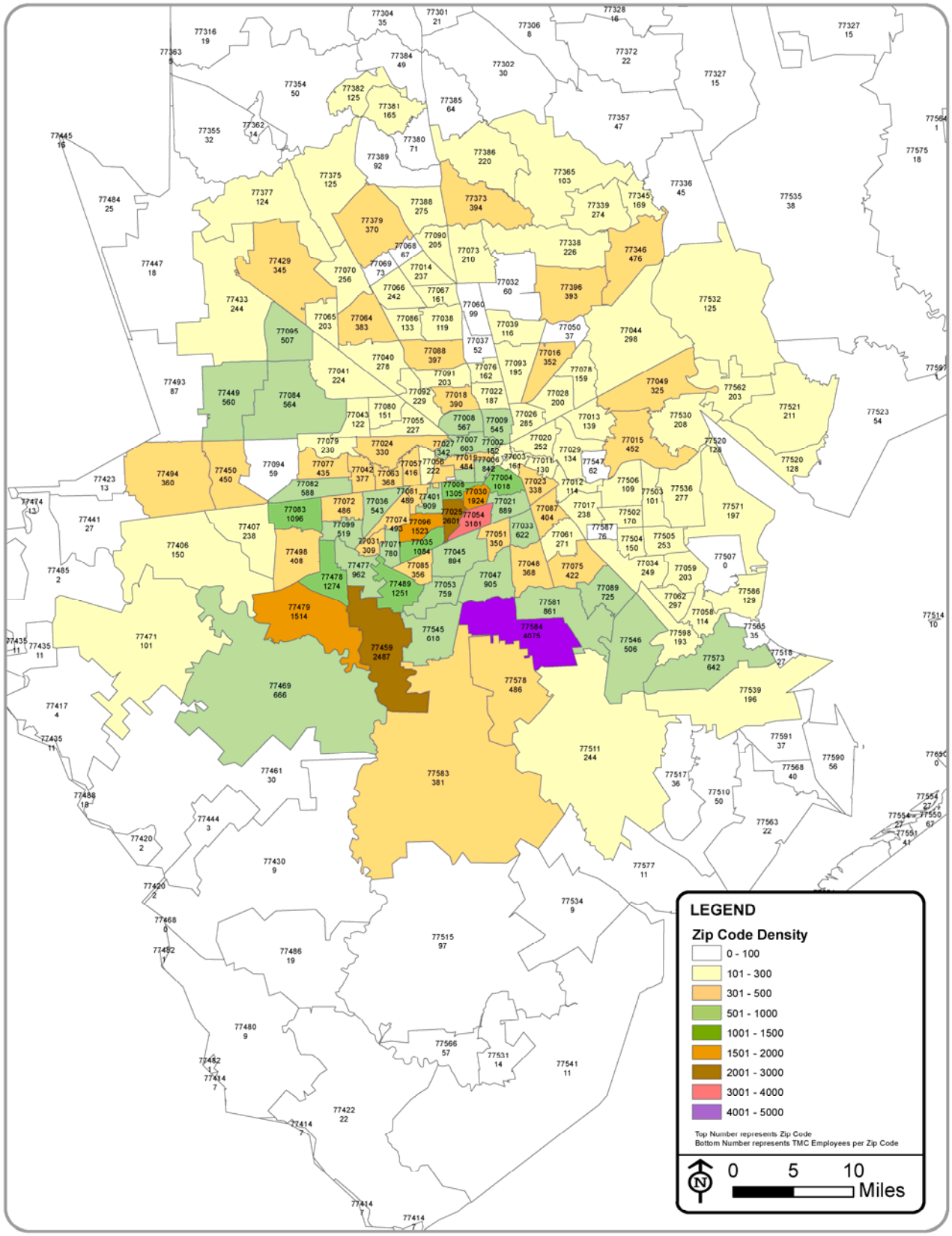

FIGURE 9.1
TMC EMPLOYEE TRIP ORIGINS BY ZIPCODE

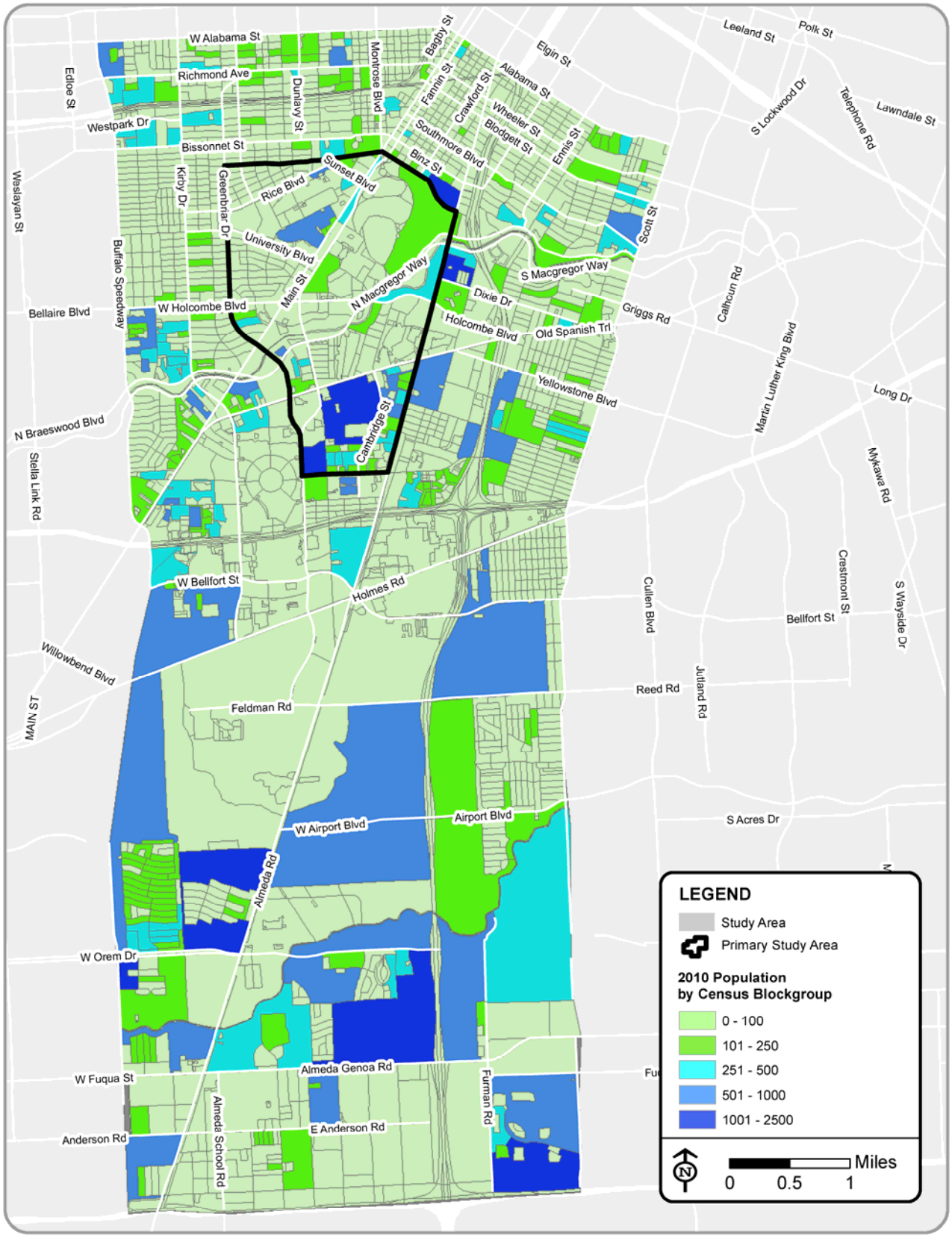

FIGURE 9.2
2010 POPULATION BY CENSUS BLOCKGROUP

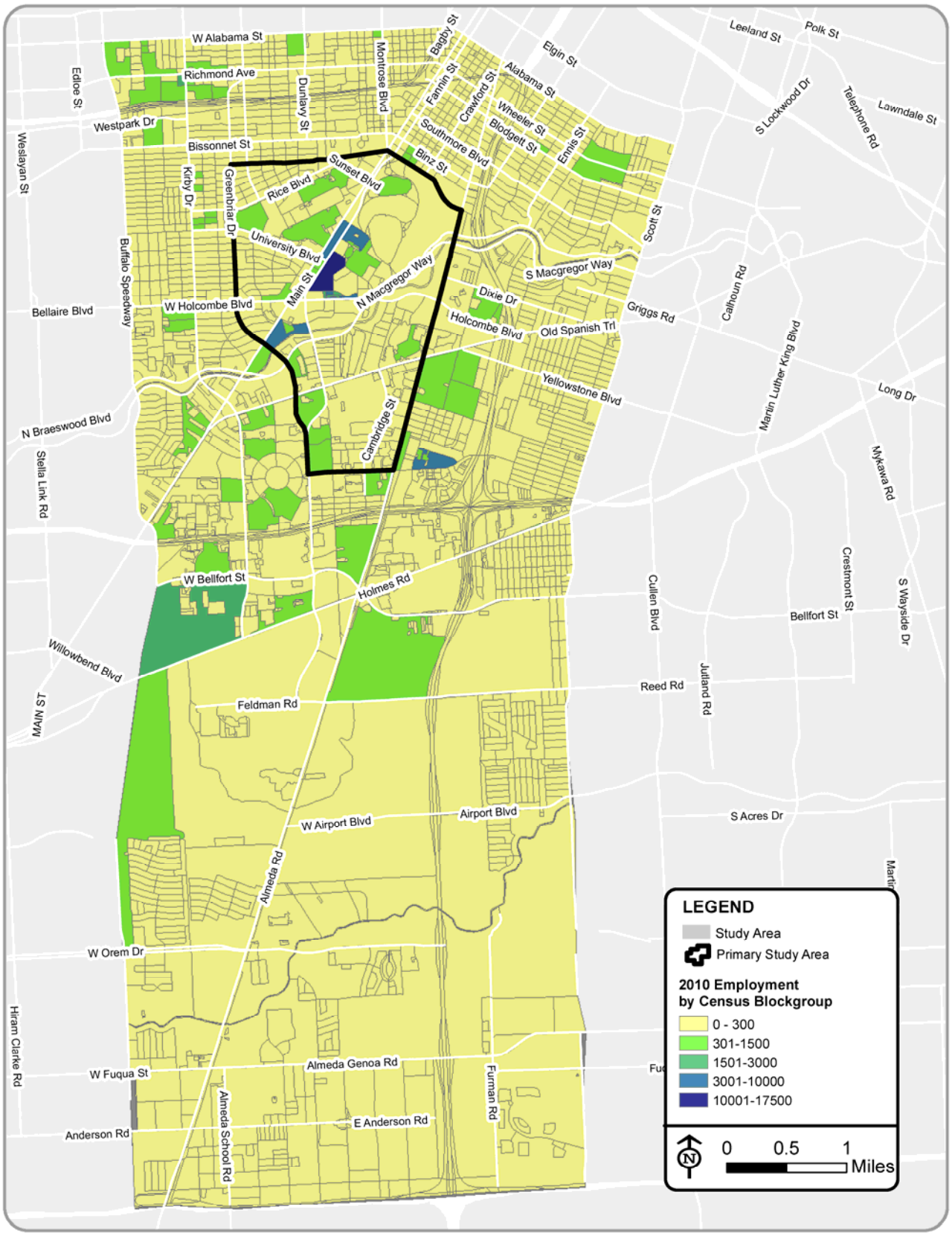

FIGURE 9.3
2010 EMPLOYMENT BY CENSUS BLOCKGROUP

10.0 LAND USE & ENVIRONMENTAL

10.1 Land Use

10.1.1 Overall Land Use

This section describes the existing land use within the Texas Medical Center (TMC) study area. Planned/future land use will be discussed in a separate report. The data used to summarize the land use characteristics were obtained from the City of Houston, Houston-Galveston Area Council (H-GAC) and the Texas Natural Resources Information Systems (TNRIS).

The TMC is an internationally-renowned as the largest medical complex in the world, with an area encompassing approximately 1,300 acres and covering nearly 45.5 million square feet of building space.

The predominant land use surrounding the TMC General Study Area is comprised of residential buildings. Table 10.1 summarizes the land use surrounding the TMC. The land use within the primary study area is comprised mainly of institutional with 38% percent coverage. Figure 10.1 shows the existing land use map for the study area. Figure 10.2 shows the community features in around the five campuses in the study area.

TABLE 10.1
EXISTING LAND USE TOTALS IN PRIMARY STUDY AREA

Land Use	Square Footage	Percentage of Total
Institutional	31,669,619	38%
Residential	19,441,710	23%
Parks	17,618,798	21%
Government	8,733,136	10%
Commercial	3,164,976	5%
Industrial	1,162,446	1%
Vacant	1,374,246	2%
Total	**83,164,931**	**-**

10.1.2 Vacant Land

As depicted in Table 10.1, the amount of vacant land represents 5% percent of the total land use throughout the study area. Much of the land surrounding the study area is completely developed.

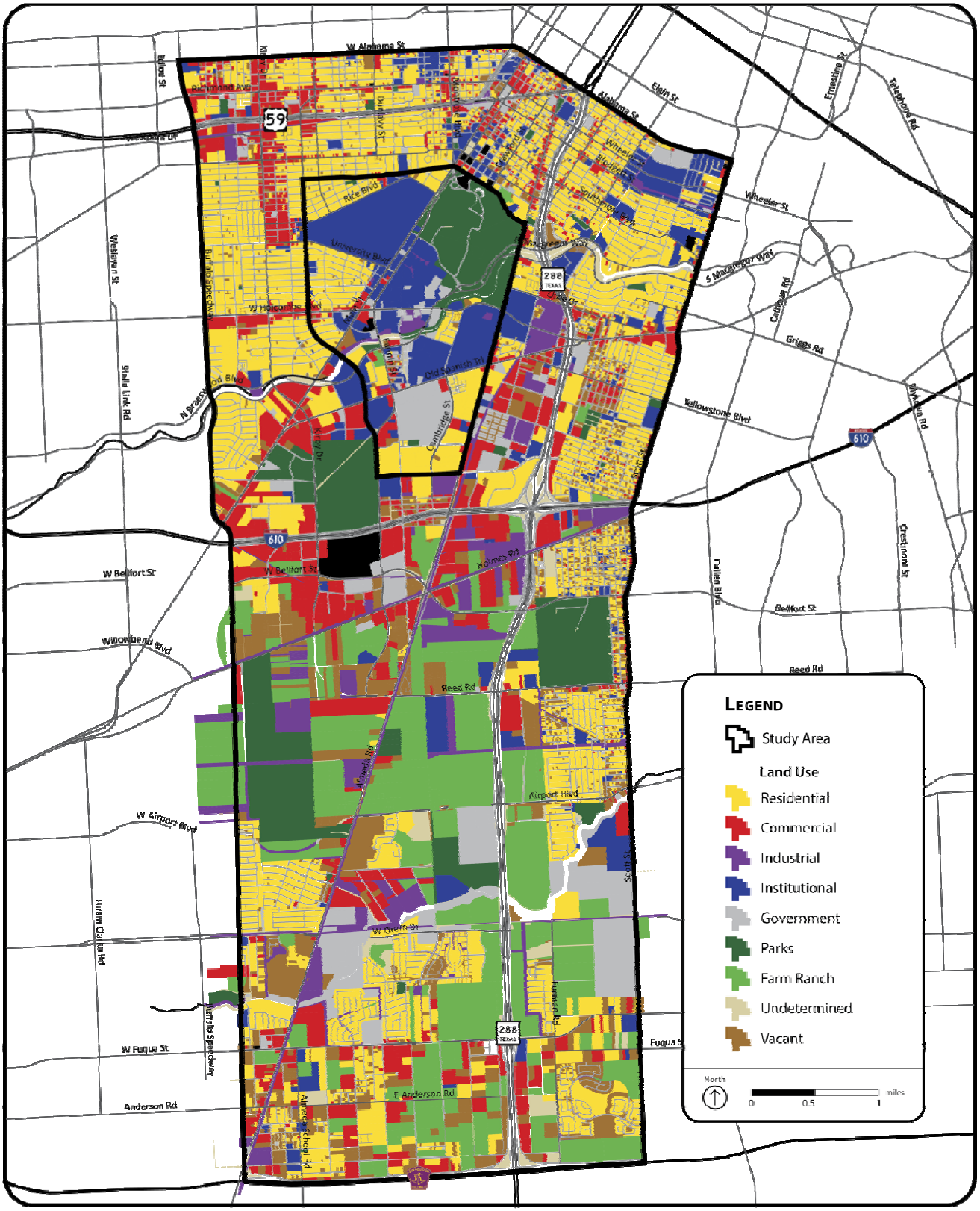

FIGURE 10.1
EXISTING LAND USE

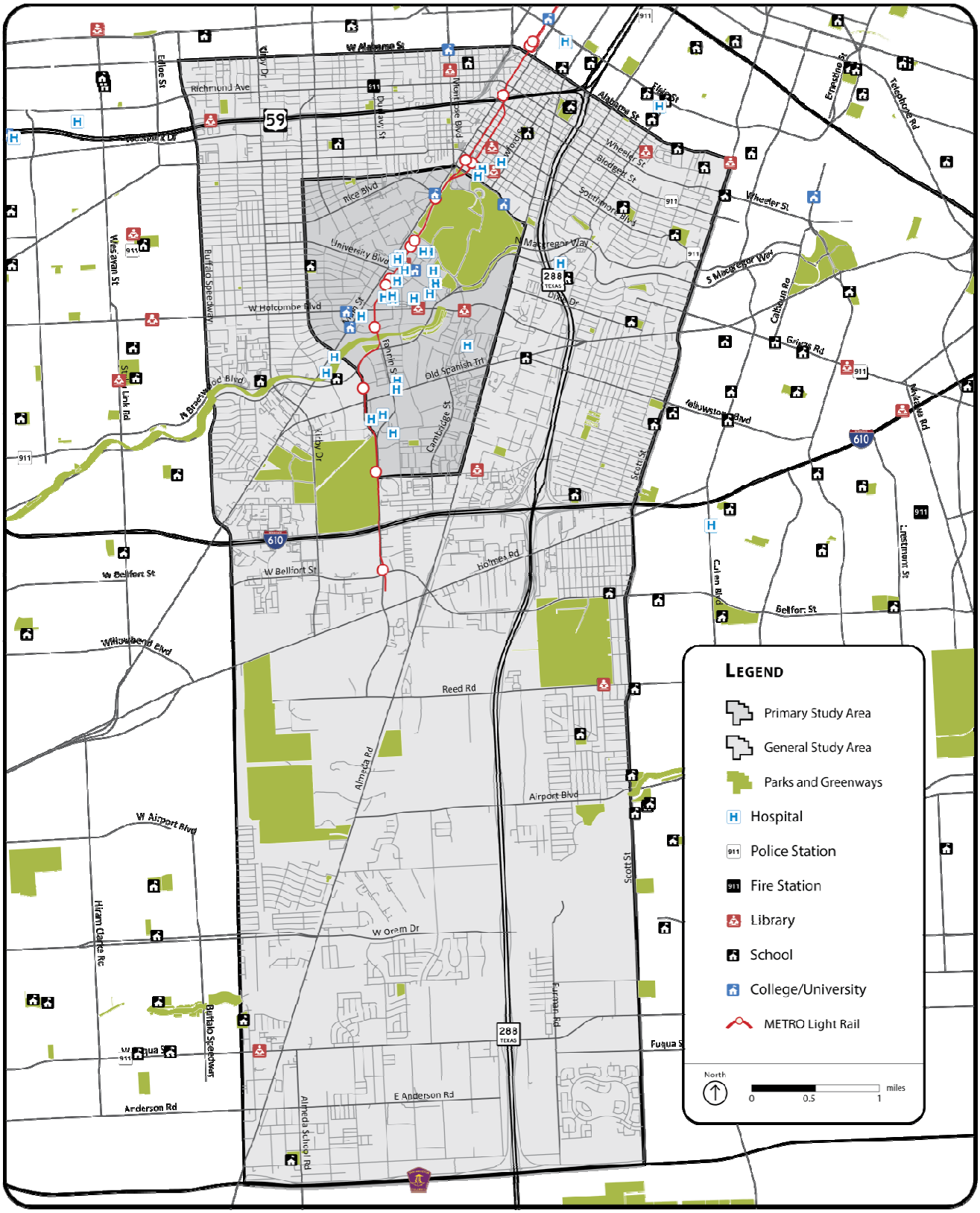

FIGURE 10.2
EXISTING COMMUNITY FACILITIES

10.2 Environmental

This section describes the environmental setting within the TMC study area. Figure 10.3 shows the wetlands and floodplains throughout for the primary and general study areas.

Using the Digital Flood Insurance Rate Maps (DFIRM) developed by the Federal Emergency Management Agency (FEMA), the floodplain boundaries were evaluated for the TMC study area. The study area includes Flood Zone A, Zone AE, and Zone X. Furthermore, as shown in the aforementioned figure, there is also a *0.2 Pct Annual Chance Flood Hazard* area covering a significant portion of the primary study area.

10.2.1 Environmentally-Sensitive Areas

Through data obtained from the Texas Commission on Environmental Quality (TCEQ), there is an area depicted as a superfund boundary located along Interstate 610, between Knights Road and Cambridge Street. Based on a review of the dataset, the facility is identified as Sol Lynn – Industrial Transformers.

Moreover, the Baylor College of Medicine is designated as a permitted and hazardous materials waste site according to the TCEQ datasets. Figure 10.4 shows the location of the superfund area including the permitted and hazardous waste sites.

10.2.2 Brownfield Sites

Other than the superfund area previously mentioned, there are no known brownfield sites located within the vicinity of the TMC study area.

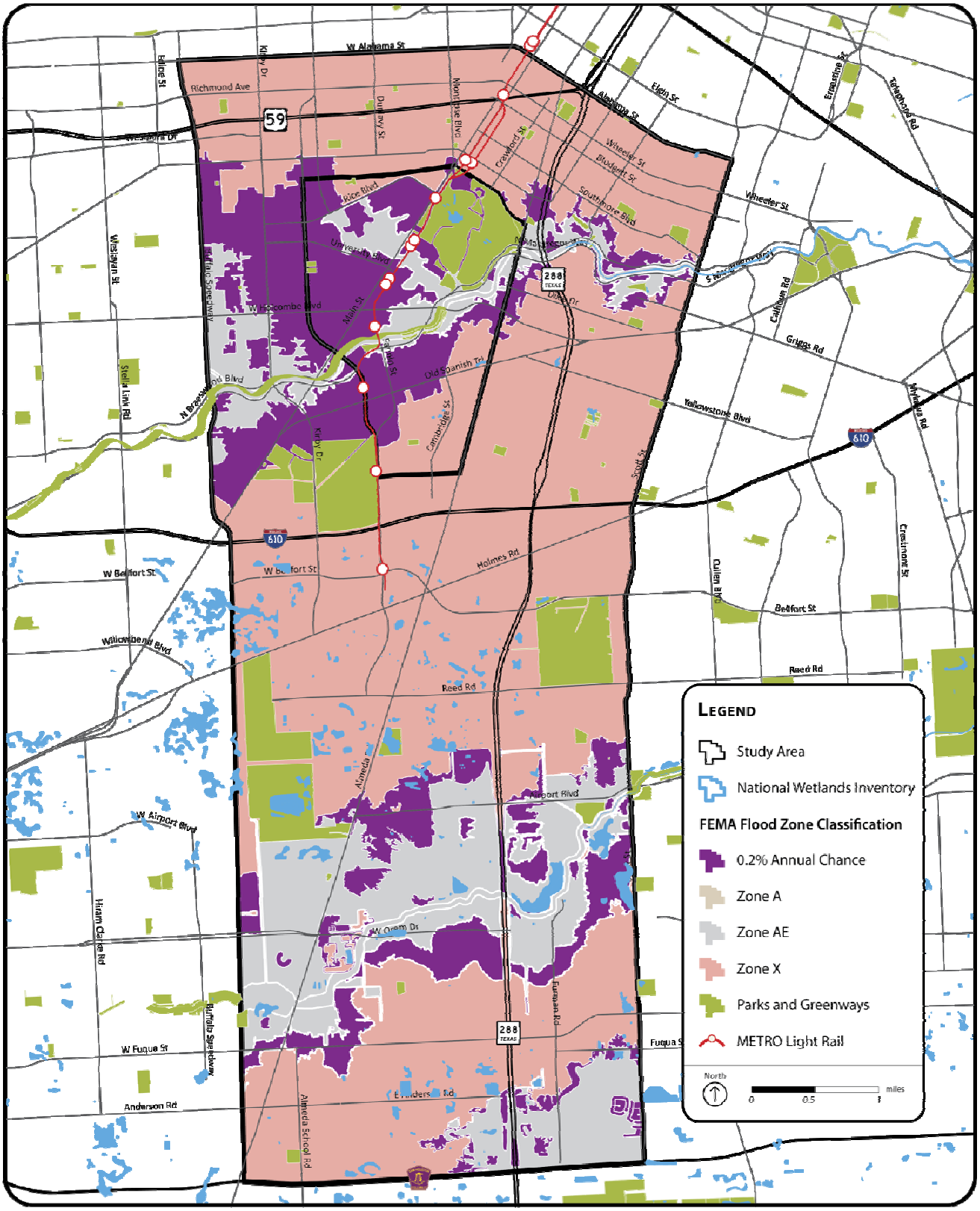

FIGURE 10.3
EXISTING WETLANDS AND FLOODPLAINS

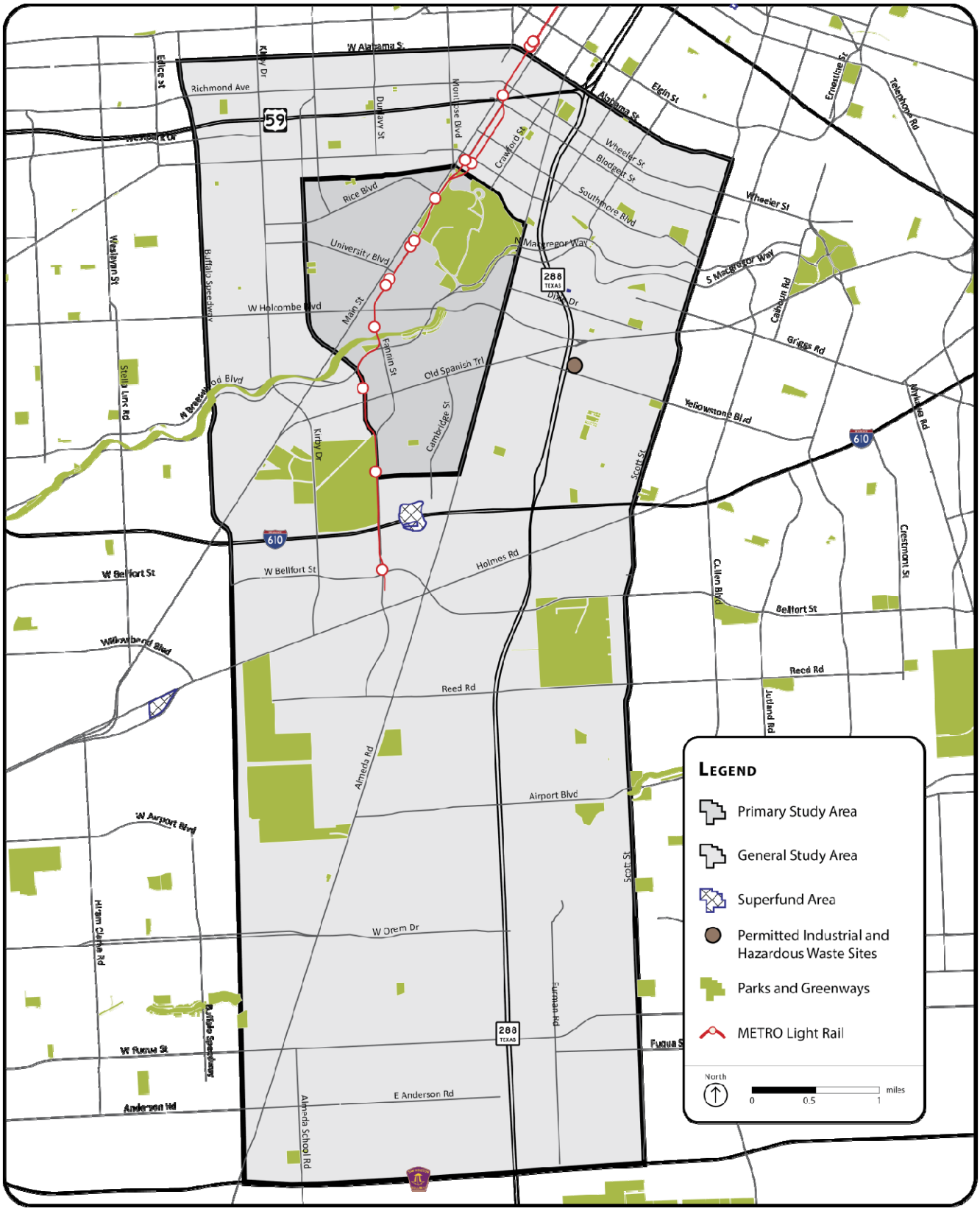

FIGURE 10.4
EXISTING SUPERFUND SITES IN THE STUDY AREA

APPENDIX

A Existing Intersection Turning Movement Counts

B Metro Rider O-D Survey

C Parking Utilization Data

D Marketing Material from Existing TDM Programs